Electrical & Computer ENGINEERING

Electrical & Computer Engineering

2021-2022 M.S. Catalog/Handbook

ECE Office of Academic Affairs

 This handbook is posted to the ECE master's webpage prior to the start of each academic year and is updated as needed. This handbook is effective August 1, 2021 through July 31, 2022.

Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
(412) 268-2000
www.cmu.edu

Carnegie Mellon University – Silicon Valley
NASA Ames Research Park
Bldg. 23
P.O. Box 98
Moffett Field, CA 94035-0001
(650) 603-7032
www.cmu.edu/silicon-valley

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WELCOME TO ELECTRICAL AND COMPUTER ENGINEERING

Welcome to the Department of Electrical and Computer Engineering at Carnegie Mellon University. Since offering our first course in electrical engineering in 1908, our research and teaching has expanded to cover areas as broad as device sciences and nanotechnology, computer systems, data science, energy, control, communications, and circuits. The 2017 US News and World Report ranked our graduate research programs in electrical engineering and computer engineering 9th and 2nd in the nation, respectively, and we offer programs in Pittsburgh, Silicon Valley, Portugal, and Africa.

Our distinguished faculty work closely with students to push the boundaries of technology and to shape the future of energy systems, bio-electronics, computing, data storage, and much more.

Please don't hesitate to contact us if you have any questions or comments.

Sincerely,

Larry Pileggi
Tanoto Professor and Department Head
Electrical and Computer Engineering

Core Values

The ECE Department has been a leader in both research and education for years; it is known for its innovative qualities, boldness of ideas, and unbridled enthusiasm. Our strategic plan is guided by our core values.

> **We value scientific truth, creativity, quality, innovation, and engineering solutions, all within a diverse and inclusive community guided by respect and joy of doing.**

Our core values form the foundation for what we do; we hold them to be intrinsically true. We believe in solving problems that have large societal impact; we also believe that to be successful, we must work within an environment of enthusiasm and openness, respect and integrity, and freedom to express and explore a variety of ideas.

Vision

Our vision is our guiding light; it informs and propels us in the right direction. The strategies of following that path change over time; the vision does not.

> **To be a creative driving force within the university and worldwide of highest scholarly and entrepreneurial quality.**

Mission and Objectives

The Carnegie Mellon University mission is:

To create a transformative educational experience for students focused on deep disciplinary knowledge; problem-solving; leadership, communication and interpersonal skills; and personal health and well-being.

To cultivate a transformative university community committed to (a) attracting and retaining diverse, world-class talent; (b) creating a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish; and (c) ensuring individuals can achieve their full potential.

To impact society in a transformative way - regionally, nationally and globally - by engaging with partners outside the traditional borders of the university campus.

The ECE Department mission is our “what, who, how”; it explains what we do, who we do it for, and how we do it so we engage the “hearts, heads, and hands” of our faculty, students, and staff in achieving our objectives.

> **To inspire, educate, and produce electrical and computer engineers capable of tackling fundamental scientific problems and important societal challenges, and to do so with the highest commitment to quality, integrity, and respect for others.**

We aim to be the best at what we do, to apply all our skills and knowledge to execute our vision. We educate young people to become engineers sought after by industry and academia alike; we do so in an environment imbued by enthusiasm and love for what we do, with respect and willingness to listen to each other, with freedom to express our ideas and look at challenges from different points of view. We strive to be the ECE department of choice for those who are willing to step off the beaten path, for the visionaries and dreamers.

Students in the Master's of Science M.S. and M.S. in Software Engineering in ECE program are provided with a thorough background in the fundamentals of electrical or computer engineering, as well as the opportunity for in-depth specialization in some particular aspect of these fields. Upon enrollment in the department, students are given the opportunity, with the help of an academic advisor and faculty mentor, to choose an educational program that is consistent with their background and is best suited to their own academic goals.

The Master of Science in Software Engineering (M.S.-SE) is a unique program offered exclusively at CMU's Silicon Valley campus. It emphasizes a rigorous foundation in the core disciplines of software engineering. The program offers students a first-hand experience in software engineering by balancing theory and practice, engaging them in active learning, and encouraging collaboration on projects drawn from real world contexts.

Our students enter the program with a strong foundation in computer science. They leave the program with a deep knowledge of software engineering.

INTRODUCTION

Graduate Degrees and Programs Offered

Master of Science in Electrical and Computer Engineering

- Pittsburgh
- Silicon Valley
- Africa

Master of Science in Software Engineering

- Silicon Valley

Doctor of Philosophy in Electrical and Computer Engineering

- Pittsburgh
- Silicon Valley
- Portugal

Please note: The instruction for all degrees and programs will occur in English.

Graduate Student Catalog/Handbook

This catalog/handbook is intended to set guidelines and expectations for new and current Master's students in Electrical and Computer Engineering at Carnegie Mellon University Silicon Valley. This catalog/handbook is not exhaustive and is subject to revision at any time by the ECE department. It covers masters' students in Silicon Valley.

It is the responsibility of each student to read and understand the contents of this catalog/handbook.

This catalog/handbook, along with any revisions, will be posted and announced annually to the ECE website (https://www.ece.cmu.edu/). Students with disabilities may request this catalog/handbook in other formats by contacting the Graduate Affairs Office.

CARNEGIE MELLON POLICIES, EXPECTATIONS, STATEMENT OF ASSURANCE, AND CODE

Carnegie Mellon Policies & Expectations

It is the responsibility of each member of the Carnegie Mellon community to be familiar with university policies and guidelines. In addition to this departmental graduate student catalog the following resources are available to assist you in understanding community expectations:

- The Word/Student Catalog https://www.cmu.edu/student-affairs/theword/
- Academic Integrity Website https://www.cmu.edu/student-affairs/ocsi/
- University Policies Website https://www.cmu.edu/policies/
- Graduate Education Website https://www.cmu.edu/graduate/policies/
- College of Engineering Website https://www.cit.cmu.edu
- Please see Appendix A for additional information about The Word and University resources.

Carnegie Mellon Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the university ombudsman, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-1018. Obtain general information about Carnegie Mellon University by calling 412-268-2000.

Carnegie Mellon University publishes an annual campus security and fire safety report describing the university's security, alcohol and drug, sexual assault and fire safety policies, and containing statistics about the number and type of crimes committed on the campus, and the number and cause of fires in campus residence facilities during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The annual security and fire safety report also is available online at www.cmu.edu/police/annualreports.

Information regarding the application of Title IX, including to admission and employment decisions, the sexual misconduct grievance procedures and process, including how to file a report or a complaint of sex discrimination, how to file a report of sexual harassment, and how the university responds to such reports is available at www.cmu.edu/title-ix. The Title IX coordinator may be reached at 5000 Forbes Ave., 140 Cyert Hall, Pittsburgh, PA 15213; 412-268-7125; or tix@cmu.edu.

Carnegie Mellon Code

Students at Carnegie Mellon, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical and moral conduct possible.

These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

As members of the Carnegie Mellon community, individuals are expected to uphold the standards of the community in addition to holding others accountable for said standards. It is rare that the life of a student in an academic community can be so private that it will not affect the community as a whole or that the above standards do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist.

The commitment of its faculty, staff and students to these standards contributes to the high respect in which the Carnegie Mellon degree is held. Students must not destroy that respect by

their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from the university.

The Carnegie Mellon Code (https://www.cmu.edu/student-affairs/theword/code/index.html) can also be found online.

Carnegie Mellon Child Protection Requirements

Carnegie Mellon is committed to providing a safe and secure environment for all minors involved in any programs or activities conducted on university premises, as well as any off-campus programs or activities sponsored by the university. Details are available through Leonard Gelfand Center Child Protection Operations https://www.cmu.edu/gelfand/child-protection-operations/index.html.

If you have questions regarding Act 153 or encounter a situation when you would need to have the clearances, please contact Meighan at meighan.harding@ece.cmu.edu.

DEPARTMENTAL INFORMATION

University Personnel

Throughout your time in the M.S. program, you will encounter a variety of faculty and staff who will help you on your way to completing your degree. You may view a list of faculty (https://www.ece.cmu.edu/directory/faculty.html) and a list of staff (https://www.ece.cmu.edu/directory/staff.html) affiliated with ECE online. Below is a list of faculty and staff whom you are likely to encounter during your time in the M.S. program.

- Dean of the College of Engineering: Bill Sanders
- Associate Dean of Graduate and Faculty Affairs: Professor Shelley Anna
- Department Head: Professor Larry Pileggi
- Executive Assistant to the Department Head: Kimmy Nguyen
- Director, CMU Africa: Professor Vijayakumar Bhagavatula
- Associate Department Head for Research: Professor Shawn Blanton
- Associate Department Head for Academic Affairs: Professor James A. Bain
- Associate Department Head for Students: Professor Dave O'Halloran
- Director of Finance and Sponsored Research: Charlotte Ambrass
- Academic Services Manager: Megan Oliver
- Director of Graduate Affairs: Tara Moe
- Student Organizations Advisor in Silicon Valley: Brittany Bristoll
- Ph.D./M.S. Academic Program Advisor in Silicon Valley: Brittany Bristoll

A general list of contacts (https://www.ece.cmu.edu/about/contact.html) can also be found on the ECE website.

University Resources

Stellic Degree Audit

Each student has access to Stellic Degree Audit Application which includes degree planning tools can show how courses taken or registered for meet the degree requirements. Access Stellic through The Hub website at https://www.cmu.edu/es/stellic/index.html. Students should also meet with their academic advisor to review how their courses have been applied to the degree requirements.

University Resource Websites

Several pertinent university policies are included in this handbook, primarily found in the University Policies section. The complete university policies are available online at the following link: http://www.cmu.edu/policies.

Additional assistance is available in understanding community expectations, with the following resources being particularly relevant to ECE students. Information about these offices can be found in Appendix A of this handbook, or at the respective website.

- The Office of the Assistant Vice Provost for Graduate Education. Website: www.cmu.edu/graduate. Email: grad-ed@cmu.edu
- The Office of the Dean of Student Affairs. Website: www.cmu.edu/student-affairs/index.html
- Student Services in Silicon Valley. Website: http://www.cmu.edu/silicon-valley/campus-life/index.html
- Assistance for Individuals with Disabilities. Contact Larry Powell, Equal Opportunity Services, 412-268-2013, lpowell@andrew.cmu.edu
- Eberly Center for Teaching Excellence. Website: www.cmu.edu/teaching
- Graduate Student Assembly. Website: http://www.cmu.edu/stugov/gsa/index.html
- Office of International Education. Website: http://www.studentaffairs.cmu.edu/oie/
- Counseling & Psychological Service. Website: https://www.cmu.edu/counseling/
- Health Services. Website: www.cmu.edu/HealthServices
- University Police. Website: www.cmu.edu/police
- The Word (student online handbook). Website: http://www.cmu.edu/student-affairs/theword
- Academic Integrity Website: www.cmu.edu/academic-integrity
- University Policies Website: www.cmu.edu/policies/

Please refer to Appendix A for additional information about each of the aforementioned resources.

University Library

Silicon Valley Campus

Library and Resources CMU-SV does not operate a library on campus, but we do have specialized library resources available for students, faculty, and staff. Resources include:

1. Interlibrary Loan
2. e-book developments
3. University Libraries Quick Links

Through the Interlibrary loan, students can request books, articles from journals and conferences, technical reports, or other materials to be sent to you. The materials may be from Carnegie Mellon libraries in the U.S. or other institutions worldwide. Electronic delivery for many articles is available. ILLiad is the system that our students use to request these items. What ILLiad can be used for:

- To request to borrow a book, a tech report, a thesis, copy of an article, etc.
- Check status of requests
- Edit requests
- Cancel requests
- Update your contact information or delivery preferences
- Request to renew an interlibrary loan

The ILLiad link can be found at https://illiad.library.cmu.edu/illiad/illiad.dll.
The first time you use the link you need to provide information about yourself. You only need to do this once. When completing the form, choose these options:

- For **Mailing Address**, state: **Silicon Valley campus**
- For **Delivery Location**, state: **E&S Library**

Ebook developments can be found on our website at http://guides.library.cmu.edu/svc.

A digital collection of science and engineering reference books. Carnegie Mellon Users Only (including Silicon Valley Campus). Our access to their new collection on Computer Hardware Engineering is now available! You'll also find the books listed in CAMEO - our online catalog.

University Quick Links can also be found on the website at http://guides.library.cmu.edu/svc.
Here are examples of some quick links below:

- Articles & Databases
  - Alphabetical and subject listings of our available databases.
- Cybersecurity
- e-Journals A to Z List
  - Our automated (partially) method of finding e-Journals that we have access to - even if buried in a full-text database.
- ECE Library Guide
  - Library research guide for Electrical & Computer Engineering.
- Off-Campus / Wireless Access
  - EZ Proxy single sign on added as an option!
- University Libraries Home Page

Our home page has links to the simple and advanced search functions for CAMEO - our online catalog.

For additional questions regarding library resources, please contact Matt Marsteller, Head, CMU Science Libraries at matthewm@andrew.cmu.edu or by phone: 412-268-7212

Department Resources

Course Instructors

ECE courses are taught by world-renown educators and researchers.

Anupam Datta, Professor
Ph.D., Computer Science, Stanford University
Hakan Erdogmus, Teaching Professor
Ph.D., Telecommunications, Université du Québec
Carlee Joe-Wong, Assistant Professor
Ph.D., Applied and Computational Mathematics, Princeton University
Ian Lane, Associate Research Professor
Ph.D., Informatics, Kyoto University
Manish Pandey, Adjunct Instructor/Professor
Ph.D., Computer Science, Carnegie Mellon University
Cecile Peraire, Associate Teaching Professor
Ph.D., Computer Science, Swiss Federal Institute of Technology
John Shen, Professor
Ph.D., Electrical Engineering, University of Southern California
Leonardo da Silva Souza, Assistant Teaching Professor
Ph.D., Computer Science, Pontifícia Universidade Católica do Rio de Janeiro
Pei Zhang, Associate Research Professor
Ph.D., Computer Engineering, Princeton University

Academic Advisors and Faculty Mentors

Your academic advisor is a resource for having any university paperwork signed, asking questions regarding registration or the curriculum, and guiding you to other important resources. Brittany Bristoll is your Academic Program Advisor.

Academic advising is done through the Graduate Affairs Office; in Silicon Valley this is in B23 123. The M.S. Academic Program Advisor administratively advises all ECE M.S. students throughout the entire duration of the M.S. program. While this advisor does not provide content-specific expertise in ECE, he/she helps students navigate through the program by tracking milestones, meeting one on one and in groups with students for questions related to registration or the curriculum, guiding students to other important resources, completing enrollment and

university-related paperwork, and answering questions for students who may not know where else to turn.

Brittany can be reached by email: brittanyjade@cmu.edu, or by phone: (650) 603-0934. To guarantee availability, you are encouraged to schedule an appointment with her by accessing her calendar in the signature block of her e-mail. Brittany advises all Silicon Valley based M.S. ECE and M.S. Software Engineering students.

Students will also be assigned a faculty mentor during the first two weeks of classes. A faculty mentor is a resource for questions related to specific content knowledge about ECE. They can also offer advice regarding future career and courses students may want to take to prepare. Whenever possible, faculty are matched to students based the area of interest indicated on the ECE application. Students are encouraged to connect with their faculty mentor once assigned as their secondary advisor in SIO.

Faculty Credentials

For all faculty please visit the ECE faculty directory here:

https://www.ece.cmu.edu/directory/faculty.html.

Faculty based in Silicon Valley and teaching in Silicon Valley:

Anupam Datta, Professor
Ph.D., Computer Science, Stanford University

Hakan Erdogmus, Teaching Professor
Ph.D., Telecommunications, Université du Québec

Cecile Peraire, Associate Teaching Professor
Ph.D., Computer Science, Swiss Federal Institute of Technology

John Shen, Professor
Ph.D., Electrical Engineering, University of Southern California

Leonardo da Silva Souza, Assistant Teaching Professor
Ph.D., Computer Science, Pontifícia Universidade Católica do Rio de Janeiro

Faculty based in Pittsburgh and broadcasting courses to Silicon Valley:

Lujo Bauer, Associate Professor
Ph.D., Computer Science, Princeton University

Franz Franchetti, Professor
Ph.D., Computational Mathematics, Vienna University of Technology

Saugata Ghose, Special Faculty Systems Scientist
Ph.D., Computer Systems, Cornell University

Virgil Gligor, Professor
Ph.D., Electrical Engineering and Computer Science, University of California at Berkeley

Limin Jia, Associate Research Professor
Ph.D., Computer Science, Princeton University

Diana Marculescu, Professor
Ph.D., Computer Engineering, University of Southern California

Bill Nace, Teaching Professor
Ph.D., Electrical and Computer Engineering, Carnegie Mellon University

Aswin Sankarayaranan, Associate Professor
Ph.D., Electrical and Computer Engineering, University of Maryland

Vyas Sekar, Associate Professor
Ph.D., Computer Science, Carnegie Mellon University

Osman Yagan, Associate Research Professor
Ph.D., Electrical and Computer Engineering, University of Maryland

Graduate Studies Committee (GSC)

The Graduate Studies Committee is a committee consisting of ECE faculty and ex-officio administrators from the Graduate Affairs Office. The Graduate Studies Committee meets throughout the academic year to address student petitions, discuss program policies, and to approve and assign qualifying exams.

The GSC Chair for the 2021-2022 academic year is Professor L.R. Carley. The dates for the GSC meetings will be posted on the ECE's Graduate Portal (https://www.ece.cmu.edu/insider/grads/index.html) (requires Andrew ID log in) under GSC procedures section before the start of each semester.

Bulletin Boards

Students in Silicon Valley can find bulletin boards located in Buildings 23. Bulletin boards will be cleared on a regular basis.

Tech & Receiving

Students on the Silicon Valley campus should work with their instructor if supplies are needed.

Computer Clusters

There are not computer clusters available in Silicon Valley.

Printers

Printers https://www.cmu.edu/idplus/services/printing.html are provided for student academic use.

Printers: Printers are for use in the hallway in B23 outside of 109/110. Instructions for adding printers and policies are posted next to each printer.

Keys

The Silicon Valley Facilities department will provide each Master student with relevant keys to B23 meeting rooms. To avoid any financial implications to you, your key must be returned prior to your final departure from CMU. To report a lost key or to request a replacement, please email facilities@sv.cmu.edu.

Graduate Student Lounges

There are several spaces for students in Silicon Valley to use. The main student lounges can be found in B23, downstairs Room 129 and upstairs Room 227. To see the full list of rooms and spaces, please see here: https://sv.cmu.edu/information-center/campus-resources/rooms-and-spaces.html.

Department Office/Building Security, Repairs and Services

Any damages, repairs, or security concerns should be reported to Stacy Marshall, Facilities and Events Manager, by emailing facilities@sv.cmu.edu. In an emergency, please contact NASA Police at 650-604-5555.

General Silicon Valley Facilities Description

The Silicon Valley campus is located in the historic Shenandoah Plaza on the NASA Ames Research Park. We occupy one building – building 23. Building 23 is a 20,111 sq. ft. two-story historic building and is our main administrative and teaching building. It largely houses our academic space: 5 classrooms, 31 faculty and staff offices, 6 conference rooms, 2 kitchen/break rooms, 1 cafe lounge, and 1 multi-function lounge & event space. Located in the annex of Building 23 is the Carnegie Mellon Innovations Lab (CMIL), a 1,247 sq. ft. multi-use lab space.

ECE Graduate Student Organizations

- EGO (ECE Graduate Student Organization) organizes academic and social events throughout the academic year.
- WinECE (Women in Electrical and Computer Engineering) provides academic and social events to women in ECE throughout the year.
- HKN (Eta Kappa Nu) is the honor society for Electrical and Computer Engineering students. HKN members engage in community service, professional engagement, and social

activities. Ph.D. students are invited by the board of HKN to join based on academic performance.

For more information on graduate student organizations and opportunities for future involvement in the ECE department, please contact Brittany Bristoll, Academic Services Coordinator and Student Organizations Advisor in Silicon Valley.

Press & Media Relations

ECE's Assistant Director of Communications is the point-of-contact between news media and the ECE, including faculty, students, and staff.

If any student, staff or faculty member of ECE is contacted by a media representative, they are required to immediately inform either the Communication Manager and/or the Director of Operations. Members of the ECE community are not required to answer any questions from the media without first seeking information from ECE's Communication Manager and/or the Director of Operations.

Electrical & Computer Engineering Brand & Logos

The Information Technology Services (ITS) website (https://userguide.its.cit.cmu.edu/services-support/ece-graphics/) contains information regarding the department's branding and identity standards.

PRE-MATRICULATION

Admissions Policies

For information about ECE's admission policies, including application requirements, application deadlines, and a link to apply, please visit these webpages:
https://www.ece.cmu.edu/admissions/graduate-application-deadlines.html
https://www.ece.cmu.edu/admissions/graduate-faq.html

TOEFL Requirements and Language Proficiency

Admission to Carnegie Mellon University graduate programs requires demonstration of completed, relevant undergraduate degree programs, as demonstrated by an original transcript from the degree-granting institution during the admission process. Domestic students who graduate from an accredited college or university in the US have demonstrated their English language facility and skill by their success and graduation from competitive undergraduate US institutions.

The TOEFL test is required of all international applicants whose native language is not English. Native language is defined as first language, or language spoken from birth. The TOEFL is not

required if the applicant has graduated from a U.S. university, or if the applicant is a CMU student or alum.

The Admissions Committee prefers the TOEFL to the IELTS. While you are encouraged to take the TOEFL, if you are unable to do so, we look for a minimum overall score of 7 on the IELTS, with minimum sub-scores of Reading-6.5, Listening-6.5, Speaking-6, and Writing-6.

Nonnative English speakers may utilize Communications and Language Services Office for additional language support for nonnative English speakers: http://sv.cmu.edu/student-services/communication-language-services.html

Deferral

ECE generally does not allow admission deferrals because admission decisions are based on the current applicant pool. Therefore, students are admitted into the program for a particular semester only. If a student wishes to attend in a future semester, the student must reapply to the ECE program.

Final Undergraduate Transcripts

Applicants admitted to any ECE program must submit final official transcripts, properly sealed, upon completion of their undergraduate program from the institution conferring their degree as a condition of enrollment at Carnegie Mellon. Certificates of graduation and/or degree certificates should also be submitted if provided by the institution. Failure to provide such documents that confirm the completion of undergraduate requirements by the end of the first semester of study at Carnegie Mellon may prevent the M.S. degree from being certified.

Responsible Conduct of Research (RCR) Education

The Office of Research Integrity and Compliance website (https://www.cmu.edu/research-compliance/index.html) describes the university's position on ethical research: "Carnegie Mellon University promotes the responsible conduct of research through high standards of ethics and accountability in planning, conducting and reporting research. The responsible conduct of research is demonstrated through behavior that meets generally accepted standards. These standards are set forth by state and federal regulations, institutional policies, professional codes of conduct and personal convictions."

In support of the university's position, ECE requires **all incoming students** to take the appropriate online training offered by the Collaborative Institutional Training Initiative (CITI). The CITI physical science module package is recommended rather than the module package for engineers, although both are acceptable. The courses are available via CITI (https://www.cmu.edu/research-compliance/responsible-conduct/training.html) through the Office of Research Integrity and Compliance website. Select Carnegie Mellon University as your participating institution when you create your account.

The course(s) may take a few hours to complete but can be done over a period of time. Upon completion of the course(s), students will need to provide their certificate to the Graduate Affairs Office. Instructions on how to submit this certificate are communicated prior to the beginning of the semester.

ENROLLMENT AND REGISTRATION

Overview

After matriculating into ECE, students should create an academic plan and register for courses. Students should actively engage in their process by reviewing degree requirements on the website, connecting with their academic advisor, and conferring with a faculty mentor. Once plans are firm, students can proceed by accessing Student Information Online (SIO).

SIO is an important online tool to use during the registration process, as well as throughout graduate school. Students can access SIO with their Andrew ID at The Hub.

Within SIO, there is a Course Planning module that allows students to view and modify their proposed schedule before registering for courses. Once a schedule is developed, it is the student's responsibility to register for courses using their SIO. Students must be registered for every course that they plan to take for the semester, even if it is not taken for credit (e.g., audited courses).

After the first semester, a student's assigned registration time is determined by the number of completed units and cannot be changed. If a student's tuition balance and/or fees are greater than $0.00, the student will not be able to register until the balance is cleared.

Degree Progress and Planning

Student Responsibility

It is the sole responsibility of the student to manage the academic progression of their program. Students are expected to ensure that they are taking the necessary prerequisites and courses to complete degree requirements on time. Students have the ability to add courses, drop courses, and select units for variable unit courses through SIO. It is the students' responsibility to be aware of all academic deadlines, including the add deadline, the drop deadline, the pass/fail deadline, and the audit deadline. Academic deadline information can be found within The HUB's Academic Calendar (https://www.cmu.edu/hub/calendar/index.html).

If a student is not progressing as expected, they are expected to seek advice and counsel from their academic advisor. If the student is concerned that they may be unable to complete degree requirements, they should contact their academic advisor for assistance.

Degree Requirements Timeframe

The duration of the ECE program is three full-time semesters (fall-spring-fall, or spring-fall-spring). In order to have full-time status, students must enroll in at least 36 units each semester. In order to complete program requirements, students may need to enroll in more than 36 units per semester. The maximum number of units allowed in a semester is 48 units. Students are responsible for completing their enrollment each semester via their Student Information Online (SIO) portal. Students who are not enrolled by the tenth day of class will be withdrawn from the university.

Students must be physically present and attend class at the start of the semester. If extenuating circumstances exist that prevent a student from attending class, a student must notify the

academic advisor and instructors immediately. Not attending class from the start of the semester will have a detrimental effect on a student's progress in the program. ECE will make an effort to verify all students have arrived to begin their program and will consider a student as "withdrawn from the university" if he or she is not here by the tenth day of class as defined by the academic calendar.

International students will be given a 16 month I-20 or DS-2019. International students must consult with CMU's Office of International Education (OIE) for questions on extension of their visa documents or if they complete their degree requirements in less than three semesters. Please see details and relevant forms on OIE's website under Maintaining Legal Status (https://www.cmu.edu/oie/foreign-students/maintain-legal-status/index.html).

Summer Registration

Students are not required to continue their studies over the summer, as the summer semester is considered a vacation semester. However, students may choose to take courses for academic credit or pursue an internship that is relevant to their M.S. degree, if appropriate.

Eligible international students who are completing an internship in the United States must complete the paperwork for Curricular Practical Training (CPT). For more information about internships and CPT, see the Internship section outlined in this handbook and OIE's website on Employment Options (https://www.cmu.edu/oie/foreign-students/employment.html) for international students. Academic and OIE advisors will provide students with information about CPT during the spring semester.

Full and Part-time Requirements

The M.S. degree program is a full-time program in which students complete three full-time (36 units) semesters (including summer if summer is a student's final semester). Students who are interested and qualified may take an accelerated course load and complete the degree in two semesters and should consult with their academic advisor.

In extenuating circumstances, students may find that they may need to take a reduced course load. Extenuating circumstances that will be considered include medical reasons, initial academic difficulty due to problems with English language or the student being unfamiliar with U.S. teaching methods, or being placed in an improper course level. These students must submit an Authorization for a Reduced Course Load form (https://www.cmu.edu/oie/foreign-students/docs/reduced.pdf) to their academic advisor.

Part-time Master's enrollment is an option available for students in special circumstances, such as students who would like to pursue an M.S. degree while maintaining external employment. Note that immigration regulations do not allow Carnegie Mellon University to issue visa documents for the part-time M.S. program.

Statute of Limitations

ECE adheres to CIT's policy on M.S. completion timelines (https://www.cit.cmu.edu/education/academic-policies/graduate-policies/registration-grading-credit.html#statute-of-limitations-for-master's-degree-students). The CIT policy is as follows:

"All units required for a master's degree in the College of Engineering, whether earned in residence or transferred from another institution, must be recorded on the transcript within six years of the date on which the student enrolled in the program." Former ECE students who did not fulfill graduation requirements and would like to return to complete a degree should refer to the statute of limitations in CIT's graduate student policies for more information.

Campus Location Change

Students enrolled in the ECE master's program at the Silicon Valley location may be eligible to request to change residence to another campus after completing one semester of full-time study. Eligibility is determined by the details included in the student's admission offer and is explicitly stated in the admission offer letter. Due to limited space, location changes are not guaranteed and are subject to the discretion of the department. The students are responsible for all academic and financial impacts related to this change. Information about the location change process will be provided to eligible students.

International student internship eligibility will not be affected if students change location between Silicon Valley and Pittsburgh campuses. Locations changes between U.S. based campuses and CMU Africa will have implications for internship eligibility for international students. Please refer to OIE's website for employment options (https://www.cmu.edu/oie/foreign-students/employment.html) and consult with your OIE advisor for additional questions.

Change of Degree Program

Sometimes students begin their M.S. program and realize that would like to transfer to a different degree program than the one they were admitted to. When this occurs, students may have the option of applying to transfer to another M.S. degree program in the ECE Department (M.S. ECE or M.S. SE). Students must meet with their academic advisor to determine if this is possible. Information about the degree change application and process will be provided to the students at that time. All degree program change applications are reviewed by the ECE Admissions Committee and are subjected to the same admission standards as initial applications to the program. Program changes are not guaranteed. In the case where a program change will also result in a campus location change, students are subject to the same policies outlined in the Campus Location Change section in this handbook.

Please note that students are not eligible to change degree programs until after they have successfully completed 36 units at CMU, and all applications will be considered for the following semester. The students are responsible for all academic and financial impacts related to the change. Prior to changing to a new M.S. degree program, international students should consult with OIE.

Please note that changing between the MS ECE Standard, Applied, Advanced, or Applied Advanced programs is not allowed at any time. You will select your program when you accept your offer and you must remain in your declared program until degree completion.

Courses Outside of Degree Requirements

Courses that do not satisfy degree requirements include StuCo courses (98), Physical Education course (69), audited courses, and pass/fail courses. Similar to courses taken for degree requirements, students must register for these other courses, and the units will count towards their course load for the semester. For a complete list of course restrictions, see the ECE website: https://www.ece.cmu.edu/academics/ms-ece/requirements.html.

Double Counting Courses

ECE follows the CIT Policy on double counting courses (https://www.cit.cmu.edu/education/academic-policies/graduate-policies/registration-grading-credit.html#double-counting-of-course-units-for-m.s.-and-ph.d.-degrees). Students are required to notify the Graduate Affairs Office prior to declaring a degree outside of ECE as this may have repercussions for your units and coursework to date.

The same course taken two separate times will not count towards the ECE M.S. If a student takes the same course twice, the course with the higher grade will be counted towards the ECE M.S. course requirements.

Maximum Units Allowed

You may not begin a new semester with 120 or more units while pursuing your degree. These units include courses taken for audit, pass/no pass, and withdrawal. Please refer to CIT policy on M.S. degree units (https://www.cit.cmu.edu/education/academic-policies/graduate-policies/registration-grading-credit.html#m.s.-degree-units) for additional information.

If it becomes clear that a student will exceed the maximum units and not be able to maintain the required 3.0 average, the student may be dropped from the M.S. ECE or SE program.

Maximum Units Allowed Outside CIT

Effective fall 2020, M.S. ECE and M.S. SE students at all campuses may take no more than 12 units outside the College of Engineering. Please see the M.S. ECE Requirements (https://www.ece.cmu.edu/academics/ms-ece/requirements.html) and M.S. SE Requirements (https://www.ece.cmu.edu/academics/ms-se/requirements.html) pages on our website for details on which students this rule affects.

M.S. Concentrations

Four concentrations are available for M.S. ECE students to choose from, allowing for focused study in a specific area of electrical and computer engineering. Students completing one or more of these concentrations should refer to their degree as a Master of Science in Electrical and Computer Engineering with a concentration in <name of concentration>. Students satisfying the requirements for more than one concentration may acknowledge all for which they fulfill the requirements.

All concentrations require a minimum of four ECE courses, distributed across categories as described below. M.S. ECE students are not required to complete a concentration in order to graduate.

For a list of concentrations and the respective approved courses within each concentration, visit the website: https://www.ece.cmu.edu/academics/ms-ece/concentrations.html

Retaking Courses

If students do not pass a course, they should take a different course that will fulfill the requirement. If you are considering retaking a course, please see your academic advisor. Students may retake a prerequisite course in which they did not receive the minimum grade required.

All grades are recorded on the transcript and factored into the cumulative QPA; however, only the best 97 units that fulfill degree requirements are factored into the required 3.0 graduation QPA.

Auditing Courses

Auditing a course is being present in a classroom without receiving academic credit or a letter grade. An audited course will appear on a student's transcript. Students who are present in a classroom and who are not receiving academic credit or a letter grade must audit the class to continue to attend regularly.

A student who wants to audit a course is required to:

1. Register for the course in SIO.
2. Obtain permission from the instructor and ask the instructor to sign the course audit approval form (https://www.cmu.edu/hub/docs/course-audit.pdf).
3. Submit the form to their academic advisor for approval.
4. If approved, the academic advisor will send the form to the HUB for processing.

Once a course audit approval form is submitted to the HUB, a letter grade ('A'-'R') will not be assigned for the course and the declaration cannot be reversed. You can find the deadline for submitting this form on the Academic Calendar. After the deadline, students will not be able to request the option to audit a course.

The extent of the student's participation must be arranged and approved by the course instructor. Typically, auditors are expected to attend class as though they are regular class members. Those who do not attend the class regularly or prepare themselves for class will receive a blank grade. Otherwise, the student receives the grade 'O', indicating an audit.

The units of audited courses count toward the maximum course load units, but do not count toward the degree requirements. If an audited course is outside the College of Engineering, those units count towards the 48 units MS ECE students may take outside the College of Engineering. Any student may audit a course. For billing, an audited course is considered the same as the traditional courses under the tuition charges. If a part-time student audits a course, he/she will be charged part-time tuition based on the per-unit tuition rate for the course.

Pass/No Pass Courses

Students who want to take a course pass/fail are required to register for the course and submit the pass/no pass approval form (https://www.cmu.edu/hub/docs/pass-fail.pdf) to their

academic advisor for approval. If approved, the academic advisor will send the form to the HUB for processing.

Once a Pass/Fail Audit Approval form is submitted to the HUB, a letter grade ('A'-'R') will not be assigned for the course and the declaration cannot be reversed. Passing work (letter grade 'A'-'C') is recorded as 'P' (passing grade) or 'S' (satisfactory) on the student's academic record, with both grades meaning the same; work with a grade at or lower than 'C-' will not receive credit and will be recorded as 'N' (not passing grade) on the student's academic record. No quality points will be assigned to 'P'/'S' or 'N' grades; the units of 'P'/'S' or 'N' grades will not be factored into the student's QPA.

The units of pass/no pass courses count toward the maximum course load units, but do not count toward the degree requirements. You can find the deadline for submitting this form on the Academic Calendar. After the deadline, students will not be able to request the option to pass/fail a course.

Any student may take a course pass/fail. For billing, the pass/fail course is considered the same as the traditional courses under the tuition charges. If a part-time student takes a course pass/fail, he/she will be charged part-time tuition based on the per-unit tuition rate for the course.

Petition Process

Petitions to the GSC may include program or transfers, increase in units, course substitutions, and any other changes that are outside of the policies stated in the student handbook. Petitions are approved by the GSC. Students are advised to discuss their petitions with their academic advisors.

The petitions process is as follows:

1. Student completes the appropriate petition form (M.S. ECE GSC Petition form: https://www.ece.cmu.edu/insider/grads/forms/gsc-ms-course-approval-petition.pdf, or M.S. SE GSC Petition form: https://www.ece.cmu.edu/insider/grads/forms/gsc-ms-se-course-approval-petition.pdf) and submits it to their academic advisor in the Graduate Affairs Office no later than 5pm ET on the Friday before the GSC meeting.
2. The academic advisor presents the petition to the GSC.
3. Students are notified of the outcome of their petition via an email from the M.S. Academic Advisor after the GSC has met. Generally, all GSC decisions are final.
4. Due to time constraints, some petitions may be tabled until the following GSC meeting. When this occurs, students will be notified via email.
5. The academic advisor saves a finalized version of the petition in the student's academic file.

Course Transfer Request Policy and Process

Only one graduate-level course, or the equivalent of 12 units, can be transferred from another university as credit toward the M.S. degree. As a guideline, three-credit courses from other universities equate to 9-unit CMU courses; a four-credit course equates to a 12-unit CMU course.

The course being transferred in must:

- Fulfill an ECE degree course requirement and is equivalent to a CMU course
- Be considered a graduate level course at the university where it was taken (unless requesting transfer credit for the one allowed undergraduate course)
- Have not been used to fulfill requirements for any previously earned degree

Please note that this policy is more restrictive than the CIT transfer credit policy (https://www.cit.cmu.edu/education/academic-policies/graduate-policies/registration-grading-credit.html#transfer-credit-&-special-students) (under 'Transfer Credit and Special Students'). A grade of 'B' or better must be earned for the course to be transferred. The transfer credits will appear on the student's transcript and will not be factored into the QPA.

Transfer credit is not granted prior to admission and must be approved by the Graduate Studies Committee and CIT Dean's Office. Courses can only be requested for transfer after the student has successfully completed 36 units of coursework at Carnegie Mellon. After matriculating to Carnegie Mellon, ECE students should consult with their academic advisor before taking a course at another university.

Transfer courses will be reviewed for academic rigor and alignment with courses offered in ECE. The course description and syllabus, learning outcomes, delivery mode, and institutional accreditation will be considered when evaluating the course for transfer.

The process for requesting to transfer a course is as follows:

1. Meet with academic advisor to discuss the course transfer
2. Complete and collect the following mandatory documents:
    a. Appropriate petition form (M.S. ECE GSC Petition form, or M.S. SE GSC Petition form)
    b. Official transcript from previous institution
    c. Detailed course description/syllabus (should include grading scale, assignments required, mandatory books, and time required in class) of the course you wish to transfer
    d. Letter from the previous institution's registrar or academic advisor stating the course intended for transfer was not used towards a degree
    e. E-mail endorsement from the instructor of the CMU course you believe your transfer course is most equivalent to
    f. CIT Graduate Transfer Credit Request form
3. Submit the completed packet to the academic advisor
4. The academic advisor will present the transfer request to the CIT Dean's office and notify the student of the result.
5. Once the petition is approved, the Graduate Affairs Office will work with the student to complete the transfer request.

ECE has not entered into an articulation or transfer agreement with any specific college or university. The transfer of credits from any college or university must follow the above policy and process. Additionally, ECE does not award credit for prior experiential learning.

Pittsburgh Council on Higher Education (PCHE) Cross-Registration Program

Full-time Carnegie Mellon students may take subjects for credit through the Pittsburgh Council on Higher Education (PCHE). The purpose is to provide opportunities for enriched educational programs by permitting *full-time* paying undergraduate and graduate students to cross-register for **one** course at any of the ten PCHE institutions. Please refer to The HUB website for additional details.

Research for Credit

Students can apply up to 15 units of research credit towards their M.S. degree requirements by registering for the 18-980, M.S. Research Project course. The number of units registered for should equal the number of hours you complete each week. For example, 12 units of research means the student should complete 12 hours of research each week. Alternative accommodations should be worked out with the supervising faculty member.

MS Research Approval Process:

- As an ECE student, you are able to view and apply for available research projects through Student Project Tracker - SPT (https://www.ece.cmu.edu/apps/spt/) electronically. New students will have access to the system on the first day of classes.
- You can view the details of the research projects listed and click the apply button to submit an application.
- Your application will be reviewed by the research instructor. You will be contacted by the research instructor (or someone from their research lab) if there is an interest in your application.
- The research instructor will inform your advisor through the SPT system if your application is approved and your advisor will register you for the appropriate research units. You will be registered for 18-980 based on the units reflected in the SPT system.
- If you already have a research project set up with a faculty member, the project still needs to be created in this portal. You must apply and get accepted through the system.
- If you are planning on conducting research with a non-ECE faculty member, the project must still be posted in SPT. You and/or your research instructor must find an ECE faculty member who will be a co-research instructor in the project.

Registering for Courses

Academic Calendar

ECE adheres to the official CMU Academic Calendar. The Heinz College and the Tepper School (https://www.cmu.edu/tepper/academic-calendar.html) follow their own calendars with dates that may differ from the University's calendar for the add, drop and pass/fail/audit deadlines. ECE students must adhere to the deadlines of the courses they are taking if the courses are in Heinz or Tepper.

Course Load

Due to the rigor of these programs, students are advised to take 37 units of courses in their first semester and 36 units of courses each semester thereafter. However, we recognize that our student body is diverse, and that includes how each student handles their course load. While students may register for a maximum of 48 units each semester, we strongly recommend students take no more than 36 units each semester. Students unsure of whether they should take 48 units may should schedule an appointment with their academic advisor to discuss their reason for overloading and prepare a plan for how to handle the additional load.

Adding Courses

Students have the option of adding courses to their schedule starting at their assigned registration time until the add/drop deadline through SIO. If a student wishes to be added to a course after the add/drop deadline, the Course Add Request Form (https://www.cmu.edu/hub/docs/late-add.pdf) must be completed and signed by the course instructor. Then, the student must submit the form to their academic advisor for approval. If approved, the academic advisor will send the form to the HUB for processing.

In the event that an ECE course (18-XXX) is cross-listed with a course from another department, ECE students must register for the ECE course number.

Courses in the Tepper School of Business may be taken and can be registered for through a site outside the SIO. Tepper will publish a list of available MBA courses, and in order to register for Tepper courses, students should visit the Tepper registration site (https://www.cmu.edu/tepper/programs/mba/curriculum/mba-course-requests/carnegie-mellon-graduate-students.html).

Course Locations

Courses will take place at various buildings and room locations across CMU campuses as assigned by the University Registrar's office each academic semester. Each course location is tied to a section and has a final assignment that is linked to the final grade. It could be in the form of a final exam, final project, or research as stated in the syllabus on the first day of classes. Students should register for sections of their courses according to their physical campus location. Please refer to the schedule of classes available on your campus.

Dropping Courses

Students have the option of dropping courses from their schedule starting at their assigned registration time until the add/drop deadline (see Academic Calendar) through SIO. When a course is dropped before the drop deadline, it does not appear on the transcript. As a courtesy to others, students should drop a course as soon as they decide not to take it. This will allow a waitlisted student to be enrolled and will limit the disruption to any team-based projects.

Withdrawing from Courses

Students should remove themselves from a course before the drop deadline each semester. If a student chooses to withdraw from a course after the drop deadline, the student must officially withdraw from the course and should consult with their advisor to discuss the withdrawal. Withdrawals take place after the drop deadline but before the last day of the semester. Students must complete and submit the Course Withdrawal Request form (https://www.cmu.edu/hub/docs/course-withdrawal.pdf) with their academic advisor in order to withdraw from a course. More information on withdrawal grades can be found on the CMU policy website under the grading policy (https://www.cmu.edu/policies/student-and-student-life/grading.html). Withdrawals receive a "W" grade for the course on a transcript; this "W" grade is not factored into the QPA but the course does count towards the maximum units. However, withdrawn courses do count towards the maximum units and, if they are outside the College of Engineering (CIT), towards the 48 units students may take outside of the College of Engineering (CIT).

Waitlists

It is typical to be waitlisted from the time of registration up until the tenth day of class. This is common practice across the university to ensure that students within the department have the opportunity to take the courses they need in order to graduate. To determine the likelihood that you will be registered from a waitlist for an ECE course, students in Silicon Valley should email their academic program advisor. You should only attend courses for which you are waitlisted if you have permission from the instructor. Students may only be waitlisted for a maximum of 5 courses.

As a courtesy, students should remove themselves from the waitlist and/or drop a course in a timely fashion so as to allow other students the opportunity to be removed from the waitlist and enrolled in a course.

Students should check their schedules frequently on SIO as they may be enrolled from a waitlist without being notified. In addition, during the registration process, the Registrar's Office will require students to "tag up" on their waitlists in order to confirm the desire to remain on the waitlist for a course. Failure to confirm their waitlists will result in being dropped from the waitlist.

It is strongly recommended that students have a back-up plan in case they are not removed from a waitlist by the tenth day of class.

Remote Courses

CMU offers courses that are taught exclusively online, and some have a live recitation component. ECE refers to them as "Technology Enhanced" courses and can be identified by the section code that includes "T" or the teaching location noted as "DNM". Departments with online courses may list their technology enhanced courses in a different format, so be sure to check with the instructor if it is unclear whether a course is online. International students on a US residential campus (Pittsburgh, Silicon Valley) may take a maximum of one online course per semester that does not have a required in-person component, per F1 regulations.

Courses with Time Conflicts

Students are not permitted to register for two courses that conflict in time. Registration may be possible with consent from an instructor, allowing the conflict or attendance at an alternate time. Students should forward permissions from instructors to their academic advisor in order to register for conflicting courses.

Prerequisites

While SIO may allow you to register for courses without the published prerequisite, it is the student's responsibility to have adequate background knowledge to be successful in the subsequent course. This background knowledge may come in the form of an introductory course taken at Carnegie Mellon, your undergraduate institution, or other work/research experience. You should consult with the instructor because it is up to their discretion whether or not a prerequisite course can be waived.

For ECE courses that require 18-613/15-213/15-513/18-213 as a prerequisite, students will not be permitted to enroll in the subsequent course without credit for 18-613/15-513. 18-613 and 15-513 are the only courses available to graduate students that satisfy the prerequisite requirement. Students attending Pittsburgh campus can plan to take 15-513 in the summer prior to their matriculation in the fall semester. Tuition will apply at a per unit rate.

Some of the graduate courses that require 18-613/15-213/15-513/18-213 anywhere in their prerequisite tree include:

- 18-648 – Embedded Real-Time Systems
- 18-649 – Distributed Embedded Systems
- 18-656 – Data Intensive Workflow Development for Software Engineers
- 18-725 – Advanced Digital Integrated Circuit Design
- 18-740 – Computer Architecture
- 18-742 – Parallel Computer Architecture
- 18-745 – Rapid Prototyping of Computer Systems
- 18-746 – Advanced Storage Systems
- 18-748 – Wireless Sensor Networks
- 18-756 – Packet Switching and Computer Networks
- 18-759 – Wireless Networks
- 18-842 – Distributed Systems

- 18-845 – Internet Services
- 18-848 – Special Topics in Embedded Systems

Final Exams

All ECE students must attend final exams as scheduled by the university and individual course instructors. If a student believes that a final exam presents a scheduling conflict, he or she must discuss the issue with the course instructor. The ECE administration does not have control over the university exam schedule. Please keep this in mind when arranging travel at the end of a semester; having purchased airline tickets is not a proper excuse for missing a final exam. Please refer to Carnegie Mellon University Policies on Examinations for additional information: https://www.cmu.edu/policies/student-and-student-life/examination-policies.html

Research Assistant and Teaching Assistant Positions

Research for Assistant for Credit

See the section titled "Research for Credit" for more information about receiving academic credit for research.

Research for Assistant for Pay

Students are permitted to pursue research opportunities for pay in any department. Students should contact faculty members individually to inquire about opportunities available and provide information on their background. The supervising faculty can provide further information about payroll procedures.

Teaching Assistant Positions

There are several levels of teaching assistant opportunities available for ECE students. For complete information please visit the Teaching Opportunities website: https://www.ece.cmu.edu/insider/teaching-opportunities.html

Employment Eligibility Verification

If you are receiving a stipend, you are going to be a TA or your are planning to have a position with CMU then Employment Eligibility Verification is required.

Form I-9 must be completed within 3 business days of beginning work for any type of compensation (stipend or employment). Additional details are highlighted below.

To ensure compliance with federal law, Carnegie Mellon University maintains the Employment Eligibility Verification (I-9) Policy [pdf] covering the university's I-9 and E-Verify requirements:

Every individual receiving a stipend from CMU or employed by CMU must comply with the I-9 Policy by completing the Form I-9 within three business days following the first day of stipend start date/employment.

Individuals who expect to work on a federally funded project are further responsible for submitting an E-Verify Processing Request Form to the Office of Human Resources.

For more information, please see CMU's Guidance for Completing the Form I-9 and E-Verify Requirements at CMU [pdf], or visit the Human Resources Service website to learn more about Form I-9 and E-Verify and to schedule an appointment to complete the Form I-9.

Evaluation and Certification of English Fluency for Instructors

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990 (https://www.cmu.edu/policies/faculty/evaluation-certification-english-fluency-instructors.html). For more information about requirements, see Evaluation & Certification of English Fluency for Instructors in the University Policies of this handbook.

Enrollment Verifications

The Hub is the primary contact for students or alumni who would like to request a transcript, enrollment verification, or other information related to their time in ECE.

ECE may verify some limited information in the form of a letter, which may be suitable for some purposes, such as the verification of skills students acquired through the ECE programs. Please contact your academic advisor for more information. ECE may verify some limited information in the form of a letter, which may be suitable for some purposes, such as the verification of skills students acquired through the ECE programs. Please note that the ECE department is only able to verify information on ECE and Computer Science courses. Information on courses offered in other departments can only be verified by the other department. To obtain a verification, the student or alumni should contact the Graduate Affairs Office.

Leave of Absence

Occasionally, students must pause their degree program due to personal, professional, or academic reasons. A student who is considering a leave of absence should speak to his or her academic advisor prior to taking a leave of absence in order to ensure his or her understanding of the leave of absence policy and its ramifications.

Leaves of absences are capped at two calendar years' total throughout the M.S. program. In extreme cases, a student may request additional leave time via a petition to the GSC. If they do not return within two academic years, they will be administratively withdrawn from the graduate program. IMB students who have declared their graduate degree but left CMU after completing their BS degree before having graduate status must also abide by this policy. Anyone who is intending to return to the program outside of the two-year leave (including CMU graduates with ECE BS degrees who have not declared their IMB prior to graduation) must re-apply to the graduate program. Questions can be addressed to the M.S. Academic Program Advisor.

Once a student decides to take a leave of absence, he or she should complete the Leave of Absence form and bring it to their academic advisor for additional processing. Please note that the student's advisor must sign the leave of absence form: https://www.cmu.edu/hub/docs/loa.pdf.

Returning from a Leave of Absence

A student intending to return from leave must submit the Petition to Return from Leave of Absence form (https://www.cmu.edu/hub/docs/return-loa.pdf) to their academic advisor at least 30 days prior to the start of the semester in which he/she plans to return. A student's return must coincide with the start of a new semester (fall, spring, or summer). Students cannot return from a leave of absence in mid-semester, with the exception of summers.

Per university policy on student leaves (https://www.cmu.edu/policies/student-and-student-life/student-leave.html), "Students on leave are not permitted to live in university housing, attend classes or maintain employment as students at Carnegie Mellon while their leave is in effect."

More information about the University's Leave of Absence and Withdrawal policies can be found in the University Policies section of this handbook.

Degree Certification Process and Commencement

A student must satisfy all degree requirements and achieve a minimum of 3.0 QPA in the courses being applied towards the required 97 units to be eligible for degree certification. In addition, students must have provided a final copy of their undergraduate transcript(s) and must have a tuition balance of $0.00 to receive a diploma.

Carnegie Mellon Commencement only occurs at the end of spring semester. ECE holds a diploma ceremony at the end of spring semester as well. Students who are certified in the summer or fall semesters will be invited to attend the next commencement ceremony. Spring graduates will be invited to the spring commencement ceremony.

Before graduation, students should update their contact information, such as mailing address and e-mail address, within SIO. Also, students should review a proxy of their diploma in SIO to verify the information displayed there, such as the spelling of their name.

The title of the degree students receive is Master of Science in Electrical and Computer Engineering or Master of Science in Software Engineering.

ACADEMIC STANDARDS

Grades

Below are the policies surrounding grades for students in the Department of Electrical and Computer Engineering.

University Policy on Grades

The university policy on grading (https://www.cmu.edu/policies/student-and-student-life/grading.html) offers details concerning university grading principles for students taking courses and covers the specifics of assigning and changing grades, grading options, drop/withdrawals and course repeats. It also defines the undergraduate and graduate grading standards.

CIT Grading Policy

ECE follows the CIT letter grade scale (https://engineering.cmu.edu/education/academic-policies/graduate-policies/registration-grading-credit.html). The letter grade scale is 'A' (highest for CIT students), 'A-', 'B+', 'B', 'B-', 'C+', 'C', 'C-', 'D+', 'D', and 'R' (lowest). CIT students cannot receive an 'A+' grade on their transcript, even if a course is taken from another college where 'A+' is given. Grades lower than 'C', meaning C- or below, are considered failure in CIT and will not count toward degree requirements.

Incomplete Grade

Incomplete grades will be assigned at the discretion of the course instructor, per the university grading policy.

Withdrawal Grade/Withdrawing from Courses

Students can withdraw from a course after the add/drop deadline until the last day of classes. This will result in a 'W' on the transcript, which is not factored into the QPA. To withdraw, the course withdrawal request form (https://www.cmu.edu/hub/docs/course-withdrawal.pdf)must be completed and submitted to the academic advisor for approval. If approved, the academic advisor will send the form to the HUB for processing.

Academic Performance

Quality Point Average

In order to graduate, each student must have a Quality Point Average (QPA) of at least 3.0 in the courses being used towards the required 97 units. Coursework or graduate project units with a grade lower than 'C' will not be considered toward graduate degree requirements. However, they will be calculated into the student's cumulative QPA.

Academic Probation

In the event that a student's semester or cumulative QPA falls below a 3.0, that student is on academic probation and will receive a letter from the department alerting them. While on probation, students must meet with their academic advisor and comply with their recommendations. Once a student's semester and cumulative QPA increase above 3.0, the student is automatically removed from probation.

Academic Integrity

Students at Carnegie Mellon are engaged in preparation for professional activity of the highest standards. Each profession constrains its members with both ethical responsibilities and disciplinary limits. To assure the validity of the learning experience a university establishes clear standards for student work.

In any presentation, creative, artistic, or research, it is the ethical responsibility of each student to identify the conceptual sources of the work submitted. Failure to do so is dishonest and is the basis for a charge of cheating or plagiarism, which is subject to disciplinary action.

ECE adheres to Carnegie Mellon's policy on academic integrity and all students are expected to review the policies prior to their arrival at CMU. ECE also adheres to CIT's policy on graduate student academic integrity violations.

Please review the University Policy on Academic Integrity (https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html). The policy includes the University expectations around academic integrity and provides definitions of cheating, plagiarism, and unauthorized assistance.

A review of the University's Academic Disciplinary Actions procedures (https://www.cmu.edu/student-affairs/theword/academic-discipline/index.html) is also recommended. These procedures outline the process for investigating, reporting, and adjudicating violations of the University Policy on Academic Integrity. The procedures also outline the appeal process.

Instructors are responsible for defining academic integrity for students in their courses, including student performance expectations and attendance requirements. Students are responsible for understanding and abiding by the instructor's academic integrity policies. Policies may vary from instructor to instructor and students should seek further guidance from a faculty member if they have specific questions about a course's academic integrity policy.

Penalties for Violating Academic Integrity

Should an instructor believe that an academic integrity violation has occurred, they may consult with the Office of the Dean of Student Affairs, who will assist the faculty member in handling a possible academic integrity violation and, if a student is found responsible for violating academic integrity policies, determining possible sanctions. In accordance with the university's policy, a student who violates the academic integrity policy will not be permitted to drop the course in which the offense occurred in order to avoid penalty. If the student attempts to drop the course, they will be reenrolled.

Multiple academic integrity violations may result in a student's dismissal from the MS ECE program. Students have the right to appeal an academic integrity decision.

Disciplinary Probation

Students who have committed an academic integrity violation are placed on disciplinary probation within the department for the remainder of their academic program. While on probation, students are allowed to continue with the program but must meet with their academic advisor.

M.S. DEGREE REQUIREMENTS

This section outlines the degree requirements for the Master's of Science in Electrical & Computer Engineering in Silicon Valley and the Master's of Science in Software Engineering in Silicon Valley. ECE course list and course descriptions are available on the ECE course website: https://courses.ece.cmu.edu.

M.S. in Electrical & Computer Engineering [Standard] – effective Fall 2020

The course option is available to students at both the Pittsburgh and Silicon Valley campuses. The project option is only available to students at the Pittsburgh campus at this time.

Course option requirements

- 60 units of ECE Core Courses
- 24 units of CIT Elective Courses
- 12 units of General Technical Elective Courses
- 1 unit of Introduction to Graduate Studies (18989)

*Preparatory Exception: 12 units of undergraduate course work (300 level and above) may be substituted as part of the 96 core and elective units

A. ECE core coursework **(Standard Program)**

60 units (for the course option) or 36 units (for the project option) must be graduate coursework (600 level or above) within ECE (18-XXX).

EXCEPTIONS – The following ECE (18) courses may not be counted toward ECE Core Coursework. They may be counted toward CIT Electives or General Technical Electives: 18-601, 18-603, 18-605, 18-606, 18-700, 18-701, 18-702, 18-703

B. CIT elective coursework **(Standard Program)**

24 units (for the course option) or 12 units (for the project option) must be graduate coursework (600 level or above) within CIT from the following departments

- ECE (18)
- Carnegie Institute of Technology (CIT) (39)
- Biomedical Engineering (42)
- Chemical Engineering (06)
- Civil & Environmental Engineering (12)
- Engineering & Public Policy (19)
- Information Network Institute (14)
- Integrated Innovation Institute (49)
- Materials Science & Engineering (27)
- Mechanical Engineering (24)
- CMU Africa (04)

EXCEPTIONS – The following CIT courses may not be counted toward CIT Elective Coursework. They may be counted toward General Technical Elective Coursework.

- Engineering & Public Policy (19) - 19-602, 19-655

- Integrated Innovation Institute (49) – 49-750, 49-751, 49-761, 49-762, 49-763, 49-764, 49-765, 49-766, 49-767, 49-770, 49-771, 49-772, 49-773, 49-774, 49-775, 49-780, 49-781, 49-782, 49-788, 49-790, 49-791, 49-792, 49-793
- Mechanical Engineering (24) – 24-792
- CMU Africa (04) – 04-601, 04-602, 04-605, 04-900, 04-980

C. General technical elective coursework **(Standard Program)**

- 12 units of coursework (600 level or above) can be from the following programs (shown under their parent college) or individually approved courses:
- Dietrich College of Humanities and Social Sciences
    - Statistics (36)
    - Center for the Neural Basis of Cognition (86)
    - Heinz School of Information Systems (95)
    - Heinz College-Wide Courses (94)
- Mellon College of Science (MCS)
    - Biological Sciences (03)
    - Chemistry (09)
    - Mathematical Sciences (21)
    - Physics (33)
    - School of Computer Science (SCS)
    - Computational Biology (02)
    - Computer Science (15)
    - Entertainment Technology Center (53)
    - Institute for Software Research (08)
    - Robotics Institute (16)
    - Human-Computer Interaction Institute (05)
    - Language Technologies Institute (11)
    - Machine Learning (10)
    - Software Engineering (17)
- Tepper School of Business (45)

Additional courses outside of these programs that are approved to be counted toward General Technical Elective Coursework:

- 46-926, 46-929
- 47-830, 47-834
- 51-882
- 57-947
- 80-713
- 84-688
- 90-756, 90-808
- 93-711

D. M.S. Graduate Project coursework **(Standard Program)**
36 units (for the project option only) of 18-980 (M.S. Graduate Project) must be completed.

*The M.S. Graduate Project is not required for students in the course option, however these students may take up to 27 project units. 12 units of research can count towards their core requirements and up to 15 project units can count toward their CIT elective requirements.

Restrictions for courses outside the College of Engineering

ECE Master's students in the standard program will take 97 units for their degree, 85 units of which must be from within the College of Engineering (61 from within ECE, 24 from within CIT; see above). This rule applies to all students matriculating fall 2020 or later and to all IMB students who sign their intent form after the start of the Fall 2020 semester. IMB students will be beholden to the program requirements in place when they sign their intent form and officially agree to enter the program.

*Please note: Additional units can be taken beyond the required 97 units described above in order to diversify your course schedule, however, they will not be counted towards the program requirements. Students who wish to take more than the recommended 36 units per semester (after their first semester) should make an appointment with their academic advisor to review your planned schedule.

Maximum units allowed

Students who are pursuing the M.S. Standard degree cannot register for their final semester if they have already completed 120 units of coursework. These units include courses taken for audit, pass/no pass, and withdrawal. Please refer to CIT policy on MS degree units for additional information.

M.S. in Electrical & Computer Engineering [Applied] – effective Fall 2020

The **M.S.-AP in ECE** is a three-semester program that is comprised of 97 units of graduate course work (600 level and above). The Applied Program has two available options detailed below. The course option is available to students at both the Pittsburgh and Silicon Valley campuses. The project option is only available to students at the Pittsburgh campus at this time.

Course option requirements

- 60 units of ECE Core Courses
- 24 units of CIT Elective Courses

- 12 units of General Technical Elective Courses
- 1 unit of Introduction to Graduate Studies (18989)
- 1 Summer Internship (18993)

*Preparatory Exception: 12 units of undergraduate course work (300 level and above) may be substituted as part of the 96 core and elective units.

*A. ECE core coursework **(Applied Program)***

60 units (for the course option) or 36 units (for the project option) must be graduate coursework (600 level or above) within ECE (18-XXX).

EXCEPTIONS – The following ECE (18) courses may not be counted toward ECE Core Coursework. They may be counted toward CIT Electives or General Technical Electives:

- 18-601, 18-603, 18-605, 18-606, 18-700, 18-701, 18-702, 18-703

*B. CIT elective coursework **(Applied Program)***

24 units (for the course option) or 12 units (for the project option) must be graduate coursework (600 level or above) within CIT from the following departments

- ECE (18)
- Carnegie Institute of Technology (CIT) (39)
- Biomedical Engineering (42)
- Chemical Engineering (06)
- Civil & Environmental Engineering (12)
- Engineering & Public Policy (19)
- Information Network Institute (14)
- Integrated Innovation Institute (49)
- Materials Science & Engineering (27)
- Mechanical Engineering (24)
- CMU Africa (04)

EXCEPTIONS – The following CIT courses may not be counted toward CIT Elective Coursework. They may be counted toward General Technical Elective Coursework.

- Engineering & Public Policy (19) - 19-602, 19-655
- Integrated Innovation Institute (49) – 49-750, 49-751, 49-761, 49-762, 49-763, 49-764, 49-765, 49-766, 49-767, 49-770, 49-771, 49-772, 49-773, 49-774, 49-775, 49-780, 49-781, 49-782, 49-788, 49-790, 49-791, 49-792, 49-793

- Mechanical Engineering (24) – 24-792
- CMU Africa (04) – 04-601, 04-602, 04-605, 04-900, 04-980

*C. General technical elective coursework **(Applied Program)***

12 units of coursework (600 level or above) can be from the following programs (shown under their parent college) or individually approved courses:

Dietrich College of Humanities and Social Sciences

- Statistics (36)
- Center for the Neural Basis of Cognition (86)
- Heinz School of Information Systems (95)
- Heinz College-Wide Courses (94)

Mellon College of Science (MCS)

- Biological Sciences (03)
- Chemistry (09)
- Mathematical Sciences (21)
- Physics (33)

School of Computer Science (SCS)

- Computational Biology (02)
- Computer Science (15)
- Entertainment Technology Center (53)
- Institute for Software Research (08)
- Robotics Institute (16)
- Human-Computer Interaction Institute (05)
- Language Technologies Institute (11)
- Machine Learning (10)
- Software Engineering (17)

Tepper School of Business (TEP)

- Tepper School of Business (45)

Additional courses outside of these programs that are approved to be counted toward General Technical Elective Coursework:

  - 46-926, 46-929
  - 47-830, 47-834

- 51-882
- 57-947
- 80-713
- 84-688
- 90-756, 90-808
- 93-711

*D. M.S. Graduate Project coursework **(Applied Program)***

36 units (for the project option only) of 18-980 (M.S. Graduate Project) must be completed. *The M.S. Graduate Project is not required for students in the course option, however, these students may take up to 27 project units. 12 project units can count towards their core requirements and up to 15 project units can count toward their elective requirements.

Restrictions for courses outside the College of Engineering

ECE Master's students in the applied program will take 97 units for their degree, 85 units of which must be from within the College of Engineering (61 from within ECE, 24 from within CIT; see above). This rule applies to students matriculating fall 2020 or later and to all IMB students who sign their intent form after the start of the Fall 2020 semester. IMB students will be beholden to the program requirements in place when they sign their intent form and officially agree to enter the program.

*Please note: Additional units can be taken beyond the required 97 units described above in order to diversify your course schedule, however, they will not be counted towards the program requirements. Students who wish to take more than the recommended 36 units per semester (after their first semester) should make an appointment with their academic advisor to review your planned schedule.

Maximum units allowed
Students who are pursuing the M.S. Standard degree cannot register for their final semester if they have already completed 120 units of coursework. These units include courses taken for audit, pass/no pass, and withdrawal. Please refer to CIT policy on MS degree units for additional information.

M.S. in Software Engineering [Standard] – effective Fall 2020

The M.S. in SE is a three semester program that is comprised of 97 units of graduate course work (600 level and above).

Course option:

The requirements for the course option are broken down as follows:
60 units of SE Core Courses
24 units of CIT Elective Courses
12 units of General Technical Elective Courses
1 unit of Introduction to Graduate Studies (18989)

*Preparatory Exception: 12 units of undergraduate course work (300 level and above) may be substituted as part of the 96 core and elective units.

A. SE core coursework (Standard Program)

The SE standard program requires 60 units (for the course option) and 48 units (for the project option) of core coursework that may not be waived or substituted. Students are required to take 18-652 Foundations of Software Engineering in their first semester. To complete the remaining required units of core coursework, please choose from the core offerings below:

- Required: 18-652 Foundations of Software Engineering (12 units)
- 18-653 Software Architecture & Design (12 units)
- 18-654 Software Verification & Testing (12 units)
- 18-657 Decision Analysis and Engineering Economics for Software Engineers (12 units)
- 18-658 Software Requirements & Interaction Design (12 units)
- 18-659 Software Engineering Methods (12 units)
- 18-668 Data Science for Software Engineering (12 units)

B. CIT elective coursework (Standard Program)

24 units (<u>for the course option only</u>) must be graduate coursework (600 level or above) within CIT from the following departments

- ECE (18)
- Carnegie Institute of Technology (CIT) (39)

- Biomedical Engineering (42)
- Chemical Engineering (06)
- Civil & Environmental Engineering (12)
- Engineering & Public Policy (19)
- Information Network Institute (14)
- Integrated Innovation Institute (49)
- Materials Science & Engineering (27)
- Mechanical Engineering (24)
- CMU Africa (04)

EXCEPTIONS – The following CIT courses may not be counted toward CIT Elective Coursework. They may be counted toward General Technical Elective Coursework.

- Engineering & Public Policy (19) - 19-602, 19-655
- Integrated Innovation Institute (49) – 49-750, 49-751, 49-761, 49-762, 49-763, 49-764, 49-765, 49-766, 49-767, 49-770, 49-771, 49-772, 49-773, 49-774, 49-775, 49-780, 49-781, 49-782, 49-788, 49-790, 49-791, 49-792, 49-793
- Mechanical Engineering (24) – 24-792
- CMU Africa (04) – 04-601, 04-602, 04-605, 04-900, 04-980

C. General technical elective coursework (Standard Program)

12 units of coursework (600 level or above) can be from the following programs (shown under their parent college) or individually approved courses:

Dietrich College of Humanities and Social Sciences

- Statistics (36)
- Center for the Neural Basis of Cognition (86)
- Heinz School of Information Systems (95)
- Heinz College-Wide Courses (94)

Mellon College of Science (MCS)

- Biological Sciences (03)
- Chemistry (09)
- Mathematical Sciences (21)
- Physics (33)

School of Computer Science (SCS)

- Computational Biology (02)
- Computer Science (15)
- Entertainment Technology Center (53)
- Institute for Software Research (08)
- Robotics Institute (16)
- Human-Computer Interaction Institute (05)
- Language Technologies Institute (11)
- Machine Learning (10)
- Software Engineering (17)

Tepper School of Business (TEP)

- Tepper School of Business (45)

Additional courses outside of these programs that are approved to be counted toward General Technical Elective Coursework:

- 46-926, 46-929
- 47-830, 47-834
- 51-882
- 57-947
- 80-713
- 84-688
- 90-756, 90-808
- 93-711

D. Research Project coursework (Standard Program)

36 units(for the project option only) of 18-980 (Graduate Research) must be completed.

*****Research is not required for students in the course option, however these students may take up to 27 units of research. 12 units of research can count towards their core requirements and up to 15 units can count toward their CIT elective requirements.

Restrictions for courses outside the College of Engineering

ECE Master's students in the standard program will take 97 units for their degree, 85 units of which must be from within the College of Engineering (61 from within ECE, 24 from within CIT; see above). This rule applies to all students matriculating fall 2020 or later and to all IMB students who sign their intent form after the start of the Fall 2020 semester. IMB students will

be beholden to the program requirements in place when they sign their intent form and officially agree to enter the program.

*Please note: Additional units can be taken beyond the required 97 units described above in order to diversify your course schedule, however they will not be counted towards the program requirements. Students who wish to take more than the recommended 36 units per semester (after their first semester) should make an appointment with their academic advisor to review your planned schedule.

Maximum Units Allowed

Students who are pursuing the M.S. Standard degree cannot register for their final semester if they have already completed 120 units of coursework. These units include courses taken for audit, pass/no pass, and withdrawal. Please refer to CIT policy on MS degree units for additional information: https://www.cit.cmu.edu/education/academicpolicies/graduate-policies/registration-grading-credit.html#m.s.-degree-units

M.S. in Software Engineering [Applied] – effective Fall 2020

The **M.S.-AP in SE** is a three semester program that is comprised of 97 units of graduate course work (600 level and above).

Program requirements:
The requirements for the course option are broken down as follows:

- 60 units of SE Core Courses
- 24 units of CIT Elective Courses
- 12 units of General Technical Elective Courses
- 1 unit of Introduction to Graduate Studies (18989)
- 1 Summer Internship (18993)

*Preparatory Exception: 12 units of undergraduate course work (300 level and above) may be substituted as part of the 96 core and elective units.

A. SE core coursework **(Applied Program)**
The SE applied program requires 60 units (for the course option) and 48 units (for the project option) of core coursework that may not be waived or substituted. Students are required to

take: 18-652 Foundations of Software Engineering in their first semester. To complete the remaining required units of core coursework, please choose from the core offerings below:

- Required: 18-652 Foundations of Software Engineering (12 units)
- 18-653 Software Architecture & Design (12 units)
- 18-654 Software Verification & Testing (12 units)
- 18-657 Decision Analysis and Engineering Economics for Software Engineers (12 units)
- 18-658 Software Requirements & Interaction Design (12 units)
- 18-659 Software Engineering Methods (12 units)
- 18-668 Data Science for Software Engineering (12 units)

B. CIT elective coursework **(Applied Program)**

24 units (for the course option only) must be graduate coursework (600 level or above) within CIT from the following departments

- ECE (18)
- Carnegie Institute of Technology (CIT) (39)
- Biomedical Engineering (42)
- Chemical Engineering (06)
- Civil & Environmental Engineering (12)
- Engineering & Public Policy (19)
- Information Network Institute (14)
- Integrated Innovation Institute (49)
- Materials Science & Engineering (27)
- Mechanical Engineering (24)
- CMU Africa (04)

EXCEPTIONS – The following CIT courses may not be counted toward CIT Elective Coursework. They may be counted toward General Technical Elective Coursework.

- Engineering & Public Policy (19) - 19-602, 19-655
- Integrated Innovation Institute (49) – 49-750, 49-751, 49-761, 49-762, 49-763, 49-764, 49-765, 49-766, 49-767, 49-770, 49-771, 49-772, 49-773, 49-774, 49-775, 49-780, 49-781, 49-782, 49-788, 49-790, 49-791, 49-792, 49-793
- Mechanical Engineering (24) – 24-792
- CMU Africa (04) – 04-601, 04-602, 04-605, 04-900, 04-980

C. General technical elective coursework **(Applied Program)**

12 units of coursework (600 level or above) can be from the following programs (shown under their parent college) or individually approved courses:

Dietrich College of Humanities and Social Sciences

- Statistics (36)
- Center for the Neural Basis of Cognition (86)
- Heinz School of Information Systems (95)

- Heinz College-Wide Courses (94)

Mellon College of Science (MCS)

- Biological Sciences (03)
- Chemistry (09)
- Mathematical Sciences (21)
- Physics (33)

School of Computer Science (SCS)

- Computational Biology (02)
- Computer Science (15)
- Entertainment Technology Center (53)
- Institute for Software Research (08)
- Robotics Institute (16)
- Human-Computer Interaction Institute (05)
- Language Technologies Institute (11)
- Machine Learning (10)
- Software Engineering (17)

Tepper School of Business (TEP)

- Tepper School of Business (45)

Additional courses outside of these programs that are approved to be counted toward General Technical Elective Coursework:

- 46-926, 46-929
- 47-830, 47-834
- 51-882
- 57-947
- 80-713
- 84-688
- 90-756, 90-808
- 93-711

D. Research Project coursework **(Applied Program)**

Research is not required for students in the course-track. However, these students may take up to 27 units of research. 12 units of research can count towards their core requirements and up to 15 units can count toward their CIT elective requirements.

Course Restrictions

Courses where more than 50% of the course grade is based on a group project or more than 20% is based on attendance cannot be used towards the required 97 units for any M.S. program in the department of Electrical and Computer Engineering. Mini courses worth 12 units cannot be used towards the required 97 units. Students are responsible for checking the syllabi for classes

to ensure their courses meet these requirements. For a complete list of all course restrictions, please visit the program websites:

M.S. ECE http://www.ece.cmu.edu/programs-admissions/masters/ms-requirements.html

M.S. SE https://www.ece.cmu.edu/academics/ms-se/requirements.html

For restrictions on the number of units taken outside the College of Engineering, see the section on Maximum Units Allowed Outside CIT.

Internship Course Option

ECE students may wish to participate in paid internships at off-campus organizations during the summer months.

ECE will enroll students who are pursuing an internship for a 3-unit credit bearing internship course (18-994 Internship for Electrical and Computer Engineering Graduate Students), which can be taken once throughout the student's ECE M.S. degree program of study, and is offered only during the summer. This internship will appear on a student's transcript and tuition will charged for 3 units. Please see details for CIT cost of attendance on HUB's website (https://www.cmu.edu/sfs/tuition/graduate/cit.html). The work for the internship must be appropriate to the goals of the academic program and units can be applied to the less restricted elective requirement.

ECE will enroll students in the applied program who are pursuing an internship as part of their required curriculum for a 0-unit internship course (18-993 Internship for Electrical and Computer Engineering Applied Graduate Students), which should be taken in their summer semester. A student cannot end their program on an internship period (summer semester). This must be completed during the summer before their final fall or spring semester.

Eligible international students who are interested in pursuing off-campus internships must meet with departmental and OIE representatives. For additional information, please refer to OIE's website on Employment Options for international students (https://www.cmu.edu/oie/foreign-students/employment.html). Academic and OIE advisors will provide students with information about CPT during the spring semester.

POST-MATRICULATION GUIDELINES

Return of University Property

ECE students must return all borrowed ECE and university materials—such as software, manuals, library books/materials, or any other Carnegie Mellon University property—prior to their departure from the program.

Career Services Employment Outcomes

ECE students are asked to complete and return a survey for Career Services updating CMU on their employment outcomes after graduation. Information about the survey is communicated in the students' final semester.

"Grandfather" Clause

When policies are changed, it is because the department believes the new rules offer an improvement; any such changes will be communicated to students. In case degree requirements are changed and certain courses are no longer offered, the department will try to find some compromise that allows those students to satisfy the original requirements.

TUITION AND FEES

As indicated in your admission offer letter, ECE does not offer financial assistance for our master's students. Unless otherwise arranged and approved in advance, ECE students are full-time and will be charged full-time ECE tuition. Total charges for a period of attendance and estimated schedule of total charges for entire educational program can be found at the following website: https://www.cmu.edu/sfs/tuition/graduate/cit.html

Estimated charges for ECE M.S. degree:

			MS ECE/SE	**MS ECE/SE**
			entire program	**first semester**
		semesters	*3*	
Type	***FY21 $***	***Frequency***		
Application Fee*	$75	one time	$75	$75
Registration Fee	$0	n/a	$0	$0
Enrollment Deposit	$0	n/a	$0	$0
M.S. Tuition	$25,050	per semester	$75,160	$25,050
Activity Fee	$108	per semester	$324	$108
Technology Fee	$210	per semester	$630	$210
Transportation Fee	$108	per semester	$324	$108
Books and Supplies	$1,106	per semester	$3,318	$1,106
Student Tuition Recovery (STRF)	$0	n/a	$0	$0
			$79,821	**$26, 657**

Tuition Billing & Payments

The tuition rate for students entering ECE programs is set in the spring for the class entering in the following fall semester. Tuition for a student's second fall semester will likely increase in accordance with the tuition increase for the new academic year. The tuition will increase approximately 3% per year.

Students will be charged tuition per semester for each semester in which they are enrolled. Summer courses, if taken, are charged additional tuition. The tuition billing and payment process for all ECE students is handled centrally by The HUB. For university billing and payment policies, please refer to The HUB's Billing and Payments website (https://www.cmu.edu/sfs/billing/index.html).

Part-Time Students

Part-time students will be charged tuition at the per-unit rate. Arranging to pay per-unit is a convenience and not intended to reduce the overall costs of the program. Be sure that if you intend to be enrolled as a part-time student, your schedule reflects this by the tenth day of classes.

If you are planning to pursue part-time coursework (<36 units), if you register full-time (>35 units) at any point in that semester, you will be assessed the full-time tuition rate and no refund will be granted. If you are pursuing part-time coursework, be sure to consult with your academic advisor before changing your course schedule.

University Financial Aid

Graduate Students should consult the graduate student financial aid information (https://www.cmu.edu/sfs/). Students will find the Graduate Financial Aid Guide, information about funding options, how to apply for financial aid and other helpful links.

Graduate students who find themselves in need of immediate funds for emergency situation should contact the Office of the Dean of Student Affairs to inquire about an Emergency Situation Loan.

Additional information on federal and state aid, and financial aid policies, may be found in APPENDIX D.

Student Financial Obligation

ECE students are subject to and must be aware of the Carnegie Mellon policy regarding student financial obligation (https://www.cmu.edu/sfs/billing/sfo.html).

CAREER SERVICES

The Student Affairs team at CMU Silicon Valley serves to provide students with guidance during their job and internship searches. The services available to students include resume reviews, mock interviewing, salary negotiation, career exploration consultation, internship and job consultation, workshops/events and employer relations. This team is also heavily involved in organizing campus-wide job fairs and bringing employers to campus.

Handshake is Carnegie Mellon's online recruiting system. Through Handshake, employers can request accounts to post jobs, request interviews and information sessions, and review student resumes. Students and alumni can apply to positions, sign up for interviews and find contact information for thousands of recruiters. Handshake can be accessed here: https://www.cmu.edu/career/handshake/.

Career Consultants

ECE has assigned career consultants who provide guidance through one-on-one appointments. Students in Silicon Valley can meet with Assistant Dean of Student Affairs Lauren Schachar or Assistant Director of Career Services Leigh Mason. Appointments with Lauren, or Leigh can be

made through Handshake. They will each also hold open student hours, which will be communicated at the beginning of each semester.

Job Search Guidelines

ECE strives to play a supportive role in the career pursuits of students, but maintains academics as a priority. It is not acceptable for students to skip classes or assignments in order to attend job interviews. Students should conduct job searched in a manner that does not impede the academic progress through their graduate program.

It is also important for students to have an understanding of how to conduct a job search. When applying for jobs, students are expected to exhibit certain ethical behavior, such as arriving on time for interviews, being truthful about their qualifications, and to honor their agreements with recruiters. Further, students should not continue looking and interviewing for a position after they have accepted an offer.

The career services team reserves the right to limit access for any users that do not follow their ethical job/internship search policy (https://www.cmu.edu/career/students-and-alumni/ethical-job-search-policy/index.html). Students who do not follow such guidelines may forfeit their on-campus interviewing and/or resume submission privileges.

Job Classification and Salary Structure

The job classification(s) the M.S. ECE and SE programs prepares its graduates for can be found at the following link:

https://cmu.box.com/s/6a6a0g83ftgfgs9fce0b1vx47cqm4gu1

UNIVERSITY POLICIES

Academic Integrity

Students at Carnegie Mellon are engaged in intellectual activity consistent with the highest standards of the academy. The relationship between students and instructors and their shared commitment to overarching standards of respect, honor and transparency determine the integrity of our community of scholars. The actions of our students, faculty and staff are a representation of our university community and of the professional and personal communities that we lead. Therefore, a deep and abiding commitment to academic integrity is fundamental to a Carnegie Mellon education. Every student is required to complete an Academic Integrity module as part of 18989 Introduction to Graduate Studies in their first semester at Carnegie Mellon in the ECE program. For more information on these standards, please visit the link below: http://www.cmu.edu/policies/student-and-student-life/academic-integrity.html

Assistance for Individuals with Disabilities

Students with disabilities are encouraged to self-identify with Office of Disability Resources by contacting Catherine Getchell, 412-268-6121, to access the services available at the University. For more information, please visit the link below: http://www.cmu.edu/education-office/disability-resources/

Evaluation & Certification of Fluency for Instructors

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990. Teaching Assistant English Fluency is managed through the International Teaching Assistant testing process administered by CMU's Student Academic Success Center. For details please visit the links below:

http://www.cmu.edu/policies/faculty/evaluation-certification-english-fluency-instructors.html

http://www.cmu.edu/icc/

Leave of Absence & Withdrawal Policies

"Leave of absence" means leaving the university temporarily, with the firm and stated intention to return. "Withdrawal" means leaving the university with no intention to return. Withdrawals or leaves taken on or before the university deadline to drop classes without receiving a 'W' (withdrawal) grade will result in all courses or grades being removed. Withdrawals or leaves taken after the university deadline to drop classes but before the last day of classes will result in 'W' grades assigned to all classes. Withdrawals or leaves taken after the last day of classes will result in permanent grades assigned by the instructors for each class. After the last day of class, courses cannot be removed from a student's transcript.

International students should consult with the Office of International Education (OIE) prior to taking a leave of absence or withdraw from their program.

Further information about Carnegie Mellon's policy on student leave is available at the following link: http://www.cmu.edu/policies/student-and-student-life/student-leave.html

Further information about Carnegie Mellon University's Silicon Valley student leave is available at the following link:
https://docs.google.com/document/d/11vS_lAQXKoay4FRC2qTQyYBYKw9SHwh8zb_P3x7Ps7U/edit?usp=sharing

Students who would like to take a leave of absence or withdraw must complete the appropriate form at the following link: http://www.cmu.edu/hub/forms.html

Please see the Leave of Absence section of this handbook for ECE's policy on leave of absence and withdrawals.

Tuition Refund Policy

If an ECE student withdraws or takes a leave of absence, the HUB will determine if a student should receive a tuition refund, as this is governed by CMU's policies, not ECE's.

Additional information is available at the following link:
https://www.cmu.edu/sfs/tuition/adjustment/index.html

Returning to Carnegie Mellon

When a student plans to return to CMU after a leave of absence, he/she must complete the Petition for Return from Leave of Absence form at least one month prior to the start of the

semester. We recommend doing so prior to the registration period for the upcoming semester (for Fall, April and for Spring, November). The student must also meet any conditions that were set by ECE or the university at the time of leave was granted. Further information about Carnegie Mellon's policy on student return is available at the following link: https://www.cmu.edu/hub/docs/return-loa.pdf

Retention of Student Records

The policy of Carnegie Mellon University is to ensure the safety, accessibility, confidentiality, and good condition of the permanent record of every Carnegie Mellon student, past and present.

Carnegie Mellon University (CMU), established in 1900, holds all permanent records of our students (current and former) in the University Registrar's Office. We maintain original paper records in an offsite secure climate-controlled underground storage facility along with a microfilmed copy of each record. In addition, a copy of microfilmed records also resides in the University Registrar's Office in Pittsburgh, PA. This includes all students globally, include those students studying at our California teaching location and instructional sites. CMU has established the University Registrar's Office as the official data steward of all student records.

Historical Records 1906-1989

For every student enrolled at Carnegie Mellon University as a new or continuing student prior to the fall semester, 1989, and dating back to 1906, the University Registrar's Office of Carnegie Mellon University maintains a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not within the student's official transcript. The official transcript provides brief personal information to identify the student as unique. It contains courses, units and grades; semester and cumulative grade point averages; all degrees earned; transfer credit or advanced placement and dean's list indications.

The University Registrar's Office has established and maintains within a microfiche copy of good, readable, and reproducible quality of the student's permanent record in a secured records unit. A secondary permanent microfilm copy of all records will be maintained in good condition in the climate-controlled, fire-proof, limited-access security at an offsite facility.

Modern Records 1989-Current

For every student enrolling at Carnegie Mellon University as a new or continuing student beginning in fall semester, 1989, the University Registrar's Office of Carnegie Mellon University will establish and maintain within an electronic data file in the University Student Services Suite (S3, our student information system) a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not. The University Registrar's Office staff will, under the direction of the University Registrar, add to the electronic record such new information as pertains to the student's demographic and academic record as it becomes available, semester-by-semester, and as the student progresses in his/her career at Carnegie Mellon University.

Daily, the Carnegie Mellon University Computing Services Division will perform a backup of all databases that have been altered during that day. Weekly, the Computing Services Division will perform a complete backup of all records within the student data file. The Computing Services

Division staff will store the daily backups in the climate-controlled, fire-proof, limited-access security facility in the Computer Operations center in Cyert Hall on the Carnegie Mellon University campus. Upon successful completion of the monthly backup, the Computing Services Division staff will securely transfer the weekly and monthly backups from the preceding month to climate-controlled, fire-proof, secured vault at an offsite facility.

Cessation of Operations

In the unlikely event that CMU (which has existed for more than 100 years) ceases to exist, it will make appropriate arrangements to comply with clauses (1) and (2) for all its students consistent with the Commonwealth of Pennsylvania statutes and law. I have an informal plan and agreement with the University of Pittsburgh's University Registrar's Office, that should either school cease, we would exchange student records.

Safeguarding Educational Equity – Sexual Harassment and Sexual Assault Policy

Safeguarding Educational Equity / Sexual Misconduct Policy:

The University prohibits sex-based discrimination, sexual harassment, sexual assault, dating/ domestic violence and stalking. The University also prohibits retaliation against individuals who bring forward such concerns or allegations in good faith. The University's Sexual Misconduct Policy is available at https://www.cmu.edu/policies/administrative-and-governance/sexual-misconduct/index.html. The University's Policy Against Retaliation is available at https://www.cmu.edu/policies/administrative-and-governance/whistleblower.html. If you have been impacted by any of these issues, you are encouraged to make contact with any of the following resources:

- Office of Title IX Initiatives, https://www.cmu.edu/title-ix/ 412-268-7125, tix@cmu.edu
- University Police, 412-268-2323

Additional resources and information can be found at: https://www.cmu.edu/title-ix/resources-and-information/resources.html.

Suspension/Required Withdrawal Policy

University suspension is a forced, temporary leave from the university. A student may be suspended for academic, disciplinary, or administrative reasons. Additional information is available at the following link: http://www.cmu.edu/policies/student-and-student-life/suspension-required-withdrawal-policy.html

Withdrawal of a Degree

The university reserves the right to withdraw a degree even though it has been granted should there be discovery granted that the work which it was based or the academic records in support of it had been falsified. The complete reference to this university policy is available at: http://www.cmu.edu/policies/student-and-student-life/withdrawal-of-a-degree.html

Withdrawal from Program

Students are able to withdraw from the department at any time. Prior to withdrawing, students should discuss their decision with their faculty advisor(s) and the Graduate Affairs Office. Students will be required to fill out the Withdrawal form located on The Hub website. International students must consult with OIE prior to filing a withdrawal form as there will be visa repercussions.

University Grievances

Students are encouraged to discuss any concerns or grievances informally within ECE. If a student is not satisfied with the results of informal discussion or formal appeal at the department level, he or she may follow the guidelines on Graduate Student Appeal and Grievance Procedures. Students are likewise encouraged to speak directly to their graduate student's representatives and to the president of the Graduate Student Assembly (GSA). The complete reference to this policy is available at: http://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

Student Maternity Accommodation Protocol

Female students seeking Maternity Accommodations should visit the following link from the Graduate Education's website: http://www.cmu.edu/graduate/programs-services/maternity-accommodation-protocol.html

Verification of Employment

Carnegie Mellon University employees or former employees are required to use Employment Verification Request Form to request employment verification. Vendors, such as mortgage companies, may continue to use standard formats with a signed authorization. Details and forms are available at https://www.cmu.edu/hr/resources/hr-partners/hr-services/.

Appendix A

2020-2021

Highlighted University Resources for Graduate Students
and
The WORD, Student Handbook

Key Offices for Graduate Student Support

Graduate Education Office
www.cmu.edu/graduate; grad-ed@cmu.edu
The Graduate Education Office provides central support for all Master's and Doctoral students with a focus on their academic experience at Carnegie Mellon. The Graduate Education Office serves as a hub for connecting graduate students to relevant campus experts and resources to support their academic success, understanding of university level policies and practices and to assist them in advancing their personal and professional development.

Examples of resources offered through the Graduate Education Office include- but are not limited to:

- Website with university resources, contact information for CMU programs and services, calendar of events related to graduate students
- Bi-monthly email to all graduate students with information on activities, resources and opportunities
- Professional Development Seminars and Workshops
- GSA/Provost Conference Funding Grants
- GSA/Provost Small Research Grants (GuSH)
- Consultations on issues related to the graduate student experience

The Graduate Education Office also works with the colleges and departments by informing and assisting in developing policy and procedures relevant to graduate students and working with departments on issues related to graduate students. Additionally we partner with many other offices and organizations, such as the Graduate Student Assembly, to support the holistic graduate student educational experience.

Office of the Dean of Students
https://www.cmu.edu/student-affairs/dean

The Office of the Dean of Students provides central leadership of the metacurricular experience at Carnegie Mellon including the coordination of student support. Vice President of Student Affairs and Dean of Students Gina Casalegno leads the Division of Student Affairs which includes the offices and departments listed below (not an exhaustive list).

Graduate students will find the enrollment information for Domestic Partner Registration and Maternity Accommodations in the Office of the Dean of Students or on their website. This

Office also manages the Emergency Student Loan (ESLs) process. Emergency Student Loans are made available through generous gifts of alumni and friends of the university. The Emergency Student Loan is an interest-free, emergency-based loan repayable to the university within 30 days. Loans are available to enrolled students for academic supplies, medication, food or other expenses not able to be met due to unforeseeable circumstances.

Additional resources for graduate students include College Liaisons and the Student Support Resources team. College Liaisons are senior members of the Division of Student Affairs who work with departments and colleges addressing student concerns across a wide range of issues. College Liaisons are identified on the student SIO page in the Important Contacts list. The Student Support Resources team offers an additional level of support for students who are navigating any of a wide range of life events. Student Support Resources staff members work in partnership with campus and community resources to provide coordination of care and support appropriate to each student's situation.

The Division of Student Affairs includes (not an exhaustive list):

- Athletics, Physical Education and Recreation
- Career and Professional Development Center (CPDC)
- Center for Student Diversity and Inclusion
- Cohon University Center
- Counseling & Psychological Services (CaPS)
- Dining Services
- Office of Community Standards and Integrity (OCSI)
- Office of Student Leadership, Involvement, and Civic Engagement (SLICE)
- University Health Services (UHS)
- Wellness Initiatives

Center for Student Diversity & Inclusion
https://www.cmu.edu/student-diversity/
Diversity and inclusion have a singular place among the values of Carnegie Mellon University. The Center for Student Diversity & Inclusion actively cultivates a strong, diverse and inclusive community capable of living out these values and advancing research, creativity, learning and development that changes the world.

The Center offers resources to enhance an inclusive and transformative student experience in dimensions such as access, success, campus climate and intergroup dialogue. Additionally, the Center supports and connects historically underrepresented students and those who are first in their family to attend college in a setting where students' differences and talents are appreciated and reinforced, both at the graduate and undergraduate level. Initiatives coordinated by the Center include, but are not limited to:

- First generation/first in family to attend college programs
- LGBTQ+ Initiatives

- Race and ethnically-focused programs, including Inter-University Graduate Students of Color Series (SOC) and PhD SOC Network
- Women's empowerment programs, including Graduate Women's Gatherings (GWGs)
- Transgender and non-binary student programs

Assistance for Individuals with Disabilities

http://www.cmu.edu/disability-resources/

The Office of Disability Resources at Carnegie Mellon University has a continued mission to provide physical, digital, and programmatic access to ensure that students with disabilities have equal access to their educational experience. We work to ensure that qualified individuals receive reasonable accommodations as guaranteed by the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973. Students who would like to receive accommodations can begin the process through Disability Resources' secure online portal or email access@andrew.cmu.edu to begin the interactive accommodation process.

Students with physical, sensory, cognitive, or emotional disabilities are encouraged to self-identify with the Office of Disability Resources and request needed accommodations. Any questions about the process can be directed to access@andrew.cmu.edu, or call (412) 268-6121.

Eberly Center for Teaching Excellence & Educational Innovation

www.cmu.edu/teaching

We offer a wide variety of confidential, consultation services and professional development programs to support graduate students as teaching assistants or instructors of record during their time at Carnegie Mellon University and as future faculty members at other institutions. Regardless of one's current or future teaching context and duties, our goal is to disseminate evidence-based teaching strategies in ways that are accessible and actionable. Programs and services include campus-wide Graduate Student Instructor Orientation events and our Future Faculty Program, both of which are designed to help participants be effective and efficient in their teaching roles. The Eberly Center also assists departments in creating and conducting customized programs to meet the specific needs of their graduate student instructors. Specific information about Eberly Center support for graduate students is found at www.cmu.edu/teaching/graduatestudentsupport/index.html.

Graduate Student Assembly

www.cmu.edu/stugov/gsa/index.html

The Graduate Student Assembly (GSA) is the branch of Carnegie Mellon Student Government that represents, and advocates for the diverse interests of all graduate students at CMU. GSA is composed of representatives from the different graduate programs and departments who want to improve the graduate student experience at the different levels of the university. GSA is funded by the Student Activities Fee from all graduate students. GSA passes legislation, allocates student activities funding, advocates for legislative action locally and in Washington D.C. on behalf of graduate student issues and needs, and otherwise acts on behalf of all graduate student interests. Our recent accomplishments are a testament to GSA making a difference, and steps to implementing the vision laid out by the strategic plan. https://www.cmu.edu/stugov/gsa/About-the-GSA/Strategic-Plan.html.

GSA offers an expanding suite of social programming on and off-campus to bring graduate students from different departments together and build a sense of community. GSA is the host of the Graduate Student Lounge on the 3rd floor of the Cohon University Center- a great place to study or meet up with friends. GSA also maintains a website of graduate student resources on and off-campus. Through GSA's continued funding for professional development and research conferences, the GSA/Provost Conference Funding Program and GSA/Provost GuSH Research Grants are able to run, as managed by the Graduate Education Office. As we move forward, GSA will continue to rely on your feedback to improve the graduate student experience at CMU. Feel free to contact us at <gsa@cmu.edu> to get involved, stop by our office in the Cohon University Center Room 304 or become a representative for your department.

Office of International Education (OIE)
http://www.cmu.edu/oie/

Carnegie Mellon hosts international graduate and undergraduate students who come from more than 90 countries. The Office of International Education (OIE) is the liaison to the University for all non-immigrant students and scholars, as well the repository for study abroad opportunities and advisement. OIE provides many services including: advising on personal, immigration, study abroad, academic, and social and acculturation issues; presenting programs of interest such as international career workshops, tax workshops, and cross-cultural and immigration workshops; international education and statistics on international students in the United States; posting pertinent information to students through email and the OIE website, and conducting orientation and pre-departure programs.

Veterans and Military Community
http://www.cmu.edu/veterans/
Military veterans are a vital part of the Carnegie Mellon University community. Graduate students can find information on applying for veteran education benefits, campus services, veteran's groups at CMU, and non-educational resources through the Veterans and Military Community website. There are also links and connections to veteran resource in the Pittsburgh community. The ROTC and Veteran Affairs Coordinator can be reached at uro-vaedbenefits@andrew.cmu.edu or 412-268-8747.

Carnegie Mellon Ethics Hotline
https://www.cmu.edu/hr/resources/ethics-hotline.html
The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to areas below:

- Academic and Student Life
- Bias Reporting
- Environmental Health and Safety
- Financial Matters
- High-Risk Incident
- Human Resource Related
- Information Systems

- Research
- Threat of Business Interruption
- Threat of Violence or Physical Harm
- Title IX

Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net(user name: tartans; password: plaid). All submissions are reported to appropriate university personnel.
The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

Policy Against Retaliation
It is the policy of Carnegie Mellon University to protect from retaliation any individual who makes a good faith report of a suspected violation of any applicable law or regulation, university Policy or procedure, any contractual obligation of the university, and any report made pursuant to the Carnegie Mellon University Code of Business Ethics and Conduct.

Additional details regarding the Policy Against Retaliation are available at https://www.cmu.edu/policies/administrative-and-governance/whistleblower.html

Key Offices for Academic & Research Support

Computing and Information Resources
www.cmu.edu/computing
Computing Services maintains and supports computing resources for the campus community, including the campus wired and wireless networks, printing, computer labs, file storage, email and software catalog. As members of this community, we are all responsible for the security of these shared resources. Be sure to review the Safe Computing (https://www.cmu.edu/computing/safe/) section and the University Computing Policy (https://www.cmu.edu/policies/information-technology/computing.html)

Visit the Computing Services website (https://www.cmu.edu/computing/) to learn more. For assistance the Computing Services Help Center is available at 412-268-4357 (HELP) or it-help@cmu.edu.

Student Academic Success Center
https://www.cmu.edu/student-success/
Student Academic Support Programs

Tartan Scholars
- The Tartan Scholars program was created to provide support for limited resourced students through an intentional first year undergraduate experience with the goals of enhancing the cohort's skill and community building through a lens of self -authorship,

growth mindset, and a sense of belonging. As part of the Student Academic Success Center, Tartan Scholars are invited to join the University and participate in summer initiatives and pre-orientation activities prior to their first year at the University.

- There are opportunities for graduate students to serve as accountability, learning, or development partners, workshop facilitators, and presenters. Contact Diane Hightower at ddhighto@andrew.cmu.edu for more details.

Learning Support

- **Supplemental Instruction:** Supplemental Instruction (SI) is an academic support model that utilizes peer-assisted study sessions. The SI program provides regularly scheduled review sessions on course materials outside the classroom. SI is a non-remedial approach to learning as the program targets high-risk courses and is available in select courses based on data related to past student performance and feasibility.
- **Peer Tutoring:** Weekly Tutoring Appointments are offered in a one-on-one and small group format to students from any discipline who need assistance with a course that may not be supported by our other services. Weekly appointments give students the opportunity to interact regularly with the same tutor to facilitate deeper understanding of concepts. Students can register online through the Student Academic Success website.
- **Academic Coaching:** Academic Coaching provides holistic one-on-one peer support and group workshops to help students find and implement their conditions for success. We assist students in improving time management, productive habits, organization, stress management, and study skills. Students will request support through the Academic Success Center website and attend in-person meetings or meet using video and audio conferencing technology to provide all students with support.
- **"Just in Time" Workshops:** The Student Academic Success team is available to partner with instructors and departments to identify skills or concepts that would benefit from supplemental offerings (workshops, boot camps) to support students' academic success and learning. We are eager to help convene and coordinate outside of the classroom skill-building opportunities that can be open to any student interested in building skill or reinforcing course concept mastery.
- **Study Partners:** Support for students to create and benefit from their own study groups: The Student Academic Success team assists students in forming and benefiting from peer study groups, whereby all students can reap the benefits of peer-to-peer learning, student agency, and collaboration skill development. Staff from the Student Academic Success Center will be made available to instructors and students to assist with the formation of peer-led study groups. This level of support is open to any course where the instructor requests or agrees such support is appropriate and students are interested in both leading and participating.

Language and Cross-cultural Support

More than 60% of graduate students at Carnegie Mellon are international students, and others

are nonnative speakers of English who have attended high school or undergraduate programs in the US. Many of these students want to hone their language and cross-cultural skills for academic and professional success. Students can choose from sessions on

- how to give a strong presentation,
- writing academic emails,
- expectations and strategies for clear academic writing,
- how to talk about yourself as a professional in the U.S.,
- developing clearer pronunciation,
- using accurate grammar,
- building fluency, and more.
- Students can make an appointment with a Language Development Specialist to get individualized coaching on language or cross-cultural issues.

The Student Academic Success Center is also charged with certifying the language of International Teaching Assistants (ITAs), ensuring that nonnative English speakers have the language proficiency needed to succeed as teaching assistants in the Carnegie Mellon classroom. Students preparing to do an ITA Certification should plan to take classes offered by the language support team at the SASC from the beginning of their first semester. Start by contacting the language support team at the SASC website or attend a Language Support Orientation at the SASC or in your department.

University Libraries

www.library.cmu.edu

The University Libraries offers a wide range of information resources and services supporting graduate students in course-work, research, teaching, and publishing. The library licenses and purchases books, journals, media and other needed materials in various formats. Library liaisons, consultants and information specialists provide in-depth and professional assistance and advice in all-things information - including locating and obtaining specific resources, providing specialized research support, advanced training in the use and management of data. Sign up for workshops and hands-on topic-specific sessions such as data visualization with Tableau, cleaning data with OpenRefine, and getting started with Zotero. Weekly drop-in hours for Digital Humanities and for Research Data Research Management are scheduled during the academic year. Start at the library home page to find the books, journals and databases you need; to identify and reach out to the library liaison in your field; to sign up for scheduled workshops; and to connect with consultants in scholarly publishing, research data management, and digital humanities.

Research at CMU

www.cmu.edu/research/index.shtml

The primary purpose of research at the university is the advancement of knowledge in all fields in which the university is active. Research is regarded as one of the university's major contributions to society and as an essential element in education, particularly at the graduate level and in faculty development. Research activities are governed by several university policies.

Guidance and more general information is found by visiting the Research at Carnegie Mellon website.

Office of Research Integrity & Compliance
www.cmu.edu/research-compliance/index.html
The Office of Research Integrity & Compliance (ORIC) is designed to support research at Carnegie Mellon University. The staff work with researchers to ensure research is conducted with integrity and in accordance with federal and Pennsylvania regulation. ORIC assists researchers with human subject research, conflicts of interest, responsible conduct of research, export controls, and institutional animal care & use. ORIC also provides consultation, advice, and review of allegations of research misconduct.

Key Offices for Health, Wellness & Safety

Counseling & Psychological Services
https://www.cmu.edu/counseling/
Counseling & Psychological Services (CaPS) affords the opportunity for students to talk privately about academic and personal concerns in a safe, confidential setting. An initial consultation at CaPS can help clarify the nature of the concern, provide immediate support, and explore further options if needed. These may include a referral for counseling within CaPS, to another resource at Carnegie Mellon, or to another resource within the larger Pittsburgh community. CaPS also provides workshops and group sessions on mental health related topics specifically for graduate students on campus. CaPS services are provided at no cost. Appointments can be made in person, or by telephone at 412-268-2922.

Health Services
www.cmu.edu/HealthServices/
University Health Services (UHS) is staffed by physicians, advanced practice clinicians and registered nurses who provide general medical care, allergy injections, first aid, gynecological care and contraception as well as on-site pharmaceuticals. The CMU Student Insurance Plan covers most visit fees to see the physicians and advanced practice clinicians & nurse visits. Fees for prescription medications, laboratory tests, diagnostic procedures and referral to the emergency room or specialists are the student's responsibility and students should review the UHS website and their insurance plan for detailed information about the university health insurance requirement and fees.

UHS also has a registered dietician and health promotion specialists on staff to assist students in addressing nutrition, drug and alcohol and other healthy lifestyle issues. In addition to providing direct health care, UHS administers the Student Health Insurance Program. The Student Health Insurance plan offers a high level of coverage in a wide network of health care providers and hospitals. Appointments can be made by visiting UHS's website, walk-in, or by telephone, 412-268-2157.

Campus Wellness

https://www.cmu.edu/wellness/

At Carnegie Mellon, we believe our individual and collective well-being is rooted in healthy connections to each other and to campus resources. The university provides a wide variety of wellness, mindfulness and connectedness initiatives and resources designed to help students thrive inside and outside the classroom. The BeWell@CMU e-newsletter seeks to be a comprehensive resource for CMU regarding all wellness-inspired events, announcements and professional and personal development opportunities. Sign up for the Be Well monthly newsletter via https://bit.ly/BeWellNewsletter or by contacting the Program Director for Student Affairs Wellness Initiatives, at alusk@andrew.cmu.edu.

Religious and Spiritual Life Initiatives (RSLI)

www.cmu.edu/student-affairs/spirituality

Carnegie Mellon is committed to the holistic growth of our students, including creating opportunities for spiritual and religious practice and exploration. We have relationships with local houses of worship from various traditions and many of these groups are members of CMU's Council of Religious Advisors. We also offer programs and initiatives that cross traditional religious boundaries in order to increase knowledge of and appreciation for the full diversity of the worldview traditions. Our RSLI staff are here to support students across the spectrum of religious and spiritual practice and would be more than happy to help you make a connection into a community of faith during your time at CMU.

University Police

http://www.cmu.edu/police/

412-268-2323 (emergency only), 412-268-6232 (non-emergency)

The University Police Department is located at 300 South Craig Street (entrance is on Filmore Street). The department's services include police patrols and call response, criminal investigations, fixed officer and foot officer patrols, event security, and crime prevention and education programming as well as bicycle and laptop registration. Visit the department's website for additional information about the staff, emergency phone locations, crime prevention, lost and found, finger print services, and annual statistic reports.

Carnegie Mellon University publishes an annual campus security and fire safety report describing the university's security, alcohol and drug, sexual assault, and fire safety policies and containing statistics about the number and type of crimes committed on the campus and the number and cause of fires in campus residence facilities during the preceding three years. Graduate students can obtain a copy by contacting the University Police Department at 412-268-6232. The annual security and fire safety report is also available online at https://www.cmu.edu/police/annualreports/.

Shuttle and Escort Services

Parking and Transportation coordinates the Shuttle Service and Escort Service provided for CMU students, faculty, and community. The Shuttle & Escort website has full information about these services, stops, routes, tracking and schedules.

The WORD

http://www.cmu.edu/student-affairs/theword//

The WORD is Carnegie Mellon University's student on-line handbook and is considered a supplement to the department (and sometimes college) handbook. The WORD contains campus resources and opportunities, academic policy information and resources, community standards information and resources. It is designed to provide all students with the tools, guidance, and insights to help you achieve your full potential as a member of the Carnegie Mellon community. Information about the following is included in The WORD (not an exhaustive list) and graduate students are encouraged to bookmark this site and refer to it often. University policies can also be found in full text at: http://www.cmu.edu/policies/.

Carnegie Mellon Vision, Mission
Statement of Assurance
Carnegie Code

Academic Standards, Policies and Procedures
- Educational Goals
- Academic and Individual Freedom
- Statement on Academic Integrity Standards for Academic & Creative Life
- Assistance for Individuals with Disabilities
- Master's Student Statute of Limitations
- Conduct of Classes
- Copyright Policy
- Cross-college & University Registration
- Doctoral Student Status Policy
- Evaluation & Certification of English Fluency for Instructors
- Final Exams for Graduate Courses
- Grading Policies
- Intellectual Property Policy
- Privacy Rights of Students
- Student's Rights

Research
- Human Subjects in Research
- Office of Research Integrity & Compliance
- Office of Sponsored Programs
- Policy for Handling Alleged Misconduct of Research
- Policy on Restricted Research

Tax Status of Graduate Student Awards

Campus Resources & Opportunities

- Alumni Relations
- Assistance for Individuals with Disabilities
- Athletics, Physical Fitness & Recreation
- Carnegie Mellon ID Cards and Services
- Cohon University Center
- Copying, Printing & Mailing
- Division of Student Affairs
- Domestic Partner Registration
- Emergency Student Loan Program
- Gender Programs & Resources
- Health Services
- Dining Services
- The HUB Student Services Center
- ID Card Services
- Leonard Gelfand Center
- LGBTQ Resources
- Multicultural and Diversity Initiatives
- Opportunities for Involvement
- Parking and Transportation Services
- Shuttle and Escort Services
- Spiritual Development
- University Police
- Student Activities
- University Stores

Community Standards, Policies and Procedures

- Alcohol and Drugs Policy
- AIDS Policy
- Bicycle/Wheeled Transportation Policy
- Damage to Carnegie Mellon Property
- Deadly Weapons
- Discriminatory Harassment
- Disorderly Conduct
- Equal Opportunity/Affirmative Action Policy
- Freedom of Expression Policy
- Health Insurance Policy Immunization Policy
- Missing Student Protocol
- Non-Discrimination Policy
- On-Campus Emergencies
- Pets
- Political Activities
- Recycling Policy
- Riotous and Disorderly Behavior

Safety Hazards
Scheduling and Use of University Facilities
Sexual Harassment and Sexual Assault Policy
Smoking Policy
Student Accounts Receivable and Collection Policy and Procedures
Student Activities Fee
Student Enterprises
Workplace Threats and Violence Policy

APPENDIX B: ADDITIONAL INFORMATION FOR CALIFORNIA PROGRAMS

Carnegie Mellon University is a private, non-profit institution, approved to operate in California by the California Bureau for Private Post-Secondary Education. Approval to operate means compliance with state standards as set forth in the California Private Postsecondary Education Act of 2009**.**

Any questions a student may have regarding this catalog that have not been satisfactorily answered by the institution may be directed to the Bureau for Private Postsecondary Education at 1747 North Market Blvd, Suite 225, Sacramento, CA 95834, www.bppe.ca.gov, toll-free telephone number (916) 574-8900.

As a prospective student, you are encouraged to review this catalog prior to signing an enrollment agreement. You are also encouraged to review the School Performance Fact Sheet, which must be provided to you prior to signing an enrollment agreement.

A student or any member of the public may file a complaint about this institution with the Bureau for Private Postsecondary Education by calling (888) 370-7589 toll-free or by completing a complaint form, which can be obtained on the bureau's internet website, at www.bppe.ca.gov.

Class session will be held:

Carnegie Mellon University
NASA Ames Research Park
Bldg. 23
P.O. Box 98
Moffett Field, CA 94035-0001
(650) 603-7032
www.cmu.edu/silicon-valley

STUDENT'S RIGHT TO CANCEL (WITHDRAWAL/LEAVES OF ABSENCE)

A student has the right to cancel the student's Enrollment Agreement by either taking a leave of absence from the Program (leaving Carnegie Mellon University temporarily with the firm and stated intention of returning) or by withdrawing from the Program (leaving Carnegie Mellon University with no intention of returning). If the student withdraws or take a leave of absence from Carnegie Mellon University, the student may be eligible for a tuition adjustment or a refund of certain fees (excluding any Application Fee, Registration Fee and Enrollment Deposit).

To cancel the student's Enrollment Agreement and take a leave of absence or withdraw, the student must complete Carnegie Mellon University's Leave of Absence or Withdrawal form, as applicable, and return it to Carnegie Mellon University's Registrar's Office, at 5000 Forbes Ave.,

Warner Hall A12, Pittsburgh, PA 15213. The Leave of Absence and Withdrawal forms, and additional information about leaves of absence and withdrawal, can be found on Carnegie Mellon University's website at https://www.cmu.edu/hub/registrar/leaves-and-withdrawals/.

If the student notifies Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is the earliest of:

- The date the student began the student's withdrawal or leave of absence process at Carnegie Mellon University;
- The date the student notified the student's home department at Carnegie Mellon University;
- The date the student notified the associate dean of the student's College at Carnegie Mellon University; or
- The date the student notified the Carnegie Mellon University Dean of Student Affairs.

If the student does not notify Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is:

- The midpoint of the relevant semester in which the student withdraws or takes a leave of absence;
- The last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day the student turned in a class assignment.

REFUND POLICY

1. Refunds in General. Students who withdraw from the Program or take a leave of absence after having paid the current semester's tuition and fees or receiving financial aid are subject to the following refund and repayment policies. No other charges are refundable.

2. Exit Counseling. All borrowers of Federal student loans must complete a Federally mandated exit counseling session when graduating or dropping to less than half-time enrollment status, including by withdrawing or taking a leave of absence. Exit counseling prepares students for repayment. Students must complete an exit counseling session in its entirety, with complete and correct information; otherwise, the student's degree, diploma and official transcripts may be withheld. Information about exit counseling sessions can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/financial-aid/exit-counseling.html.

3. Withdrawals/Leaves On or Before 10th Class Day (during the Cancellation Period). Students who withdraw or take a leave of absence on or before the 10th class day of the relevant semester will receive a refund of 100% of tuition and fees (excluding any Application Fee or Registration Fee and Enrollment Deposit).

4. Withdrawals/Leaves after 10th Class Day (after the Cancellation Period). Students who withdraw or take a leave of absence after the 10th class day of the relevant semester but before completing 60% of the semester will be assessed tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. STRF will be adjusted accordingly with any adjustment of tuition. There is no tuition adjustment after 60% of the semester is completed. There is no refund of University fees after the 10th class day of the relevant semester.

5. Tuition Adjustment Appeals. Students may appeal to have tuition adjustments for their leave of absence or withdrawal if they feel that they have extenuating circumstances. These appeals will be reviewed in the context of Carnegie Mellon University's tuition adjustment policy, as stated above. These appeals must be made in writing to Carnegie Mellon University's Registrar using Carnegie Mellon University's Tuition Appeal Adjustment form. Information about Carnegie Mellon University's tuition adjustment policy and tuition adjustment appeals can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/tuition/adjustment.

6. Repayment to Lenders/Third Parties. If any portion of refundable tuition and/or fees was paid from the proceeds of a loan or third party, the refund may be sent to the lender, third party or, if appropriate, to the Federal or state agency that guaranteed or reinsured the loan, as required by law and/or Carnegie Mellon University policy. Any amount of the refund in excess of the unpaid balance of the loan shall be first used to repay any student financial aid programs from which the student received benefits, in proportion to the amount of the benefits received, and any remaining amount shall be paid to the student.

7. Responsibility for Loan. If the student obtains a loan to pay for an educational program, the student will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If the student has received Federal student financial aid funds, the student is entitled to a refund of moneys not paid from Federal student financial aid program funds. If the student is eligible for a loan guaranteed by the Federal or state government and the student defaults on the loan, both of the following may occur: 1) The Federal or state government or a loan guarantee agency may take action

against the student, including applying any income tax refund to which the person is entitled to reduce the balance owed on the loan. 2) The student may not be eligible for any other Federal student financial aid at another institution or other government assistance until the loan is repaid.

Meeting the cost of a graduate education is a significant investment. Carnegie Mellon University is committed to making it financially possible for graduate students to enhance educational development and reach their career goals. There are many financial aid resources available to students pursuing graduate studies at Carnegie Mellon University. Carnegie Mellon University participates in a number of Federal and state financial aid programs. Information about these financial aid programs can be found on Carnegie Mellon University's website, at http://www.cmu.edu/finaid/index.html.

If you obtain a loan to pay for the M.S. in Electrical and Computer Engineering or Software Engineering degree programs on the Silicon Valley campus, you will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If you have received federal student financial aid funds, you are entitled to a refund of moneys not paid from federal student financial aid program funds.

Carnegie Mellon University does not have a pending petition in bankruptcy, is not operating as a debtor in possession, and has not filed a petition in bankruptcy within the preceding 5 years, nor has Carnegie Mellon had a petition in bankruptcy filed against it within the preceding 5 years that resulted in re-organization under Chapter 11 of the United States Bankruptcy Code.

The State of California established the Student Tuition Recovery Fund (STRF) to relieve or mitigate economic loss suffered by a student in an educational program at a qualifying institution, who is or was a California resident while enrolled, or was enrolled in a residency program, if the student enrolled in the institution, prepaid tuition, and suffered an economic loss. Unless relieved of the obligation to do so, you must pay the state-imposed assessment for the STRF, or it must be paid on your behalf, if you are a student in an educational program, who is a California resident, or are enrolled in a residency program, and prepay all or part of your tuition.

You are not eligible for protection from the STRF and you are not required to pay the STRF assessment, if you are not a California resident, or are not enrolled in a residency program.

It is important that you keep copies of your enrollment agreement, financial aid documents, receipts, or any other information that documents the amount paid to the school. Questions regarding the STRF may be directed to the Bureau for Private Postsecondary Education, 1747 North Market Blvd, Suite 225, Sacramento, CA 95834, (916) 574-8900 or (888) 370-7589.

To be eligible for STRF, you must be a California resident or are enrolled in a residency program, prepaid tuition, paid or deemed to have paid the STRF assessment, and suffered an economic loss as a result of any of the following:

1. The institution, a location of the institution, or an educational program offered by the institution was closed or discontinued, and you did not choose to participate in a teach-out plan approved by the Bureau or did not complete a chosen teach-out plan approved by the Bureau.

2. You were enrolled at an institution or a location of the institution within the 120 day period before the closure of the institution or location of the institution, or were enrolled in an educational program within the 120 day period before the program was discontinued.
3. You were enrolled at an institution or a location of the institution more than 120 days before the closure of the institution or location of the institution, in an educational program offered by the institution as to which the Bureau determined there was a significant decline in the quality or value of the program more than 120 days before closure.
4. The institution has been ordered to pay a refund by the Bureau but has failed to do so.
5. The institution has failed to pay or reimburse loan proceeds under a federal student loan program as required by law, or has failed to pay or reimburse proceeds received by the institution in excess of tuition and other costs.
6. You have been awarded restitution, a refund, or other monetary award by an arbitrator or court, based on a violation of this chapter by an institution or representative of an institution, but have been unable to collect the award from the institution.
7. You sought legal counsel that resulted in the cancellation of one or more of your student loans and have an invoice for services rendered and evidence of the cancellation of the student loan or loans.

To qualify for STRF reimbursement, the application must be received within four (4) years from the date of the action or event that made the student eligible for recovery from STRF.

A student whose loan is revived by a loan holder or debt collector after a period of noncollection may, at any time, file a written application for recovery from STRF for the debt that would have otherwise been eligible for recovery. If it has been more than four (4) years since the action or event that made the student eligible, the student must have filed a written application for recovery within the original four (4) year period, unless the period has been extended by another act of law.

However, no claim can be paid to any student without a social security number or a taxpayer identification number.

NOTICE CONCERNING TRANSFERABILITY OF CREDITS AND CREDENTIALS EARNED AT OUR INSTITUTION The transferability of credits you earn at Carnegie Mellon University is at the complete discretion of an institution to which you may seek to transfer. Acceptance of the M.S. degree you earn in Electrical and Computer Engineering or Software Engineering is also at the complete discretion of the institution to which you may seek to transfer. If the credits or degree that you earn at this institution are not accepted at the institution to which you seek to transfer, you may be required to repeat some or all of your coursework at that institution. For this reason you should make certain that your attendance at this institution will meet your educational goals. This may include contacting an institution to which you may seek to transfer after attending Carnegie Mellon University to determine if your credits or degree will transfer.

Meeting the cost of a graduate education is a significant investment. Carnegie Mellon University is committed to making it financially possible for graduate students to enhance educational development and reach their career goals. There are many financial aid resources available to students pursuing graduate studies at Carnegie Mellon University. Carnegie Mellon University participates in a number of Federal and state financial aid programs. Information about these

financial aid programs can be found on Carnegie Mellon University's website, at http://www.cmu.edu/finaid/index.html.

Carnegie Mellon University is accredited through a voluntary, peer-review process coordinated by the Middle States Commission on Higher Education (MSCHE or Middle States). MSCHE is one of six regional accrediting agencies in the United States, each accrediting institutions of higher education within a specific geographic region. Middle States is recognized by the U.S. Department of Education. This recognition enables MSCHE's member institutions to establish eligibility to participate in federal financial aid programs (e.g., federal loans, grants, and work-study) administered by the U.S. Department of Education. Carnegie Mellon University has been accredited by Middle States since 1921.

Please visit http://www.cmu.edu/middlestates/ to learn more about accreditation standards and processes and to view the University's reaccreditation reports.

The address and telephone number for the Middle States Commission on Higher Education is 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104, (267) 284-5000.

APPENDIX C: LIST OF PROGRAM COURSES

Entrepreneurship and Innovation in Technology (18-601) – 12 Units
Have an idea you want to bring to the world? Ever want to start a company?? Do you wonder what it takes to be an entrepreneur? Then this is the class for you. Entrepreneurship and Innovation in Technology is an introductory course in entrepreneurship for graduate students. The course targets non-business students and assumes no background in business. Students are exposed to fundamental concepts and issues around innovation and entrepreneurship. The course provides a foundation for starting a new venture and innovating new technologies and products within existing organizations. Topics covered will include: identifying a business opportunity, acquiring customers, building a team, developing a business model, understanding investment, managing risk, and achieving differentiation. Emphasis will be on team projects, including developing an investor pitch for an original idea.

Fundamentals of Modern CMOS Devices (18-610) – 12 Units
This course is intended to provide a foundation in device operation for circuit designers working in today's sub-micron CMOS. This course will also provide advanced understanding of CMOS technology for those interested in integrated circuit process technology and device physics. We review semiconductor device physics, including carrier dynamics and the basic equations of semiconductor device physics. The operation of the p-n junction diode is also reviewed. The course includes a description of integrated circuit fabrication technology and how it is used to fabricate CMOS devices. With this foundation, we then discuss the MOS capacitor (including its application as a varactor). The theory of the MOS transistor will then be developed, followed by a discussion of important phenomena in sub-micron devices such as: velocity saturation; breakdown; drain-induced barrier lowering; random dopant fluctuations, etc. The student will learn the relationship between device geometry, e.g. length, and fabrication, e.g. doping, and the corresponding circuit performance. The course will primarily be lecture-based, with some selected simulation exercises. Students are expected to be acquainted with the basic concepts of electrical circuits; electromagnetic fields at the level of a sophomore level physics course, and to have adequate preparation in mathematics (basic differential equations and MATLAB or similar applications). Prior coursework in device physics is helpful but not required for graduate students. Lecture: 4 hrs

Neural Technology: Sensing and Stimulation (18-612) – 12 Units
This course gives engineering insight into the operation of excitable cells, as well as circuitry for sensing and stimulation nerves. Initial background topics include diffusion, osmosis, drift, and mediated transport, culminating in the Nernst equation of cell potential. We will then explore models of the nerve, including electrical circuit models and the Hodgkin-Huxley mathematical model. Finally, we will explore aspects of inducing a nerve to fire artificially, and cover circuit topologies for sensing action potentials and for stimulating nerves. If time allows, we will discuss other aspects of medical device design. Students will complete a neural stimulator or sensor design project. Although students in 18-612 will share lectures and recitations with students in 18-412, students in 18-612 will receive distinct homework assignments, distinct design problems, and distinct exams from the ones given to students in 18-412 and will be graded on a separate curve from students taking 18-412.

Foundations of Computer Systems (18-613) – 12 Units
This course provides a programmer's view of how computer systems execute programs, store information, and communicate. It enables students to become more effective programmers, especially in dealing with issues of performance, portability and robustness. It also serves as a foundation for courses on compilers, networks, operating systems, and computer architecture, where a deeper understanding of systems-level issues is required. Topics covered include: machine-level code and its generation by optimizing compilers, performance evaluation and optimization, computer arithmetic, processor architecture, memory organization and management, networking technology and protocols, and supporting concurrent computation. This course is modeled after 15-213/18-213/15-513, and is intended for ECE MS students with expanded course contents presented at the graduate level. It prepares students for other graduate level computer systems courses as well as working in the industry. Anti-requisites: 15213, 18213, 15513

Microelectromechanical Systems (18-614) – 12 Units
This course introduces fabrication and design fundamentals for Microelectromechanical Systems (MEMS): on-chip sensor and actuator systems having micron-scale dimensions. Basic principles covered include microstructure fabrication, mechanics of silicon and thin-film materials, electrostatic force, capacitive motion detection, fluidic damping, piezoelectricity, piezoresistivity, and thermal micromechanics. Applications covered include pressure sensors, micromirror displays, accelerometers, and gas microsensors. Grades are based on exams and homework assignments. 4 hrs. lec.

Micro and Nano Systems Fabrication (18-615) – 12 Units
This is a new course intended to introduce students to the process flow and design methodology for integrated systems fabrication. The course will present this material through two paths. Lectures will be presented on the basic unit processes of micro and nanosystems fabrication: deposition, patterning, and etching. Lectures will draw on examples from: Semiconductor device fabrication; Microelectromechanical systems (MEMS) fabrication; Magnetic device fabrication; and Optical device fabrication. Problem sets will be given based on this lecture material to allow

students to quantitatively analyze certain process steps in detail. The second path for material presentation will be through a series of labs that allow students to design, fabricate and test an integrated device. These laboratories will be scheduled at regular meeting times, and will use research facilities within the ECE department. This is a PhD level course. MS or senior students must obtain permission from the instructor to be registered.

Nano-Bio-Photonics (18-616) – 12 Units

Light can penetrate biological tissues non-invasively. Most of the available bio-optic tools are bulky. With the advent of novel nanotechnologies, building on-chip integrated photonic devices for applications such as sensing, imaging, neural stimulation, and monitoring is now a possibility. These devices can be embedded in portable electronic devices such as cell phones for point of care diagnostics. This course is designed to convey the concepts of nano-bio-photonics in a practical way to prepare students to engage in emerging photonic technologies. The course starts with a review of electrodynamics of lightwaves. The appropriate choice of wavelength and material platform is the next topic. Then optical waveguides and resonators are discussed. Resonance-based sensing is introduced followed by a discussion of the Figure of Merits (FOMs) used to design on-chip sensors. Silicon photonics is introduced as an example of a CMOS-compatible platform. On-chip spectroscopy is the next topic. The second part covers nano-plasmonics for bio-detection and therapy. The design methods are discussed, followed by an overview of nanofabrication and chemical synthesis, and then a discussion of applications. The last part of this course will be dedicated to a review of recent applications such as Optogenetic neural stimulation, Calcium imaging, Cancer Imaging and Therapy. Senior or graduate standing required. This course is cross-listed with 18416. Although students in 18-616 and 18-416 will share the same lectures and recitations, students in 18-616 will receive distinct course projects. Students in 18-416 and 18-616 will be graded on separate curves.

Smart Grids and Future Electric Energy Systems (18-618) – 12 Units

The course offers an advanced presentation of modern electric power systems, starting from a brief review of their structure and their physical components, through modeling, analysis, computation, sensing and control concepts. Great care is taken to avoid presenting "practical" techniques built on dubious theoretical foundations and also to avoid building elaborate "mathematical" models whose physical validity and relevance may be questionable. Mastering both principles and relevant models is important for those who wish to seriously understand how today's electric power grids work and their challenging technical issues. This prepares students for working on applying many novel information processing concepts for designing and operating more reliable, secure, and efficient electric energy systems. Students interested in both applied physics and signals and systems should consider taking this subject. Once the fundamentals of today's power systems are understood, it becomes possible to consider the role of smart electric power grids in enabling evolution of future electric energy systems. Integration of intermittent energy resources into the existing grid by deploying distributed sensors and actuators at the key locations throughout the system (network, energy sources, consumers) and changes in today's Supervisory Control and Data Acquisition (SCADA) for better performance become well-posed problems of modeling, sensing and controlling complex dynamic systems. This opens opportunities to many innovations toward advanced sensing and actuation for enabling better

physical performance. Modeling, sensing and control fundamentals for possible next generation SCADA in support of highly distributed operations and design are presented. Prior knowledge in 18-418 or 18-771 is highly recommended.

Digital Integrated Circuit Design (18-622) – 12 Units
This course covers the design and implementation of digital circuits in a modern VLSI process technology. Topics will include logic gate design, functional unit design, latch/flip-flop design, system clocking, memory design, clock distribution, power supply distribution, design for test, and design for manufacturing. The lab component of the course will focus on using modern computer aided design (CAD) software to design, simulate, and lay out digital circuits. The final project for the course involves the design and implementation to the layout level of a small microprocessor. 18-240 and 18-320 or equivalent background material with permission of the instructor. Although students in 18-422 and 18-622 will share lectures, labs, and recitations, students in 18-422 and 18-622 will receive different homework assignments, design projects, and exams, and in some cases 18-622 students will also have different or additional lab sessions.

Analog Integrated Circuit Design (18-623) – 12 Units
Some form of analog circuit design is a critical step in the creation of every modern IC. First and foremost, analog circuits act as the interface between digital systems and the real world. They act to amplify and filter analog signals, and to convert signals from analog to digital and back again. In addition, high performance digital cell design (either high speed or low power) also invokes significant analog circuit design issues. The goal of this course is to teach students some of the methods used in the design and analysis of analog integrated circuits, to illustrate how one approaches design problems in general, and to expose students to a broad cross-section of important analog circuit topologies. The course will focus on learning design through carrying out design projects. Design and implementation details of wide-band amplifiers, operational amplifiers, filters and basic data converters will be covered. Example topics to be covered include transistor large- and small-signal device models, small-signal characteristics of transistor-based amplifiers, large-signal amplifier characteristics and nonidealities, operational amplifier design, basic feedback amplifier stability analysis and compensation, and comparator design. The course will focus primarily on analog CMOS, but some aspects of BJT design will be discussed. 18-290 and 18-320 or equivalent background material with permission of the instructor. Although students in 18-623 will share Lectures and Recitations with students in 18-421, students in 18-623 will receive distinct homework assignments, distinct design problems, and distinct exams from the ones given to students in 18-421 and will be graded on a separate curve from students taking 18-421.

ULSI Mobile Platform and Server Product Design (18-625) – 12 Units
The objective of this class is to design an ULSI (Ultra Large Scale Integrated) mobile platform and a server product in two scenarios: System on Chip (SoC) and System in Package (SiP). State-of-the-art 2016 technology nodes (28nm, 20nm or 14nm) will be assumed for the SoC scenario and full 3-D integration with Through Silicon Vias (TSV) will be pursued for the 2020 SiP scenario.

Students will be given all the necessary technology data (device performance, interconnect parasitics, wafer and TSV/packaging costs, and also the expected yield data). The design objective is to deliver a product competitive to the leading products available on the market or anticipated in 5 years. The complete product design will be carried out focusing on the processor cores, graphics and the embedded memories (including new generation memories in the 2020 scenarios). System performance and power will be estimated using provided simulators for specified benchmarks. The goal is to minimize the product cost by maximizing the number of good die per wafer while achieving competitive product performance and power objectives. Prerequisites: 18664 or instructor permission

Introduction to Information Security (18-631) – 12 Units

Our growing reliance on information systems for daily activities, ranging from remote communications to financial exchanges, has made information security a central issue of our critical infrastructure. The course introduces the technical and policy foundations of information security. The main objective of the course is to enable students to reason about information systems from a security engineering perspective, taking into account technical, economic and policy factors. Topics covered in the course include elementary cryptography; access control; common software vulnerabilities; common network vulnerabilities; policy and export control laws, in the U.S., Japan, and elsewhere; privacy; management and assurance; economics of security; and special topics in information security. Prerequisites: The course assumes a basic working knowledge of computers, networks, C and UNIX programming, as well as an elementary mathematics background, but does not assume any prior exposure to topics in computer or communications security. Students lacking technical background (e.g., students without any prior exposure to programming) are expected to catch up through self-study.

Introduction to Hardware Security (18-632) – 12 Units

This course covers basic concepts in the security of hardware systems. Topics covered include active and passive attacks, reverse engineering, counterfeiting, and design of hardware security primitives (e.g., random number generators, physical unclonable functions, crypto-processors). Lab sessions will give students hands on experience with performing attacks, developing countermeasures, and implementing secure hardware building blocks. Students are expected to have basic knowledge of digital logic and Register-Transfer Level (RTL) design, but no specific background in security/cryptography is necessary.

Browser Security (18-636) – 12 Units

The Web continues to grow in popularity as platform for retail transactions, financial services, and rapidly evolving forms of communication. It is becoming an increasingly attractive target for attackers who wish to compromise users' systems or steal data from other sites. Browser vendors must stay ahead of these attacks by providing features that support secure web applications. This course will study vulnerabilities in existing web browsers and the applications they render, as well as new technologies that enable web applications that were never before possible. The material will be largely based on current research problems, and students will be expected to criticize and improve existing defenses. Topics of study include (but are not limited to) browser encryption, JavaScript security, plug-in security, sandboxing, web mashups, and authentication.

The course will involve an intensive group research project focusing on protocols/algorithms, vulnerabilities, and attacks as well as several individual homework and programming tasks. Groups will perform a sequence of cumulative tasks (literature review, analysis, simulation, design, implementation) to address aspects of their chosen topic, occasionally reporting their results to the class through brief presentations, leading to a final report.

Wireless Security (18-637) – 12 Units

With the surge of mobile device use, embedded system deployment, and development of always-connected devices, the underlying wireless communication and network systems are becoming more critical for everyday use. Even though security and privacy have emerged as important focus areas for modern technology, the wireless links that connect our pervasive devices are still less understood from the perspectives of security and privacy than other system aspects. This course will focus on the challenges in providing secure communication and network services in a variety of wireless systems and current and past approaches to manage these challenges. Topic coverage will include vulnerabilities, attacks, security mechanisms, and trade-offs at various layers of the network protocol stack, from aspects of physical communication to application and service security issues; examples include jamming, MAC-layer misbehavior, selective packet dropping, decentralized trust and reputation, and cross-layer holistic attacks. Systems of interest include (but are not limited to) personal devices, connected vehicles, embedded and IoT systems, wireless infrastructure, and ad hoc networks. Class material will be largely based on recent and current research. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

Mobile and IoT Security (18-638) – 12 Units

For many people, mobile and embedded devices have become an essential part of life and work. As such devices represent many and varied combinations of technologies, they have unique security and privacy issues that potentially impact users, developers, service providers, manufacturers, and regulators. This course will focus on various aspects of security and privacy that are faced by mobile and Internet of Things devices, including aspects of wireless communication and networking, mobile computing, data analytics, security, and privacy. The course will include studies of security and privacy aspects of networking (including telecom, enterprise, personal, etc.), applications, and data analytics as relevant to mobile and embedded/IoT devices. One of the main goals of the course is to improve knowledge and awareness of security issues faced by mobile application developers, embedded system builders, and smart system designers. Material will cover standards, best practices, and research challenges in both deployed and emerging systems. Topics of study include (but are not limited to) telecom protocols and vulnerabilities; mobile/IoT network security; security and privacy in edge computing; mobile application security; and location and activity privacy. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

Policies of the Internet (18-639) – 12 Units

This course will address public policy issues related to the Internet. This may include policy issues such as network neutrality and the open Internet, Internet governance and the domain name system (and the role of the United Nations), copyright protection of online content, regulation of indecency and pornography, universal access to Internet and Internet as a "human right," government surveillance of the Internet, Internet privacy and security, and taxation of electronic commerce. It will also teach some fundamentals of Internet technology. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. Senior or graduate standing required.

Hardware Arithmetic for Machine Learning (18-640) – 12 Units

In this course, students explore the techniques for designing high-performance digital circuits for computation along with methods for evaluating their characteristics. We begin by reviewing number systems and digital arithmetic along with basic arithmetic circuits such as ripple-carry adders. From there, we move to more complex adders (carry-look-ahead, carry-skip, carry-bypass, etc.), multipliers, dividers, and floating-point units. For each circuit introduced, we will develop techniques and present theory for evaluating their functionality and speed. Other methods will be described for analyzing a circuit's power consumption, testability, silicon area requirements, correctness, and cost. In addition, we will utilize various CAD tools to evaluate the circuits described. Finally, advanced timing and clocking concepts will be investigated. For example, the notion of clock skew will be introduced and its impact on clock period for sequential circuits will be analyzed. We will also learn how to analyze and design asynchronous circuits, a class of sequential circuits that do not utilize a clock signal. Course projects focus on key arithmetic aspects of various machine learning algorithms including: K-nearest neighbors, neural networks, decision trees, and support vector machines.

*Note: Although students in 18-340 and 18-640 will share lectures, labs, and recitations, students in 18-340 and 18-640 will receive different homework assignments, design projects, and exams. In some cases 18-640 students will also have different or additional lab sessions. The homework assignments, design projects, and exams that are given to the students registered for 18-640 will be more challenging than those given to the students registered for 18-340 in that they will have more complex designs, involve additional theoretical analysis, and have more stringent specifications (e.g., in area, power, performance, and robustness).

Design Patterns for Smartphone Development (18-641) – 12 Units

This course provides an intensive exploration of computer programming by reviewing the basics of Object-Orientated programming and moving quickly to advanced programming using design patterns and a multi-tiered architecture. As part of the course work, students will learn smartphone development and how to apply the learned programming techniques to create extensible, reusable and quality software. It is intended for master's students who have had some prior, but perhaps limited, programming experience in Java or another object-oriented programming language; it is not intended as a first course in programming.

Embedded System Software Engineering (18-642) – 12 Units

In a very real sense, embedded software is what makes our everyday world function. From self-driving cars to chemical processing plant equipment, and from medical devices to the electric grid, embedded software is everywhere. You already know how to write code for a microcontroller. Now, learn software quality, safety, and security skills that are required to make embedded systems that can handle the messiness of the real world. This course provides in-depth coverage of the topics that are essential to the success of embedded software projects based on case studies of industry project teams that have suffered or failed. Students will learn about a variety of topics including: lightweight but high quality embedded software processes, technical best practices for embedded software, effective testing and validation, causes of software system failures, software for safety-critical systems, and embedded-specific aspects of software security. The material will generally be broken up into a set of four related topics each week, with one assignment per topic weekly, involving a combination of programming assignments, tool use experiences, and research questions to get hands-on experience at dealing with the types of problems that are encountered in industry embedded projects. We assume you already know how to code in C and understand the basics of microcontrollers. This course is about getting you ready to build industry-strength embedded projects. Undergraduate students are required to take 18349 prior to enrolling in this course. Graduate students are strongly encouraged to take 18-600/15-213/15-513/18-213 before or concurrently with this course.

Reconfigurable Logic: Technology, Architecture and Applications (18-643) – 12 Units
Three decades since its original inception as a lower-cost compromise to ASIC, modern Field Programmable Gate Arrays (FPGAs) are versatile and powerful systems-on-a-chip for many applications that need both hardware level efficiency and the flexibility of reprogrammability. More recently, FPGAs have also emerged as a formidable computing substrate with applications ranging from data centers and mobile devices. This course offers a comprehensive coverage of modern FPGAs in terms of technology, architecture and applications. The coverage will also extend into on-going research investigations of future directions. Students will take part in a substantial design projects applying the latest FPGA platforms to compute acceleration. Register-Transfer Level (RTL) hardware design experience is required.

Special Topics in Computer Systems (18-644) – 12 Units
This course covers applications of mobile hardware systems and the hardware associated with these systems. The course enables students 1) to analyze the implications of mobile hardware capabilities and restrictions in order to plan and develop mobile applications, 2) to propose and justify new ideas in the mobile space, and 3) to expose students to a range of mobile systems. Students will be able to devise and interface simple hardware additions to enable new applications. The course covers the elements of embedded systems development, such as hardware fundamentals, system development, as well mobile topics such as power management, machine-to-machine communication, and applications. Student teams will undertake small HW/SW interfacing projects on Arduino to sharpen their experience, and shape and build a novel application with the faculty. Unlike a conventional hardware course, the course would instead focus on the system and software implications, rather than the hardware components (i.e. CPU and radio). Prerequisites: Some understanding of basic electrical terminology; Java programming and C programming desired

How to Write Fast Code (18-645) – 12 Units
The fast evolution and increasing complexity of computing platforms pose a major challenge for developers of high performance software for engineering, science, and consumer applications: it becomes increasingly harder to harness the available computing power. Straightforward implementations may lose as much as one or two orders of magnitude in performance. On the other hand, creating optimal implementations requires the developer to have an understanding of algorithms, capabilities and limitations of compilers, and the target platform's architecture and microarchitecture. This interdisciplinary course introduces the student to the foundations and state-of-the-art techniques in high performance software development using important functionality such as linear algebra kernels, transforms, filters, and others as examples. The course will explain how to optimize for the memory hierarchy, take advantage of special instruction sets, and how to write parallel code for multicore, manycore, and cluster platforms, based on state-of-the-art research. Further, a general strategy for performance analysis and optimization is introduced that the students will apply in group projects that accompany the course. Finally, the course will introduce the students to the recent field of automatic performance tuning. Prerequiste: Senior ECE or CS undergraduate student or higher, solid C programming skills.

Low-Power System-on-Chip Architecture (18-646) – 12 Units
This course provides the architectural foundations for low-power systems out of which sensors, low power embedded systems, internet of things devices and the like are created. It includes microarchitecture, energy-aware programming, energy harvesting, energy management, and real-time measurement and abstraction of energy usage at runtime. As a part of the course, we will naturally build embedded systems at a level where energy usage can be measured and controlled.

Embedded Real-Time Systems (18-648) – 12 Units
Real-time embedded systems pervade many aspects of modern life ranging from household appliances, transportation and motion control systems, medical systems and devices, robotics, multimedia and mobile communications, video-games, energy generation/distribution/management, to aerospace and defense systems. This course has three complementary goals. One, it will cover the core concepts and principles underlying these systems, including resource management, scheduling, dependability and safety. Implications to multi-core platforms, SoCs, networks and communication buses will also be discussed. Mathematical models and analysis techniques will be presented. Two, the course will offer hands-on experience with implementing real-time embedded systems on realistic platforms. This will be facilitated by detailed discussions of hardware-software interfaces, concurrency and communications. Finally, application-level concepts such as signal processing, image processing, computer vision, sensor fusion and feedback control will complete an overview of the breadth and depth of real-time embedded systems. Knowledge of the C programming language, basic computer architecture and an assembly language will be assumed.

Distributed Embedded Systems (18-649) – 12 Units

Embedded computers seem to be everywhere, and are increasingly used in applications as diverse as transportation, medical equipment, industrial controls, and consumer products. This course covers how to design and analyze distributed embedded systems, which typically consist of multiple processors on a local area network performing real time control tasks. The topics covered will include issues such as communication protocols, synchronization, real-time operation, fault tolerance, distributed I/O, design validation, and industrial implementation concerns. The emphasis will be on areas that are specific to embedded distributed systems as opposed to general-purpose networked workstation applications. This course assumes that students already know fundamental topics such as interrupts, basic I/O, and uniprocessor scheduling that are commonly taught in introduction-level embedded system courses such as 18-348 and 18-349. Any graduate student who has not taken one of the pre-requ isites is responsible for understanding relevant material necessary for this course. Additionally, all students are responsible for knowing or learning on their own intermediate-level programming in Java. Prerequisites: 18348 or 18349 and senior or graduate standing.

Policies of Wireless Systems (18-650) – 12 Units

This course will address public policy issues related to wireless systems. It investigates policies related to a wide variety of emerging wireless systems and technologies, including current and next-generation cellular systems, wifi and white space devices, emerging methods of accessing spectrum, communications systems for emergency responders (firefighters, police, emergency medical services), current and next-generation television, and satellite communications. This can include the government role in facilitating the creation of infrastructure, in advancing competition among broadcasters and communications service providers, in using scarce spectrum efficiently, in promoting public safety and homeland security, and in protecting privacy and security. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. This course is cross-listed as 18-650, 19-403, 19-713, and 95-824. Senior or graduate standing required.

Networked Cyber-Physical Systems (18-651) – 12 Units

Cyber-physical systems (CPS) represent a new class of systems that bring together sensing, computation, communication, control and actuation to enable continuous interactions with physical processes. This integration of networked devices, people, and physical systems provides huge opportunities and countless applications in biology and healthcare, automotive and transportation, power grids and smart buildings, social and financial markets, etc. Hence, CPS need to provide real-time efficiency, adaptability, optimality, security and robustness to natural disasters or targeted attacks. While the focus on embedded systems relies on building computational models for specific applications, CPS need a multidisciplinary approach and a more general computational paradigm such that more-direct interactions between the system and physical world become possible. This course is primarily an in-depth introduction to networked CPS with an emphasis on methods for modeling, design, and optimization. Focus is on the dominant design paradigms like low-power and communication-centric design. Topics to be covered include: physical processes, models of concurrency, sensing and workload modeling, human behavior modeling, data-driven modeling, networking at micro- and macro-scale, system-

wide resources management, programming, validation and integration. From a practical standpoint, students will directly experiment with hardware prototypes and software tools to explore concrete CPS examples. By structure and contents, this class is primarily targeted to ECE students; it can also provide a valuable basis for interdisciplinary research to students in CS and related disciplines.

Foundations of Software Engineering (18-652) – 12 Units

In this course, you will learn about software engineering paradigms that have shaped the software industry over the past few decades. You will be exposed to fundamental disciplines of software engineering as well as engineering practices that crosscut system, project, and user perspectives. You will learn to iteratively define requirements, and architect, design, implement, integrate, test, and deploy a solution. You will work on self-organizing teams and manage the work collaboratively. You will also learn to solve a real problem subject to multiple constraints while keeping the stakeholders involved throughout the lifecycle and balancing the underlying engineering tradeoffs. The topics are applied in the context of a semester-long group project. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the "Software Engineering and Design" course area requirement. Prerequisites: Basic software development experience with proficiency in at least one modern programming language and modern programming concepts. Prior to admission, students must successful complete a programming assignment to demonstrate familiarity with required software technologies. Students who have successfully completed 18-652, Foundations in Software Engineering, are not eligible to take this course.

Software Architecture and Design (18-653) – 12 Units

Software Architecture and Design is a one-semester course, aiming to train our graduate students from software engineers toward becoming a Software Architect, who is the ¿Technical Lead¿ of a software project team. The primary objective of the course is to help students develop skills in designing, developing, and justifying reasonable software architecture for enterprise-scale software-intensive systems, considering both functional and non-functional requirements as well as contextual system environments. Core topics include: overview of software architecture, micro architectural patterns (so-called design patterns) and macro architectural patterns (i.e., modern patterns), service oriented architecture, architectural modeling, viewpoints and perspectives, architectural analysis techniques, architectural tactics (QoS), agile architecture, and some advanced topics. Literature survey and study of state-of-the-art technologies, as well as both individual and group project work, are essential ingredients of this class. Research and practical projects build upon one another. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the Software Engineering and Design requirement. Anti-requisites: 17-655 from CS Dept. Pre-requisites: 18-652

Software Verification and Testing (18-654) – 12 Units

Verification and testing (V&T) support software engineers and development teams in their endeavor to build dependable systems. These interrelated activities form the backbone of a high-quality software solution that performs its function as intended. V&T is no longer considered an exclusively backend phase undertaken by a separate quality assurance unit, vulnerable to

availability of discretionary resources near project end. Rather, V&T is a cross-functional discipline applied throughout the software lifecycle from beginning to end. As such V&T is an integral and essential part of any sensible software development process. This course introduces the students to concepts, principles, theory, types, tools, and techniques of V&T with exposure to both modern, widely-applicable approaches and traditional, formal techniques. Students will acquire sufficient depth and breadth in V&T through a balanced coverage of topics. The course syllabus spans fundamentals such as V&T principles, systematic testing, input space analysis, and test coverage; practical strategies such as test-driven development, unit testing, and test design; and formal approaches such as abstraction, model checking, static analysis, and symbolic execution. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the ¿Analysis¿ area core course requirement. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the Analysis area core course requirement.

Decision Analysis and Engineering Economics for Software Engineers (18-657) – 12 Units
Engineering software systems entails continuously making resource and technical decisions at multiple levels subject to different sources of uncertainty, cost-benefit tradeoffs, historical data, and flexibility demands. This course will develop quantitative and modeling skills for economics-based and decision-theoretic reasoning in software engineering through a repertoire of techniques from several fields. Special consideration will be given to reasoning under uncertainty and empirical approaches to tackle a variety of software engineering decision-making problems, including technology, architecture, design, product, and process decisions. The analysis techniques covered will be illustrated through domain-specific examples. Analysis techniques that will be covered include Monte Carlo Simulation, Net Present Value, Expected Value of Information, Decision Tree Analysis, Real Options Theory, Utility Theory, and Analytic Hierarchy Process. Basic data analysis concepts, including descriptives, linear regression, correlation, and hypothesis testing will be explained and used. Examples and fully-developed case studies will illustrate how these techniques can be combined to best leverage their strengths. The course has a practical focus, but includes coverage of the necessary background theories. Orientation is distinctly quantitative. Knowledge of basic probability is required. Pre-requisites: 18-652 (can be taken concurrently)

Software Requirements and Interaction Design (18-658) – 12 Units
Good software systems should be engineered with user experience in mind. How can we design software systems that are at once useful, usable, and enjoyable to use?
This course addresses these challenges by integrating two disciplines: requirements engineering and interaction design. Students learn to combine user research, design-based ideation and validation, and requirements definition, within an agile software development process.
Students apply this knowledge during a semester-long project. Their goal is to envision and implement the first version of an innovative software system that could make a unique contribution to society. The system should address a real problem, satisfy real stakeholders' needs, and provide a superior user experience. Students collaborate closely with their stakeholders throughout the project for needs elicitation, design concepts validation, and usability testing.

This course is intended for ECE master students with a concentration in Software Engineering. It is a core course of the MS-SE program satisfying the "Software Engineering and Design" course area requirement.

Software Engineering Methods (18-659) – 12 Units

There has been a rapid evolution of software engineering development methods over the past decades. From Waterfall to Iterative and Incremental, to Agile and Lean, we have witnessed waves of new methods, each adding significant value to the field. However, the plethora of available methods poses a challenge for software practitioners: Which method should be adopted on a specific software project? Software Engineering Methods addresses this challenge by introducing students to emerging approaches for developing software-intensive systems. Given the vast spectrum of software development endeavors, these approaches aim at defining custom hybrid methods by focusing on software development principles and practices together with their applicability to specific project contexts. Students learn to analyze the context of a software project and recommend a custom hybrid development method that satisfies the project's specific needs. Students apply this knowledge in the context of a semester-long project where the entire class works together as a team of teams. They define the optimal software development method for their project aimed at evolving an existing software system. They build new system increments by adopting their own method. They monitor their progress and reflect on the effectiveness of their approach and the need for continuous improvement. This course is intended for ECE master students with a concentration in Software Engineering and will satisfy the "Systems" course area requirement. Prerequisites: 18652 or instructor permission

Optimization (18-660) – 12 Units

Many design problems in engineering (e.g., machine learning, finance, circuit design, etc.) involve minimizing (or maximizing) a cost (or reward) function. However, solving these problems analytically is often challenging. Optimization is the study of algorithms and theory for numerically solving such problems, and it underpins many of the technologies we use today. This course is an introduction to optimization. Students will: (1) learn about common classes of optimization problems, (2) study (and implement) algorithms for solving them, and (3) gain hands-on experience with standard optimization tools. We will focus on convex optimization problems, but will also discuss the growing role of non-convex optimization, as well as some more general numerical methods. The course will emphasize connections to real-world applications including machine learning, networking, and finance. The course will involve lectures, homework, exams, and a project.

This course is crosslisted with 18460. Although students in 18460 will share lectures with students in 18660, students in 18460 will receive distinct homework assignments, distinct design problems, and distinct exams from the ones given to students in 18660. Specifically, the homework assignments, design problems and exams that are given to the 18660 students will be more challenging than those given to the 18460 students.

Introduction to Machine Learning for Engineers (18-661) – 12 Units

This course provides an introduction to machine learning with a special focus on engineering applications. The course starts with a mathematical background required for machine learning and covers approaches for supervised learning (linear models, kernel methods, decision trees, neural networks) and unsupervised learning (clustering, dimensionality reduction), as well as theoretical foundations of machine learning (learning theory, optimization). Evaluation will consist of mathematical problem sets and programming projects targeting real-world engineering applications.

Hardware Architectures for Machine Learning (18-663) – 12 Units
Machine learning is poised to change the landscape of computing in more ways than its broad societal applications. Indeed, hardware architectures that can efficiently run machine learning face increasing challenges due to power consumption or run time constraints that technology, platforms, or users impose. This course provides an overview of current advances in hardware architectures that can enable fast and energy efficient machine learning applications from the edge to the cloud. Topics include hardware accelerators, hardware-software co-design, and general or application specific system design and resource management for machine learning applications.

ULSI Technology Status and Roadmap for System on Chips and System in Package (18-664) – 12 Units
This course provides the necessary background for the state-of-the art technologies utilized by the leading edge products covering full spectrum of market drivers from mobile platforms, microprocessors, game chips to the highest performance systems for enterprise solutions computing. We will present all key components of such systems, i.e., logic, analog/RF and embedded memories. Then we present the technology roadmap for the upcoming generations in terms of device architecture options for logic devices (FinFET, Nanowire and Tunnel FET) and memories (Phase Change Memory , Resistive RAM and Magnetic RAM/Spin-Transfer Torque RAM) from the device level all the way to the system level specifications. The last part of the class will be devoted to the system integration issues, namely 3-dimensional integration approaches. This course is designed for MS and PhD students from diverse areas: System/Hardware Design, Circuits and Devices/Nanofabrication and is aimed at bridging the gap among these areas.

Analytical Performance Modeling & Design of Computer Systems (18-687) – 12 Units
In designing computer systems one is usually constrained by certain performance requirements. For example, certain response times or throughput might be required of the system. On the other hand, one often has many choices: One fast disk, or two slow ones? What speed CPU will suffice? Should we invest our money in more buffer space, or a faster processor? Which migration policy will work best? Which task assignment policy will work best? How can we redesign the scheduling policy to improve the system performance? Often answers to these questions are counter-intuitive. Ideally, one would like to have answers to these questions before investing the time and money to build a system. This class will introduce students to analytic stochastic modeling with the aim of answering questions such as those above. Topics covered include Operational

Laws, Markov Chain Theory, Queuing Theory, Modeling Empirical Loads, Simulations, and Management of Server Farms.

Introduction to Neuroscience for Engineers (18-690) – 12 Units
The first half of the course will introduce engineers to the neurosciences from the cellular level to the structure and function of the central nervous system (CNS) vis-à-vis the peripheral nervous system (PNS) and include a study of basic neurophysiology; the second half of the course will review neuroengineering methods and technologies that enable study of and therapeutic solutions for diseases or damage to the CNS. A goal of this course is to provide a taxonomy of neuroengineering technologies for research or clinical application in the neurosciences. This course is cross listed with 42-630

Statistical Discovery and Learning (18-697) – 12 Units
This course is designed to give students a thorough grounding in the methods, theory, mathematics and algorithms needed to do research and applications in machine learning. The topics of the course draw from machine learning, classical statistics, data mining, Bayesian statistics and information theory and other areas. This course is project-oriented and is intended to give students abundant hands-on experience with different machine learning algorithms. Students who have already taken CS 10-701/15-781 Machine Learning should not take this course.

Neural Signal Processing (18-698) – 12 Units
The brain is among the most complex systems ever studied. Underlying the brain's ability to process sensory information and drive motor actions is a network of roughly 1011 neurons, each making 103 connections with other neurons. Modern statistical and machine learning tools are needed to interpret the plethora of neural data being collected, both for (1) furthering our understanding of how the brain works, and (2) designing biomedical devices that interface with the brain. This course will cover a range of statistical methods and their application to neural data analysis. The statistical topics include latent variable models, dynamical systems, point processes, dimensionality reduction, Bayesian inference, and spectral analysis. The neuroscience applications include neural decoding, firing rate estimation, neural system characterization, sensorimotor control, spike sorting, and field potential analysis. Prerequisites: 18-290; 36-217, or equivalent introductory probability theory and random variables course; an introductory linear algebra course; senior or graduate standing. No prior knowledge of neuroscience is needed

Technical Writing for Engineers: Linguistic Foundations (18-701) – 6 Units
Mini 1 (Linguistic Foundations) is designed for engineering students who are preparing for taking Qualifying exams. We will review the structure of Quals that have succeeded and Quals that have been less successful. Students will learn the linguistic foundations of successful overview papers (like those required in Qualifying exams). They will learn the linguistic basis of appropriate citation and the competent elaboration of the work of others. They will learn effective linguistic practices of transitioning from the work of others to their own work and elaborating their own work. They will learn principles of concision, character/action, topical coherence, cohesion, and emphasis, principles that work together to provide the written portion of a Qualifying exam with

an easy flow and readability. They will learn how this system of principles can help them detect gaps in knowledge they will need to fill in by the time of the oral examination, if not in the written portion of the Qual itself. To the greatest extent possible, students will learn to apply these linguistic principles on the written portion of the Quals they are preparing that semester or have prepared in previous semesters. Prerequisites: ECE PhD standing is required.

Technical Writing for Engineers: Genre Foundations (18-702) – 6 Units
Mini 2 (Genre Foundations) is designed for engineering students ready to focus on archival genres that report new knowledge, genres including but not limited to conference papers and journal publications. Students will learn principles of academic novelty and its history in the Royal Society. We will use customized software that give students a "zoomed-in" look at the impressive variety through which introductions establish significance and how they open a "gap" that the author's research was designed to fill. We will overview the important genre features and functions of the various sections of the archival paper. Students are expected to bring to the course archival documents they are currently preparing to submit. Students will use the mini to execute a systematic revision of their document based on the genre functions and features discussed. Prerequisites: ECE PhD standing is required.

Managing and Leading Research and Development (18-703) – 12 Units
This course will provide an insider's look at issues in industrial research and development laboratories that future industrial R&D personnel are likely to face.
The instructor, Prof. Mark Kryder spent nine years as Chief Technical Officer and Senior Vice President, Research for Seagate Technology, the largest disk drive manufacturer in the world. In the course, he will try to give students an improved understanding of how research and development are done in a major high-tech firm today.
The course is built around the instructor's personal experiences, but also draws heavily from business management literature and business case studies. It is expected that the course will make the transition from the university to industry easier and faster for students who have taken it and enable them to become more effective in an industrial setting in a shorter period of time.
Examples of issues to be discussed will be the impact of various organizational structures upon R&D; What characteristics are desired in a research staff member vs. a staff development engineer?, What is the importance of diversity in a R&D setting? What are the relative importances of technology, marketing expertise and corporate business models in determining success of a product?; What is meant by "corporate culture" and how does it get defined?; How important are collaboration and teamwork in R&D and are they different?; What is Six Sigma and how important is it in today's business world?; How do you measure performance in R & D?, how do you effectively transfer technology from research to development?; how can you effectively leverage university research and industrial consortia?: How important is intellectual property in various industries? How important is corporate size?: What is the role of technology vision?; What are the effects of globalization on R&D?; What is a technology steering council and how can it be used to facilitate technology transfer and development?

Advanced Cloud Computing (18-709) – 12 Units

Computing in the cloud has emerged as a leading paradigm for cost-effective, scalable, well-managed computing. Users pay for services provided in a broadly shared, power-efficient datacenter, enabling dynamic computing needs to be met without paying for more than needed. Actual machines may be virtualized into machine-like services, abstract programming platforms, or application-specific services, with the cloud infrastructure managing sharing, scheduling, reliability, availability, elasticity, privacy, provisioning and geo-replication.

This course will survey the aspects of cloud computing through about 30 papers and articles, executing cloud computing tasks on a state-of-the-art cloud computing service, and implementing a change or feature in a state-of-the-art cloud computing framework. There will be no final exam, but there will be one or two in-class exams. Grades will be about 50% project work and about 50% examination results.

Elements of Photonics for Communication Systems (18-712) – 12 Units
The aim of this course is to provide students with a basic understanding of the elements of photonics, including the necessary primary devices that form the building blocks of modern optical communication systems. The photon is the fundamental unit particle of light, with frequencies in the range of several hundred Terahertz (~100 x 1012 Hz). It is a fact of the fundamental theorem of communication that information capacity increases directly with frequency. It is no wonder then that photonic communication systems have become the backbone of modern, ultra-fast and high capacity communication networks. The use of light in communication systems involves the generation, transmission, and detection of photons, along with the encoding (modulation) of signals of interest onto the light carrier wave, and the subsequent decoding (de-modulation) at the destination.

This course begins with an introduction to basic electromagnetic theory (in the frequency range that corresponds to light). The introduction includes Maxwell's equations in both free space and dielectric media. The scalar wave equation derived from the vector Maxwell equations is solved in free space as well as in dielectric media, taking into account the boundary conditions that affect the transmission and reflection of light at the dielectric interfaces. This background is then used in the discussion of the dielectric slab and the related fiber-optic waveguide that is used in the transmission of optical signals in short- and long-haul communication systems.

The course continues with a discussion of semiconductor light generators, with a particular focus on edge-emitting and surface-emitting lasers. Photon detectors—of the semiconductor variety—are then discussed. The course ends with a discussion of other important optical components such as modulators, filters, couplers, multiplexers and demultiplexers. Prerequisites: 18-300 and 18-310 and (18-402 or 33-439) and senior or graduate standing.

Physics of Applied Magnetism (18-715) – 12 Units
In this course we address the physics of magnetism of solids with emphasis on magnetic material properties and phenomena which are useful in various applications. Various applications of magnetism are used to motivate the understanding of the physical properties and phenomena. The content of this course includes the origins of magnetism at the atomic level and the origins

of magnetic ordering (ferro-, ferri-, and antiferro-magnetism), magnetic anisotropy, magnetic domains, domain walls, spin dynamics and electronic transport at the crystalline level. The principles of magnetic crystal symmetry, tensors, and energy minimization are utilized to explore magnetic properties such as resonance, domain structures, magnetocrystalline anisotropy, magnetostriction and magnetoelasticity, and susceptibility. Phenomenological properties, such as the technical magnetization process, are used to describe mechanisms of coercivity, eddy current effects and losses, while energy minimization and relaxation are used to explain properties such as single domain particle behavior, memory mechanisms, magnetic aftereffects and thermal stability. Prerequisite: 18-300 or equivalent background in electromagnetic fields; Senior level solid state physics and materials, or the equivalent, and a senior or graduate student standing.

Advanced Analog Integrated Circuits Design (18-721) – 12 Units

This course will familiarize students with advanced analog integrated circuit design issues. Analog circuit design issues play an important role in creating modern ICs. First and foremost, analog circuits act as the interface between digital systems and the real world. They act to amplify and filter analog signals, and to convert signals from analog to digital and back again. These analog interfaces appear in all communications devices (e.g., cell phones) both to condition the "transmitted" signal and as sensitive "receivers." In addition, these analog interfaces appear in sensors (e.g., accelerometer). The goal of this course is to familiarize students with some of the advanced analog circuit design ideas that are involved in these tasks. Specific topics will include analog filtering (continuous-time and discrete-time), sample-and-hold amplifiers, analog-to-digital converters, digital-to-analog converters. Prerequisites: 18-623 (was 18-523 before Fall 2005) and senior or graduate standing.

RFIC Design and Implementation (18-723) – 12 Units

This course covers the design and analysis of radio-frequency integrated systems at the transistor level using state of the art CMOS and bipolar technologies. It focuses on system-level trade-offs in transceiver design, practical RF circuit techniques, and physical understanding for device parasitics. Accurate models for active devices, passive components, and interconnect parasitics are critical for predicting high-frequency analog circuit behavior and will be examined in detail. The course will start with fundamental concepts in wireless system design and their impact on design trade-offs in different transceiver architectures. Following that, RF transistor model, passive matching networks will be discussed. Noise analysis and low-noise amplifier design are studied next. The effects of nonlinearity are treated along with mixer design techniques. Practical bias circuit for RF design will be illustrated. Then, the importance of phase noise and VCO design will be considered together. The course will conclude with a brief study of frequency synthesizer and power amplifier design. Senior or graduate standing required.

Advanced Digital Integrated Circuit Design (18-725) – 12 Units

The purpose of this course is to study the design process of VLSI CMOS circuits. This course covers all the major steps of the design process, which include: logic, circuit and layout design. A variety of computer-aided tools are discussed and used in class. The main objective of this course is to provide VLSI design experience that includes design of basic VLSI CMOS functional blocks,

verification of the design, testing and debugging. During the course, one complex VLSI project is submitted for fabrication. 4 hrs. lec.

Introduction to Computer Security (18-730) – 12 Units
This course provides a principled introduction to techniques for defending against hostile adversaries in modern computer systems and computer networks. Topics covered in the course include operating system security; network security, including cryptography and cryptographic protocols, firewalls, and network denial-of-service attacks and defenses; user authentication technologies; security for network servers; web security; and security for mobile code technologies, such as Java and Javascript. More advanced topics will additionally be covered as time permits, such as: intrusion detection; techniques to provide privacy in Internet applications; and protecting digital content (music, video, software) from unintended use. Anti-requisites: 18-631 and 18-487

Network Security (18-730) – 12 Units
Some of today's most damaging attacks on computer systems involve exploitation of network infrastructure, either as the target of attack or as a vehicle to advance attacks on end systems. This course provides an in-depth study of network attack techniques and methods to defend against them. Topics include firewalls and virtual private networks; network intrusion detection; denial of service (DoS) and distributed denial-of-service (DDoS) attacks; DoS and DDoS detection and reaction; worm and virus propagation; tracing the source of attacks; traffic analysis; techniques for hiding the source or destination of network traffic; secure routing protocols; protocol scrubbing; and advanced techniques for reacting to network attacks. Prerequisite: 18-630 OR 18-730, and senior or graduate standing.

Secure Software Systems (18-732) – 12 Units
Poor software design and engineering are the root causes of most security vulnerabilities in deployed systems today. Moreover, with code mobility now commonplace--particularly in the context of web technologies and digital rights management--system designers are increasingly faced with protecting hosts from foreign software and protecting software from foreign hosts running it. This class takes a close look at software as a mechanism for attack, as a tool for protecting resources, and as a resource to be defended. Topics covered include the software design process; choices of programming languages, operating systems, databases and distributed object platforms for building secure systems; common software vulnerabilities, such as buffer overflows and race conditions; auditing software; proving properties of software; software and data watermarking; code obfuscation; tamper resistant software; and the benefits of open and closed source development. Senior or graduate standing required.

Applied Cryptography (18-733) – 12 Units
A wide array of communication and data protections employ cryptographic mechanisms. This course explores modern cryptographic (code making) and cryptanalytic (code breaking) techniques in detail. This course emphasizes how cryptographic mechanisms can be effectively used within larger security systems, and the dramatic ways in which cryptographic mechanisms

can fall vulnerable to cryptanalysis in deployed systems. Topics covered include cryptographic primitives such as symmetric encryption, public key encryption, digital signatures, and message authentication codes; cryptographic protocols, such as key exchange, remote user authentication, and interactive proofs; cryptanalysis of cryptographic primitives and protocols, such as by side-channel attacks, differential cryptanalysis, or replay attacks; and cryptanalytic techniques on deployed systems, such as memory remanence, timing attacks, and differential power analysis. Senior or graduate standing required.

Foundation of Privacy (18-734) – 12 Units
Privacy is a significant concern in modern society. Individuals share personal information with many different organizations - healthcare, financial and educational institutions, the census bureau, web services providers and online social networks - often in electronic form. Privacy violations occur when such personal information is inappropriately collected, shared or used. We will study privacy in a few settings where rigorous definitions and enforcement mechanisms are being developed - statistical disclosure limitation (as may be used by the census bureau in releasing statistics), semantics and logical specification of privacy policies that constrain information flow and use (e.g., by privacy regulations such as the HIPAA Privacy Rule and the Gramm-Leach-Bliley Act), principled audit and accountability mechanisms for enforcing privacy policies, anonymous communication protocols - and other settings in which privacy concerns have prompted much research, such as in social networks, location privacy and Web privacy (in particular, online tracking & targeted advertising).

Special Topics in Computer Systems: Engineering Safe Software Systems (18-737) – 12 Units
Modern software systems suffer from poor reliability and security due to overwhelming complexity. Traditional software testing and debugging, which account for more than half the cost of software development, often fail to find critical bugs in software. In recent years there has been an increasing interest in developing automated techniques for improving software reliability. These techniques combine ideas from program analysis, constraint solving, and model checking and have shown great promises in making software more reliable and secure. In this course, we will study these new techniques, with emphasis on automated test-case generation based on symbolic execution and fuzz testing. We will see how these techniques can be used for detecting bugs in software, finding performance bottlenecks, detecting and preventing security vulnerabilities, and analyzing the reliability of software components. We will further study component-based verification and emerging techniques for automated software repair. Finally, we will discuss challenges related to the analysis of systems with deep learning components, which have a simpler structure than more traditional software but tend to be massive in scale. Senior or graduate standing required.

Sports Technology (18-738) – 12 Units
The course's lecture content will cover background material on key aspects of sports technology, including topics such as computer vision, artificial intelligence, data mining, the physics of sports and understanding of real-world systems and guest lectures from experts in the field. The topics covered in depth will include the types of sensors and algorithms used in real-world systems

deployments today, as well as new applications of the Internet of Things to different aspects of sports, including training, performance, coaching, etc.
This course also comprises a semester-long project experience and research paper geared towards the development of skills to design realistic and practical embedded/mobile systems and applications that enhance various aspects of the training, coaching, playing and scouting of different sports, including football, hockey, baseball, soccer, etc. Students will work in teams on a project that will involve the hands-on design, configuration, engineering, implementation and testing of an embedded-system prototype of an innovative sports technology of their choice. Students will be expected to leverage proficiency and background gained from other courses, particularly with regard to embedded real-time principles, software systems and embedded programming. The project will utilize a synergistic mixture of skills in system architecture, modular system design, software engineering, subsystem integration, debugging and testing. From inception to demonstration of the prototype, the course will follow industrial project practices, such as version control, design requirements, design reviews, user studies and quality assurance plans. Advanced undergraduate or graduate standing required.

Computer Architecture – (18-740) – 12 Units
The Internet has transformed our everyday lives, bringing people closer together and powering multi-billion dollar industries. The mobile revolution has brought Internet connectivity to the last-mile, connecting billions of users worldwide. But how does the Internet work? What do oft repeated acronyms like "LTE", "TCP", "WWW" or a "HTTP" actually mean and how do they work? This course introduces fundamental concepts of computer networks that form the building blocks of the Internet. We trace the journey of messages sent over the Internet from bits in a computer or phone to packets and eventually signals over the air or wires. We describe concepts that are common to and differentiate traditional wired computer networks from wireless and mobile networks. Finally, we build up to exciting new trends in computer networks such as the Internet of Things, 5-G and software defined networking. Topics include: physical layer and coding (CDMA, OFDM, etc.); data link protocol; flow control, congestion control, routing; local area networks (Ethernet, Wi-Fi, etc.); transport layer; and introduction to cellular (LTE) and 5-G networks. A final project asks you to a build a HTTP video server of your own. This course is cross-listed with 18-441 - both editions will share Lectures and Recitations. However, students in the two courses will receive different exams and will have a different project. The students in the two versions of the course will be graded on a separate curve.

Computer Architecture and Systems (18-742) – 12 Units
Historically, the performance and efficiency of computers has scaled favorably (according to "Moore's Law") with improvements at the transistor level that followed a steady trend (so-called "Dennard scaling"). Unfortunately, device scaling has hit a limit on performance and power improvements dictated by physical device properties. To continue to make systems capable, fast, energy efficient, programmable, and reliable in this "post-Dennard" era, computer architects must be creative and innovate across the layers of the system stack. This course begins with a recap of conventional, sequential computer architecture concepts. We will then discuss the end of convention, brought about by the end of Dennard Scaling and Moore's Law, and several trends that these changes precipitated. The first trend is the wholesale shift to parallel computer

architectures and systems, covering parallel hardware and software execution models, cache coherence, memory consistency, synchronization, transactional memory, and architecture support for programming, debugging, and failure avoidance. The second trend is the shift to incorporating specialized, heterogeneous components into parallel computer architectures. Topics will include reconfigurable architectures, FPGAs in the datacenter, ASIC accelerators, GPGPU architectures, and the changes to the system stack that these components demand. The third trend is the emergence of newly capable hardware and software systems and new models of computation. Topics will include approximate and neuromorphic computing, intermittent computing, emerging non-volatile memory and logic technologies, and analog and asynchronous architectures, and may include future emerging topics.

Energy Aware Computing (18-743) – 12 Units
This course provides a comprehensive coverage of topics related to energy aware and green computing. While it is widely recognized that power consumption has become the limiting factor in keeping up with increasing performance trends, static or point solutions for power reduction are beginning to reach their limits. This course is intended to provide an insight into: (i) power and energy consumption modeling and analysis; (ii) energy aware computing, i.e., how various power reduction techniques can be used and orchestrated such that the best performance can be achieved within a given power budget, or the best power efficiency can be obtained under prescribed performance constraints; and (iii) green computing in the context of large scale computing systems or smart grid-aware computing. Recommended: basic VLSI design, basic computer system organization, basic compiler design and OS knowledge. Prerequisites: Senior or Graduate Standing.

Connected Embedded Systems Architecture (18-744) – 12 Units
Connected Embedded Systems Architecture (CESA) is a one-semester lab-based course that addresses the core concepts of modern embedded systems with a particular emphasis on the emerging field of apps that span small, embedded devices (including wearable electronics, so-called Internet of Things devices, and mobile phones) to the cloud. We will examine the evolution of the nature of IoT from the early days of wireless sensor networks to the future vision of federated, time-synchronized, scalable, virtualized "fog computing" platforms.

The course is designed to take a systems approach and, as such, will include relevant topics from both software (cloud, network, device) and hardware (network and device). The course content is aimed at systems engineers who wish to architect, develop and deploy cloud-connected embedded systems in which the "apps" change, mature and evolve over time. The course stresses the creation of engineering frameworks in which tradeoffs can be rationally made between computing and storage that should be done on coin-cell-powered devices vs. computing and storage that should be done in the network or in the cloud.

Rapid Prototyping of Computer Systems (18-745) – 12 Units
This is a project-oriented course which will deal with all four aspects of project development; the application, the artifact, the computer-aided design environment, and the physical prototyping

facilities. The class, in conjunction with the instructors, will develop specifications for a mobile computer to assist in inspection and maintenance. The application will be partitioned between human computer interaction, electronics, industrial design, mechanical, and software components. The class will be divided into groups to specify, design, and implement the various subsystems. The goal is to produce a working hardware/software prototype of the system and to evaluate the user acceptability of the system. We will also monitor our progress in the design process by capturing our design escapes (errors) with the Orthogonal Defect Classification (ODC). Upon completion of this course the student will be able to: generate systems specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of numerous subsystems; use computer-aided design tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application. This course is cross-listed as 18540.

Storage Systems (18-746) – 12 Units
This course covers the design, implementation, and use of storage systems, from the characteristics and operation of individual storage devices through the OS, database, and networking approaches involved in tying them together and making them useful to key applications' demands and technology trends. Topics to be covered include: network-attached storage, disk arrays, storage networking, storage management, advanced file systems, disk performance enhancement, wide-area data sharing, and storage security. 3 hrs. lec. The class will continue to be like previous years, with the same advanced content and high-level expectations.

Wireless Device Architecture (18-747) – 12 Units
Growth of the Internet of Things depends on semiconductor devices ¿ systems-on-chip (SoC) ¿ with significant computational, communications and sensing capabilities. Integration of entire systems on one or a very small number of dies has made it possible to deploy hundreds of billions of end-points that will link the cyber world with the physical world. At this scale, a key design requirement is that such devices can be handled at most once during their lifetime. Batteries should be life-long, and reprogramming should be over-the-air. How then should such devices be architected? We begin by examining modern digital communications including modulation and coding schemes, basic RF subsystems and antennas. We examine the computational structures that allow us to reduce communication to computation. Anticipating that such devices will need to be highly programmable, we consider concepts from traditional computer architecture and their applicability to this energy-constrained domain. We also examine the rapid evolution of transducer technologies and how these are being integrated into SoCs. Then, we consider how an architect can make tradeoffs across these domains to meet design objectives. Students will take advantage of a purpose-built experimental platform called PowerDué that enables deep exploration of these topics in realistic applications. Background in computer architecture, signals and systems, and E&M field theory is recommended. Graduate standing is required to register for this course.

Wireless Sensor Networks (18-748) – 12 Units
The use of distributed wireless sensor networks have surged in popularity in recent years with applications ranging from environmental monitoring, to people- and object-tracking in both

cooperative and hostile environments. This course is targeted at understanding and obtaining hands-on experience with the state of the art in such wireless sensor networks which are often composed using relatively inexpensive sensor nodes that have low power consumption, low processing power and bandwidth. The course will span a variety of topics ranging from radio communications, network stack, systems infrastructure including QoS support and energy management, programming paradigms, distributed algorithms and example applications. Some guest lectures may be given. Each discussion-oriented lecture will be preceded by the reading of 1-2 papers, resulting in a rich collection of papers by the end of the semester. Early in the semester, hands-on exercises will be used to teach the programming of FireFly sensor nodes by using the 'nano-RK' power-aware sensor real-time operating system (RTOS) and using 802.15.4 radio communications. Then, project groups of no more than 3 students will define, design, implement and test a sensor network project. Final in-class project presentations will be supplemented by a written report. A final exam may be conducted to evaluate the students' understanding of the materials covered. Grading criteria will include classroom participation, course project content and report, and a final exam. Class size will be limited to 20 students or less. Hands-on experience with network programming, operating systems and assembly language are essential. Exceptions only with explicit permission of instructor. Prerequisites: 15-213 and ((18-348 or 18-349) or 15-410), and senior or graduate standing.

Building Reliable Distributed Systems (18-749) – 12 Units

The course provides an in-depth and hands-on overview of designing and developing reliable distributed systems, throughout a system?s lifecycle, starting from fault-tolerant design and execution (replication, group communication, databases) to fault-recovery (fault-detection, logging, check-pointing, failure-diagnosis) for various classes of faults (crashes, communication errors, software upgrades). The course will cover real-world practices for reliability, supplemented by case studies of large-scale downtime incidents. The concepts will be taught in the context of contemporary cloud-computing platforms, and the course will include a hands-on project that involves the design, implementation and empirical evaluation of a reliable distributed cloud-based system. Students will be taught to write, review, and present a conference-style research paper by the end of the semester, with the goal of documenting the design, lessons learned and experimental results of their team project. Students can expect to learn about the reliability issues underlying cloud computing, the tools and best practices for implementing and evaluating reliability, and the strengths and weaknesses of current cloud-computing platforms from the perspective of reliability. Prerequisites: Graduate standing or instructor permission

Wireless Networks and Applications (18-750) – 12 Units

This course introduces fundamental concepts of wireless networks. The design of wireless networks is influenced heavily by how signals travel through space, so the course starts with an introduction to the wireless physical layer, presented in a way that is accessible to a broad range of students. The focus of the course is on wireless MAC concepts including CSMA, TDMA/FDMA, and CDMA. It also covers a broad range of wireless networking standards, and reviews important wireless network application areas (e.g., sensor networks, vehicular) and other applications of wireless technologies (e.g., GPS, RFID, sensing, etc.). Finally, we will touch on public policy issues,

e.g., as related to spectrum use. The course will specifically cover: Wireless networking challenges Wireless communication overview Wireless MAC concepts Overview of cellular standards and LTE Overview of wireless MAC protocols WiFi, bluetooth and personal area networks, etc. Wireless in today's Internet: TCP over wireless, mobility, security, etc. Advanced topics, e.g., mesh and vehicular networks, sensor networks, DTNs, localization, sensing, etc. Although students in 18-750 will share Lectures and Recitations with students in 18-452, they will receive distinct homework assignments and exams from students in 18-452. The main project will also be different. The students in the two version of the course will also be graded on a separate curve.

Applied Stochastic Processes (18-751) – 12 Units

Basic probability concepts : Probability space, simple and compound events, statistical independence, and Bayes Rule. Total Probability Concept; Bernoulli trials; Poisson Law. De Moivre-Laplace Theorem. Definition of a Random Variable (RV); Probability distribution of an RV: cumulative distribution function (CDF) and probability density function (PDF). Two Random Variables; several Random Variables. Functions of RV?s; conditional distributions; conditional expectations; joint distributions. Moments, generating functions, and characteristic functions of RVs. Chebyshev inequality. Estimation; linear estimation; minimum mean square estimation; and orthogonality principle. Limit theorems; Central Limit Theorem; Law of Large Numbers (both strong LLN and Weak LLN). Definition of a Random Process (RP). Different notions of stationarity. Poisson and Gaussian processes. Autocorrelation and Power Spectral Density (PSD) of an RP. Processing of random (stochastic) processes by linear systems. Ergodicity. Spectral analysis. Matched Filtering. Selected applications from telecommunications, data networking (queuing), Kalman filtering.

Estimation, Detection and Learning (18-752) – 12 Units

This course discusses estimation, detection, identification and machine learning, covering a variety of methods, from classical to modern. In detection, the topics covered include hypothesis testing, Neyman-Pearson detection, Bayesian classification and methods to combine classifiers. In estimation, the topics include maximum-likelihood and Bayesian estimation, regression, prediction and filtering, Monte Carlo methods and compressed sensing. In identification and machine learning, topics include Gaussian and low-dimensional models, learning with kernels, support vector machines, neural networks, deep learning, Markov models and graphical models.

Information Theory (18-753) – 12 Units

The first half of the course comprises of the concepts of entropy, mutual information, the Asymptotic Equipartition property, applications to source coding (data compression), applications to channel capacity (channel coding), differential entropy and its application to waveform channel capacities, and a subset of advanced topics such as network information theory, or rate-distortion theory, as time permits. The second half of the course comprises finite-field algebra, Hamming codes, cyclic codes (CRC and BCH codes), a brief introduction to Reed-Solomon codes, and perhaps universal codes (Lempel-Ziv coding). Prerequisites: 36-217 and senior or graduate standing.

Error Control Coding: Theory and Applications (18-754) – 12 Units
Modern digital communication systems and digital data storage systems owe their success, in part to the use of error control coding. By careful insertion of redundant bits or symbols in the transmitted or stored bit streams, the receiver can detect and correct errors induced by channel impairments such as noise, inter-symbol interference and noise. For example, compact disc (CD) owes its ruggedness to the use of cross-interleaved Reed-Solomon (CIRC) code. High-speed networks employ Cyclic Redundancy Check (CRC) to ensure that the data was transmitted accurately. This course is aimed at introducing the basic theory and select applications of error control coding (ECC). Towards that goal, following topics will be covered. Mathematical background Linear block codes Low density parity check (LDPC) codes Cyclic codes Reed-Solomon (RS) codes Convolutional codes Turbo codes Example application of ECC in digital communications Example application of ECC in digital data storage.

Networks in the Real World (18-755) – 12 Units
18-755 is a graduate-level course that focuses on networks and their applications to various natural and technological systems. Specifically, this class delves into the new science behind networks and their concrete applications technological, biological, and social systems, as well as various design synergies that exist when looking at these systems from a cyber-physical perspective. By scope and contents, this is not just another class on ?networks?. Want to know how complex networks dominate our world? How communities arise in social networks? How group behavior dominates Twitter? How swarms of bacteria can navigate inside the human body? How patterns of interaction can be identified in hardware and software systems? Want to work on cutting edge projects involving systems and synthetic biology? Or social networks? Or networks-on-chip and internet-of-things? Then this class is for you! Course requirements consist of a few homework assignments, a semester-long project, and in-class presentations of relevant papers. By structure and contents, this class targets primarily the computer engineering and computer science students, but it also provides a valuable foundation for interdisciplinary research to students in related disciplines. Senior or graduate standing standing is required to take this course.

Packet Switching and Computer Networks (18-756) – 12 Units
This course is designed to provide graduate students an understanding of the fundamental concepts in computer networks of the present and the future. In the past, the scarce and expensive resource in communication networks has been the bandwidth of transmission facilities. Accordingly, the techniques used for networking and switching have been chosen to optimize the efficient use of this resource. These techniques have differed according to the type of information carried: circuit switching for voice and packet switching for data. It is expected that elements of circuit and packet switching will be used in the integrated networks. This course focuses on packet switching for computer networks and protocol design. Topics in the course include: computer networks over-view; OSI layers, queuing theory; data link protocol; flow control; congestion control; routing; local area networks; transport layer. The current networks and applications will be introduced through the student seminars in the last weeks of the course. 4 hrs. lec. Prerequisites: 18-345 and senior or graduate standing.

Network Management and Control (18-757) – 12 Units
This course provides an understanding of the principles of broadband networks. The broadband networks differ from currently existing communication networks in many aspects and these issues will be dealt with in the course. Broadband networks are designed to support many different services, ranging from low bandwidth (telemetry) to high bandwidth applications (digitized video). The course will cover the underlying concepts of the broadband networks, and expose the research problems in next generation networks. Many concepts (ATM, SONET, MPLS, high-speed switching architecture, high-speed network control, unified control plane (GMPLS), and optical networks) will be discussed. The course project will explore latest network technologies, design networking systems, and evaluate via simulation techniques. 4 hrs. lec. Prerequisites: A course in probability; 18-756 and senior or graduate standing.

Wireless Communications (18-758) – 12 Units
In this course, the communication problem will be introduced, and channel impairments such as noise, inter-symbol interference and fading will be described. Solutions to combat these impairments, based on digital communication theory, will be described. These will include signal space analysis, detection, equalization, coding and diversity. Examples drawn from communication standards will illustrate how the theory is implemented in practical communication systems.

Wireless Networks (18-759) – 12 Units
In this course, we will do a quick review of wireless communications and networking principles which will be the basis of more advanced work and research. The emphasis will be on understanding the impact of mobility and connectivity that can be provided or supported by different wireless networks. To this end, wireless communications standards such as GSM (2G), 3G, 4G, and the ongoing work on 5G in addition to key wireless technologies such as Bluetooth, WiFi, Zigbee, RFID, and WiMax will be reviewed. Then, we will study the key papers in the following hot topics in wireless networking: 1) Ad Hoc Wireless Networks and Sensor Networks; 2) Self-organizing networks and adaptive complex networks; 3) Cognitive Networks; 4) Vehicular Ad Hoc Networks; 5) Social Networks; 6) The challenges of 5G wireless networks; 7) Internet of Things (IoT); 8) Role of Artificial Interference (AI) and Machine Learning (ML) in wireless networks.

VLSI CAD: Logic to Layout (18-760) – 12 Units
A large digital integrated circuit (IC) may require 100,000 lines of high-level description in a hardware modeling language, which then turns into 10,000,000 logic gates, which ultimately end up as 1 billion polygons on the masks that define the integrated circuit. This course describes in detail the important CAD tools that perform the many steps of the transformation from Boolean equations to fabrication masks. We focus on mathematical models, algorithms, and data structures. We will write programs for simple versions of these tools. We will look at, and experiment with, a few real tools. The course covers a review of Boolean algebra, followed by (i) synthesis tools for 2-level and multi-level logic, that transform Boolean equations and finite state machine descriptions into optimized logic, and (ii) verification tools that decide whether the logic

you built does the same thing as the specification you started with. Finally, the course covers geometric layout synthesis tools for component partitioning, placement, and wire routing and timing verification tools that determine if performance constraints are met. The CAD algorithms covered in the lectures are applicable not only to VLSI systems, but also to non-silicon applications (e.g., social computing, biology, financial).

Circuit Simulation: Theory and Practice (18-762) – 12 Units
This course explores the models, numerical methods and algorithms that are used for simulation and optimization of circuits. The course begins with coverage of the algorithms that are used in the ubiquitous SPICE program and its many variants. This is followed by an overview of the numerous analog and digital simulation techniques that have followed since the introduction of SPICE. The course further covers some of the most recent modeling and simulation work including, but not limited to, model order reduction, harmonic balance methods, nonlinear macromodeling, compact device modeling, and statistical timing analysis. Finally, the use of circuit simulation algorithms for non-circuit problems will be explored. 4 hrs. lec.

Digital System Testing and Testable Design (18-675) – 12 Units
For this course, time- and topic-indexed videos of lecture, homework, projects, etc. will be available from the online learning portal/website. In addition to these resources, two 1-hour live sessions are scheduled per week for recitation. Each student is strongly urged to attend one of these two sessions each week, either remotely or in the classroom on the Carnegie-Mellon Pittsburgh campus. This course examines in depth the theory and practice of fault analysis, test generation, and design for testability for digital ICs and systems. The topics to be covered include circuit and system modeling; fault sources and types; the single stuck-line (SSL), delay, and functional fault models; fault simulation methods; automatic test pattern generation (ATPG) algorithms for combinational and sequential circuits, including the D-algorithm, PODEM, FAN, and the genetic algorithm; testability measures; design-for-testability; scan design; test compression methods; logic-level diagnosis; built-in self-testing (BIST); VLSI testing issues; and processor and memory testing. Advance research issues, including topics on MEMS and mixed-signal testing are also discussed. 4 hours of lecture per week Prerequisites: 18-240 and 15-211 and (18-340 or 18-341) Senior or graduate standing required.

Linear Systems (18-771) – 12 Units
A modern approach to the analysis and engineering applications of linear systems. Modeling and linearization of multi-input-- multi-output dynamic physical systems. State-variable and transfer function matrices. Emphasis on linear and matrix algebra. Numerical matrix algebra and computational issues in solving systems of linear algebraic equations, singular value decomposition, eigenvalue-eigenvector and least-squares problems. Analytical and numerical solutions of systems of differential and difference equations. Structural properties of linear dynamic physical systems, including controllability, observability and stability. Canonical realizations, linear state-variable feedback controller and asymptotic observer design. Design and computer applications to electronic circuits, control engineering, dynamics and signal processing. 4 hrs. lec. Pre-Reqs: 18-470 or 18-474 and Graduate standing in CIT or MCS.

Non Linear Control (18-776) – 12 Units

This course provides an introduction to the analysis and design of nonlinear systems and nonlinear control systems; stability analysis using Lyapunov, input-output and asymptotic methods; and design of stabilizing controllers using a variety of methods selected from linearization, vibrational control, sliding modes, feedback linearization and geometric control. 4 hrs. lec.

Complex Large-Scale Dynamic Systems (18-777) – 12 Units
This course is motivated by the ever-growing complexity of man-made dynamic systems and the need for flexible monitoring, operations and design techniques for such systems. Of particular interest are systematic model-based methods for relating the key real-life problems for such systems and the state-of-the-art techniques for large-scale dynamic systems. Examples of such real-life complex systems are critical man-made infrastructure systems (electric power systems, gas networks, transport industries, data networks, and their interdependencies) as well as large-scale systems on chips. In this course we will first review the traditional large-scale methods for model simplification (aggregation), time scale separation of sub-processes and singular perturbation techniques to account for these, stability analysis, and estimation and control. In the second, novel part of this course, we recognize the highly interactive nature of the evolving complex systems, in which much monitoring, data gathering, and decision making is made at the lower, physical levels of the system, and some coordination exists at the higher system level at which physical layers interact. Several conceptual challenges are posed for minimal coordination of such decision makers under high uncertainties, in order to have predictable performance. These concepts will be illustrated using the same man-made network systems of interest introduced at the beginning of the course. Requirements: Some background in dynamic systems is highly desirable. Students interested in large-scale real-life complex systems, their relation to the state-of-the-art methods available and new research challenges will gain from taking this course. 4 hrs lec. Prerequisites: senior or graduate standing.

Speech Recognition and Understanding (18-781) – 12 Units
The technology to allow humans to communicate by speech with machines or by which machines can understand when humans communicate with each other is rapidly maturing. This course provides an introduction to the theoretical tools as well as the experimental practice that has made the field what it is today. We will cover theoretical foundations, essential algorithms, major approaches, experimental strategies and current state-of-the-art systems and will introduce the participants to ongoing work in representation, algorithms and interface design. This course is suitable for graduate students with some background in computer science and electrical engineering, as well as for advanced undergraduates. Prerequisites: Sound mathematical background, knowledge of basic statistics, good computing skills. No prior experience with speech recognition is necessary. This course is primarily for graduate students in LTI, CS, Robotics, ECE, Psychology, or Computational Linguistics. Others by prior permission of instructor.

Machine Learning (18-782) – 12 Units
Machine Learning is a foundational discipline of the Information Sciences. It combines elements from Mathematics, Computer Science, and Statistics with applications in Biology, Physics, Engineering and any other area where automated prediction is necessary. The aim of the course

is to present some of the topics which are at the core of modern Machine Learning, from fundamentals to state-of-the-art methods. Emphasis will be put both on the essential theory and on practical examples and lab projects. Each exercise has been carefully chosen to reinforce concepts explained in the lectures or to develop and generalize them in significant ways. This course is directed both at students without previous knowledge in Machine Learning, and at those wishing to broaden their expertise in this area. The course assumes some basic knowledge of probability theory and linear algebra. Nevertheless, the first module of the course will revisit these topics. Students are also expected to have knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program. Students who have already taken CS 10-701/15-781 or ECE 18-697 should not take this course.

Data, Inference, and Applied Machine Learning (18-785) – 12 Units

Please see the ECE website https://www.ece.cmu.edu/ for more information. This course will provide the methods and skills required to utilize data and quantitative models to automate predictive analytics and make improved decisions. From descriptive statistics to data analysis to machine learning the course will demonstrate the process of collecting, cleaning, interpreting, transforming, exploring, analyzing and modeling data with the goal of extracting information, communicating insights and supporting decision-making. The advantages and disadvantages of linear, nonlinear, parametric, nonparametric and ensemble methods will be discussed while exploring the challenges of both supervised and unsupervised learning. The importance of quantifying uncertainty, statistical hypothesis testing and communicating confidence in model results will be emphasized. The advantages of using visualization techniques to explore the data and communicate the outcomes will be highlighted throughout. Applications will include visualization, clustering, ranking, pattern recognition, anomaly detection, data mining, classification, regression, forecasting and risk analysis. Participants will obtain hands-on experience during project assignments that utilize publicly available datasets and address practical challenges.

Wavelets and Multiresolution Techniques (18-790) – 12 Units

The goal of this course is to expose students to multiresolution signal processing methods and their use in real applications as well as to guide them through the steps of the research process. All the necessary mathematical tools are introduced with an emphasis on extending Euclidean geometric insights to abstract signals; the course uses Hilbert space geometry to accomplish that. With this approach, fundamental concepts---such as properties of bases, Fourier representations, sampling, interpolation, approximation, and compression---are often unified across finite dimensions, discrete time, and continuous time, thus making it easier to focus on the few essential differences. The course covers signal representations on sequences, specifically local Fourier and wavelet bases and frames. It covers the two-channel filter bank in detail, and uses this signal-processing device as the implementation vehicle for all sequence representations that follow. The local Fourier and wavelet methods are presented side-by-side, without favoring any one in particular. Through the project, students will learn how to choose an appropriate representation and apply it to the specific problem at hand. There will be 2-3 hours of pre-recorded video per week that can be viewed online at any time. There will also be two 1-hour sessions in person that are not mandatory and can be viewed later online. The instructor will also

be available for meetings in person or online as needed. The total amount of work per week is expected to be around 12 hours on average Pre-requisite: 18-491. Students are expected to have a good background in basic engineering mathematics, signal processing and linear algebra. This course is cross listed with 42-732

Methods in Medical Image Analysis (18-791) – 12 Units
Students will gain theoretical and practical skills in medical image analysis, including skills relevant to general image analysis. The fundamentals of computational medical image analysis will be explored, leading to current research in applying geometry and statistics to segmentation, registration, visualization, and image understanding. Student will develop practical experience through projects using the National Library of Medicine Insight Toolkit (ITK), a popular open-source software library developed by a consortium of institutions including Carnegie Mellon University and the University of Pittsburgh. In addition to image analysis, the course will include interaction with clinicians at UPMC. It is possible that a few class lectures may be videoed for public distribution. Prerequisites: Knowledge of vector calculus, basic probability, and either C++ or python.

Advanced Digital Signal Processing (18-792) – 12 Units
This course will examine a number of advanced topics and applications in one-dimensional digital signal processing, with emphasis on optimal signal processing techniques. Topics will include modern spectral estimation, linear prediction, short-time Fourier analysis, adaptive filtering, plus selected topics in array processing and homomorphic signal processing, with applications in speech and music processing. 4 hrs. lec.

Image and Video Processing (18-793) – 12 Units
This course covers signal processing techniques specialized for handling 2D (images) and 3D (videos) signals. It builds upon 1D signal processing techniques developed in 18-290 and 18-491 and specializes them for the case of images and videos. In this class, you will learn fundamental tools and techniques for processing images and videos, and will learn to apply them to a range of practical applications. This course provides the fundamentals for studying images and videos. We will develop signal models specific to images and videos, develop associated optimization techniques for solving restoration problems like denoising, inpainting, study specialized compression algorithms. Specific focus will be on transform-domain, PDE and sparsity-based models and associated optimization techniques. These formal techniques will be enriched via applications in mobile devices, medical image processing, and compressive sensing.

Pattern Recognition Theory (18-794) – 12 Units
Decision theory, parameter estimation, density estimation, non-parametric techniques, supervised learning, linear discriminant functions, clustering, unsupervised learning, artificial neural networks, feature extraction, support vector machines, and pattern recognition applications (e.g., face recognition, fingerprint recognition, automatic target recognition, etc.). 4 hrs. lec. Prerequisites: 36-217, or equivalent introductory probability theory and random variables course and an introductory linear algebra course and senior or graduate standing.

Bioimage Informatics (18-795) – 12 Units

Bioimage Informatics (formerly Bioimaging) 12 units This course gives an overview of tools and tasks in various biological and biomedical imaging modalities, such as fluorescence microscopy, electron microscopy, magnetic resonance imaging, ultrasound and others. The major focus will be on automating and solving the fundamental tasks required for interpreting these images, including (but not restricted to) deconvolution, registration, segmentation, pattern recognition, and modeling, as well as tools needed to solve those tasks (such as Fourier and wavelet methods). The discussion of these topics will draw on approaches from many fields, including statistics, signal processing, and machine learning. As part of the course, students will be expected to complete an independent project. Prerequisites: 18-396 Signals and Systems

Machine Learning for Signal Processing (18-797) – 12 Units

Signal Processing is the science that deals with extraction of information from signals of various kinds. This has two distinct aspects -- characterization and categorization. Traditionally, signal characterization has been performed with mathematically-driven transforms, while categorization and classification are achieved using statistical tools. Machine learning aims to design algorithms that learn about the state of the world directly from data. A increasingly popular trend has been to develop and apply machine learning techniques to both aspects of signal processing, often blurring the distinction between the two. This course discusses the use of machine learning techniques to process signals. We cover a variety of topics, from data driven approaches for characterization of signals such as audio including speech, images and video, and machine learning methods for a variety of speech and image processing problems. Prerequisites: Linear Algebra, Basic Probability Theory, Signal Processing and Machine Learning. 18-797 is a cross listing of 11-755 offered by LTI.

Fundamentals of Semiconductors and Nanostructures (18-817) – 12 Units

This course is designed to provide students with a foundation of the physics required to understand nanometer-scale structures and to expose them to different aspects of on-going research in nanoscience and nanotechnology. Illustrative examples will be drawn from the area of semiconductor nanostructures, including their applications in novel and next-generation electronic, photonic, and sensing devices. The course begins with a review of basic concepts in quantum physics (wave-particle duality, Schrödinger's equation, particle-in-a-box, approximation methods in quantum mechanics, etc.) and then continues with a discussion of bulk three-dimensional solids (band structure, density of states, the single-electron effective-mass approximation). Size effects due to nanometer-scale spatial localization are then discussed within a quantum-confinement model in one-, two-, and three- dimensions for electrons. An analogous discussion for photons is also presented. The basic electronic, optical, and mechanical properties of the low-dimensional nanostructures are then discussed. A select number of applications in electronics, photonics, biology, chemistry, and bio-engineering will be discussed to illustrate the range of utility of nanostructures. Upon completion of the course, students will have an appreciation and an understanding of some of the fundamental concepts in nanoscience and nanotechnology. The course is suitable for first-year graduate students in engineering and science (but advanced undergraduates with appropriate backgrounds may also take it with permission from the instructor). Prerequisites: 09-511, 09-701, 09-702, 18-303, 18-310, 18-

402, 27-770, 33-225, 33-234 or familiarity with the material or basic concepts covered in these courses and senior or graduate standing.

Mobile and Pervasive Computing (18-843) – 12 Units
This is a course exploring research issues in the newly emerging field of mobile computing. Many traditional areas of computer science and computer engineering are impacted by the constraints and demands of mobility. Examples include network protocols, power management, user interfaces, file access, ergonomics, and security. This will be an "advanced" course in the truest sense --- most, if not all, the topics discussed will be ones where there is little consensus in the research community on the best approaches. The course will also offer significant "hand-on" experience in this area. Each student will have to present and lead the discussion on a number of papers. Students will work in groups of three under the guidance of a mentor on a hands-on project. Each student will also be required to write one of two documents: (a) a research proposal (similar in spirit to an NSF proposal) on an idea in mobile computing or (b) a short business plan for a commercial opportunity in mobile computing. Grading will be based on the quality of the presentations, the project, and the proposal or business plan. Prerequisites: 15-410 and senior or graduate standing.

Internet Services (18-845) – 12 Units
This course investigates the issues involved in providing scalable and highly available network services over the best-effort Internet. Examples of such services include Web servers, application servers, search engines, proxy caches, online auction systems, and remote visualization. Topics include network programming, server design, clustering, caching, proxies, remote execution, resource naming, discovery, and monitoring, and wide-area metacomputing. The course consists of lectures on existing technology, student presentations of research papers, and a project where students design and implement a significant network service.

Wireless Systems Design Experience (18-846) – 12 Units
This project-oriented course is the culmination of the MS ECE Wireless Systems Concentration. It provides third-semester students with a design experience that brings together concepts from the Wireless Systems core to solve a real-world problem.
The class organizes the students as a design team to build an outdoor system for distributed sensing of physical quantities, wireless connectivity to a data repository, and analysis and presentation of the data. The specific problem domains (e.g., pavement-mounted traffic sensors, sensors for overland water flow, soil moisture, or stream height) are selected to present specific challenges in wireless connectivity, low-power operation, distributed synchronization, federation of dissimilar sensor types, real-time computation, and information presentation. The instructors and project sponsors (customers) will guide the students in developing an understanding of the problem domain (environment and requirements) and selecting suitable technologies for addressing the challenges specific to it, creating and documenting a system architecture with verifiable interfaces, decomposing the architecture into sub-problems that sub-groups of students can address, integrating the results into a single system, and verifying system performance against the documented requirements. Consistent with the Wireless Systems

concentration methodologies, student work will be organized around fixed-length sprints followed by an evaluation of progress with the customer and instructors.

Upon completion of this course, the student will be able to: generate systems specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of wirelessly-connected subsystems; use power and RF modeling tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application.

Engineering and Economics of Electric Energy Systems (18-875) – 12 Units
The course has two parts. The first part introduces basic components and networks used in the electric power industry. This is followed by systematic modeling of these components, as well as of the entire system. Methods for modeling and analyzing both system equilibria and dynamics are presented. Simulations and lab demos are given to simulate and analyze typical system blackouts. This is followed by introducing decision and control methods for preventing these problems, as well as for managing the system more reliably, securely and efficiently over broad ranges of its operating conditions. The emphasis is on IT, software and control (both distributed and coordination) for achieving pre-specified system performance. This part of the course will involve simulation demos and hands on studies in which students create their own power network, simulate it and assess for performance. The second part of the course will review the industry structure, the experience with deregulatio n, and economic issues concerning choice of generating fuel and technology, the costs of blackouts, and environmental discharges. The course will integrate engineering and economic aspects to examine the design, investment, and operations that satisfy public desires for low cost, nonpolluting, reliable, and secure power. Knowledge of basic electric circuits and/or basic economics is assumed. 3 hrs. lec., 1 hr. rec. Prerequisites: Basic electric circuits and/or basic economics and at least graduate standing.

M.S. Graduate Project (18-980) – Variable Units
Master's level research.

Introduction to Graduate Studies (18-989) – 1 Unit
The Introduction to Graduate Studies course is designed to increase awareness and understanding of academic integrity issues, Carnegie Mellon community standards and the ethical job search. This is done via various sessions/modules that are already offered via several entities throughout campus (such as the CPDC, ICC, and GCC). Topics covered include: paraphrasing and citation, participating in the US classroom, avoiding plagiarism, unconscious bias, combating sexual violence on campus, finding jobs and internships, negotiation, communication, relationship building and other topics of interest. The course culminates in students writing a reflection paper. For international students, the paper should compare western academic and cultural standards to those of their home country. For domestic students, the paper should be a reflection on CMU's community standards. Active participation in various sessions/modules in the above mentioned areas and the submission of the reflection paper will determine a pass/fail grade.

Internship for Electrical and Computer Engineering MS Students (18-994) – 3 Units

The Department of Electrical and Computer Engineering considers experiential learning opportunities important educational options for its graduate students. One such option is an internship, normally completed during the summer. The ECE Graduate Office will add the course to the student's schedule. This process should be used by any Electrical and Computer Engineering graduate student wishing to have their internship experience reflected on their official University transcript. International students should also be authorized by the Office of International Education (OIE). Completion of written assignments and requirements will determine the letter grade for the course. Prerequisites: Graduate standing in ECE

APPENDIX D: ADDITIONAL INFORMATION ON FEDERAL AND STATE AID / FINANCIAL AID POLICIES

Carnegie Mellon University Consumer Information

Below is a summary of consumer information made available to all Carnegie Mellon University prospective and current students as required by the Higher Education Act of 1965, as amended. Required Disclosure have been categorized into five topics. Each disclosure gives a brief description of information that is required to be disclosed and explains how it can be obtained. This information may be changed from time to time as required.

If you need assistance or would like a paper copy, contact the Student Financial Aid Office, 5000 Forbes Avenue, Warner Hall, Pittsburgh, PA. If you wish to speak with a representative about the information contained here, please contact Associate Director Catherine Demchak at (412) 268-1353.

Information about the Institution:

Accreditation Information

Carnegie Mellon University is accredited by the Middle States Commission on Higher Education (MSCHE), 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104 (www.msche.org). The Commission may be contacted by telephone at 267-284-5000 or via email at info@msche.org or espanolinfo@msche.org (Spanish/Español). The university's current "Statement of Accreditation Status" can be found at, https://www.msche.org/institution/.

State Approvals

Carnegie Mellon University is licensed to operate in the states listed below. Individuals may contact the relevant agency for more information or information about how to file a complaint.

California

Bureau for Private Postsecondary Education
1747 North Market Blvd, Suite 225,
Sacramento, CA 95834
Telephone: (916) 574-8900
Email: bppe@dca.ca.gov
Website: www.bppe.ca.gov

New York

New York State Education Department
Office of Higher Education
Room 977 Education Building Annex
Albany, NY 12234
Telephone: 518-486-3633
Email: hedepcom@nysed.gov
Website: www.highered.nysed.gov

Pennsylvania

Pennsylvania Department of Education
Office of Postsecondary and Higher Education
333 Market Street, 12th Floor
Harrisburg, PA 17126-0333
Telephone: 717-783-8228
Email: ra-collunivseminfo@pa.gov
Website: www.education.state.pa.us

Washington, D.C.

Office of the State Superintendent of Education
Government of the District of Columbia
810 First Street NE 9th Floor
Washington, DC 20002
Telephone: 202-727-6436
Email: osse@dc.gov
Website: osse.dc.gov

Inquiries regarding the university's accreditation status or authorization to operate in any of the above states may be directed to: Associate Vice President / Director of Enrollment Services, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh PA 15213, telephone: 412-268-5399, email: krieg@andrew.cmu.edu.

Distance Education, State Authorization and Reciprocity Agreement (SARA)

The State Authorization Reciprocity Agreement (SARA) is an agreement among member states, districts, and territories in the United States, which establishes national standards for interstate offering of postsecondary distance education courses and programs. It is intended to standardize the process of offering online courses and programs by postsecondary institutions located in states other than the state in which the enrolled student(s) are residing. SARA is overseen by a national council (NC-SARA) and administered by four regional education compacts.

Carnegie Mellon University has been approved by the Commonwealth of Pennsylvania to participate in NC-SARA and was accepted as a SARA institution on May 2, 2017; additionally, Carnegie Mellon secured approval through NC-SARA on May 18, 2017. Carnegie Mellon University is listed as an approved, participating institution on the NC-SARA website (http://www.nc-sara.org/). At this time, 49 of the 50 United States are SARA members. California is not a member of SARA; however, Carnegie Mellon is able to offer online education to California residents.

Except where prohibited by applicable law, students who reside outside of the United States generally are not restricted from enrolling in our online programs. Some online programs do require in-person attendance at one of Carnegie Mellon's teaching locations (e.g., Carnegie Mellon's Pittsburgh, Pennsylvania campus) for short portions of the program. Students interested in enrolling in a specific online program are encouraged to contact the person designated by the online program for questions about the program's requirements or enrollment.

Copyright Infringement Policies

Carnegie Mellon University takes copyright violation seriously. Besides raising awareness about copyright law, it takes appropriate action in support of enforcement as required by policy and law. United States copyright law (http://www.copyright.gov/) "protects the original works of authorship fixed in any tangible medium of expression, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device".

The University's Fair Use Policy (http://www.cmu.edu/policies/administrative-and-governance/fair-use.html) states that all members of the University must comply with US copyright law and it explains the fair use standards for using and duplicating copyrighted material. In addition, the policy prohibits the duplication of software for multiple uses, meeting the Digital Millennium Copyright Act (DMCA) (http://www.copyright.gov/legislation/dmca.pdf) requirements. The DMCA criminalizes the development or use of software that enables users to access material that is copyright protected. Furthermore, the Computing Policy (http://www.cmu.edu/policies/information-technology/computing.html) prohibits the distribution of copyright protected material via the University network or computer systems, unless the copyright owner grants permission.

The Higher Education Opportunity Act of 2008 (Public Law 110-315) Section 488, requires institutions of higher education to annually inform students that "unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject the students to civil and criminal liabilities". Carnegie Mellon does this by publication of a news article on Computing Services' website or via mass mail communication each semester. The law goes on to require institutions "to provide a summary of penalties for violation of Federal copyright laws, including disciplinary actions that are taken against students who engage in unauthorized distribution of copyrighted materials using the institution's information system." Copyright protected materials can include, but are not necessarily limited to:

Music

Movies or other videos

Literary works

Software

Digital images or libraries

Cost of Attending the University

Actual tuition and fee charges can be found on the Student Financial Services' website at https://www.cmu.edu/sfs/tuition/index.html.

For estimated books and supplies, room and board, and personal/miscellaneous expenses view the cost of attendance for the Graduate program at https://www.cmu.edu/sfs/tuition/graduate/index.html.

Descriptions of Academic Programs

Information on the university's graduate academic programs and degree offerings is available from the various schools/colleges and admitting offices. Links to those programs can be found at https://www.cmu.edu/academics/index.html.

Faculty

Information on the university's faculty and instructional personnel is available from individual schools/colleges. This information can be found on the university's academics website at https://www.cmu.edu/academics/index.html.

Facilities & Services for Disabled Students

The Office of Disability Resources provides responsive and reasonable accommodations to students who self-identify as having a disability, including physical, sensory, cognitive and emotional disabilities. If you would like to learn more about the services and accommodations provided by the Office of Disability Resources, visit their website at https://www.cmu.edu/disability-resources/students/. To discuss your accommodation needs, please email us at access@andrew.cmu.edu or call us at 412-268-6121 to set up an appointment.

Student Privacy & FERPA

One of the most significant changes a parent or guardian experiences in sending a student to college is the difference in privacy standards for educational records. Carnegie Mellon values the student's right to privacy. The university adheres to a federal law called the Family Educational Rights and Privacy Act (also called FERPA or the Buckley Amendment) that sets privacy standards for student educational records and requires institutions to publish a compliance statement, including a statement of related institutional policies. For more detailed information, view the university's brochure at https://www.cmu.edu/hub/privacy/ferpa-brochure.pdf.

Return to Title IV Funds Policy and Procedural Statement

Policy Reason

The U. S. Department of Education requires that the university determine the amount of Federal Title IV aid earned by a student who withdrawals of fails to complete the period of enrollment. The university must determine the earned and unearned portions of Title IV aid as of the date the student ceased attendance based on the amount of time the student spent in attendance. Up through the 60% point in the period of enrollment, a pro rata schedule is used to determine the amount of Title IV funds the student has earned at the time of withdrawal. After the 60% point in the period of enrollment, a student has earned 100% of the Title IV funds he or she was scheduled to receive. For a student who withdraws after the 60% point-in-time, there are no unearned funds. Federal regulations can be found at:

Federal Student Aid Handbook, Volume 5

Chapter 1 Withdrawals and the Return of Title IV Funds 34 CFR 668.22

Policy and Procedural Statement

At Carnegie Mellon Title IV funds are awarded to a student under the assumption that the student will attend school for the entire period for which the assistance is awarded. When a student withdraws, the student may no longer be eligible for the full amount of Title IV funds that the student was originally scheduled to receive.

If a recipient of Title IV grant or loan funds withdraws from a school after beginning attendance, the amount of Title IV grant or loan assistance earned by the student must be determined. If the amount disbursed to the student is greater than the amount the student earned, the unearned funds must be returned. If the amount disbursed to the student is less than the amount the student earned, and for which the student is otherwise eligible, he or she is eligible to receive a Post-withdrawal disbursement of the earned aid that was not received.

Carnegie Mellon determines the Withdrawal Date and Date of Determination to complete the return calculation. A student's withdrawal date and date of determination varies depending on the type of withdrawal. When a student provides official notification to Carnegie Mellon through the Student Leave of Absence and Withdrawal Process, the withdrawal is defined as official withdrawal. When the student does not complete the Student Leave of Absence and Withdrawal Process and no official notification is provided by the student it is considered an unofficial withdrawal.

Leave of Absence/Withdrawal Process

A student may leave Carnegie Mellon by either taking a leave of absence (leaving the university temporarily with the firm and stated intention of returning) or by withdrawing from the university (leaving the university with no intention of returning). Students choosing to take a leave of absence should first contact their academic advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon. A student deciding to leave the university should take the following steps:

- Complete a Leave of Absence or Withdrawal Form.
- The form must include all necessary signatures or the process will not be completed.
- Return the completed form to the University Registrar's Office, 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213.

Determination of Withdrawal Date

Official Withdrawals (Notification Provided by the Student)

Those withdrawals defined as official are processed in accordance with federal regulations. The Office of the Registrar provides information that identifies which students have processed a Student Leave of Absence and Withdrawal Form for each semester. This information includes the Date of Withdrawal, the Date of Determination, Withdrawal/Leave Status (LA, LS, & W2) and the semester of attendance. This information is maintained in the student’s academic file and in the university’s Student Information System.

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- Date the student began the withdrawal or leave of absence process;

- Date the student notified his or her home department;
- Date the student notified the associate dean of his or her college; or
- Date the student notified the dean of students.

Unofficial Withdrawal (No Official Notification Provided by the Student)

For a student who withdraws without providing notification to Carnegie Mellon, the institution determines the withdrawal date using defined criteria. This category of withdrawals includes students that drop out and students that do not earn a passing grade.

To identify the unofficial withdrawals the Registrar develops a preliminary list of students that did not complete the semester by reviewing the final student grade reports. The list includes all students with: a) semester units carried, b) 0 semester units passed, c) 0 quality points earned, and d) 0.0 QPA. The Registrar contacts the academic divisions about each student to determine if the student actually completed the semester and earned the grades (0.0) or failed to complete the semester and did not notify the University of their status.

For students who do not notify the University of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- The midpoint of the semester;
- The last date the student attended an academically-related activity such as an exam, Tutorial or study group, or the last day a student turned in a class assignment.

Date of Determination that the Student Withdrew

Carnegie Mellon is not required to take attendance and the Date of Determination that a student withdrew varies depending upon the type of withdrawal: Official or Unofficial.

For withdrawals where the student provided *Official Notification* the Date of Determination is: The student's withdrawal date, or the date of notification, whichever is later.

For withdrawals where the student did not provide *Official Notification* the Date of Determination is: The date the institution becomes aware the student has ceased attendance.

For a student who withdrawals without providing notification to the institution, the institution must determine the withdrawal date no later than 30 days after the end of the enrollment period.

Calculation of Earned Title IV Assistance

The withdrawal date is used to determine the point in time that the student is considered to have withdrawn so the percentage of the period of enrollment completed by the student can be determined. The percentage of Title IV aid earned is equal to the percentage of the period of enrollment completed.

The amount of Title IV federal aid earned by the student is determined on a pro-rata basis up to the end of 60% of the semester. If the student completed 30% of a term, 30% of the aid originally scheduled to be received would have been earned. Once a student has completed more than 60% of a term, all awarded aid (100%) has been earned. The percentage of federal aid earned

and the order in which the unearned aid is returned are defined by federal regulatory requirements.

The calculation of earned Title IV funds includes the following grant and loan funds if they were disbursed or could have been disbursed to the student for the period of enrollment for which the Return calculation is being performed:

- Pell Grant
- Iraq and Afghanistan Service Grant
- TEACH Grant (not available at Carnegie Mellon)
- FSEOG Grant
- Federal Direct Loan

Institutional Charges

Institutional charges are used to determine the portion of unearned Title IV aid that the school is responsible for returning. Carnegie Mellon ensures that all charges for tuition, fees, room and board, as well as all other applicable institutional charges are included in the return calculation. Institutional charges do not affect the amount of Title IV aid that a student earns when he or she withdraws.

The institutional charges used in the calculation usually are the charges that were initially assessed the student for the period of enrollment. Initial charges are only adjusted by those changes the institution made prior to the student's withdrawal (for example, for a change in enrollment status unrelated to the withdrawal). If, after a student withdraws, the institution changes the amount of institutional charges it is assessing a student, or decides to eliminate all institutional charges, those changes affect neither the charges nor aid earned in the calculation.

Return of Unearned Funds to Title IV

If the total amount of Title IV grant and/or loan assistance that was earned as of the withdrawal date is less than the amount that was disbursed to the student, the difference between the two amounts will be returned to the Title IV program(s) and no further disbursements will be made.

If a student has received excess funds, the College must return a portion of the excess equal to the lesser of the student's institutional charges multiplied by the unearned percentage of funds, or the entire amount of the excess funds.

The funds will be returned in the order below as prescribed by federal regulations, within 45 days from the date of determination that a student withdrew.

- Unsubsidized Federal Stafford Loans
- Subsidized Federal Stafford Loans
- Federal PLUS loans
- Federal Pell Grants
- Federal Supplemental Educational Opportunity Grants (FSEOG)

Post-Withdrawal Disbursements

If the total amounts of the Title IV grant and/or loan assistance earned as of the withdrawal date is more than the amount that was disbursed to the student, the difference between the two amounts will be treated as a post-withdrawal disbursement. In the event that there are outstanding charges on the student's account, Carnegie Mellon will credit the student's account for all or part of the amount of the post-withdrawal disbursement up to the amount of the allowable charges.

Any amount of a post-withdrawal disbursement that is not credited to a student's account will be offered to the student within 30 days of the date that the institution determined that the student withdrew. Upon receipt of a timely response from the student, the College will disburse the funds within 90 days of the date of determination of the student's withdrawal date.

Return of Title IV Funds – Withdrawals for Programs Offered in Modules

The return of Title IV funds for programs offered in modules is defined in a separate policy statement at Carnegie Mellon. This document is included as an addendum to the Carnegie Mellon University Return to Title IV Funds Policy and Procedural Statement (see below).

Policies and Procedures

Federal Student Aid Handbook, Volume 5, Chapter 2 Withdrawals and the Return of Title IV Funds

CFR 668.22 (a), (f) and (l)

Dear Colleague Letter GEN-11-14 July 2011

For all programs offered in modules, a student is a withdrawal for Title IV purposes if the student ceases attendance at any point prior to completing the payment period or period of enrollment (unless the institution has written confirmation from the student that that they will attend a module that begins later in the enrollment period).

The regulations require the institution to determine whether Title IV funds must be returned based on the number of days actually completed versus the number of days the student was scheduled to attend in the payment period. The regulations prevent students from enrolling in modules or compressed courses spanning the period, completing a portion of the period, and retaining all aid for the period.

A program is considered to be offered in modules if a course or courses in the program do not span the entire length of the payment period or period of enrollment. The rule impacts all programs offering courses shorter than an entire semester, including semester-based programs with a summer term consisting of two consecutive summer sessions.

The Student Financial Aid Office has established the following procedures associated with handling withdrawals from programs offered in modules. An Associate Director of Student Financial Aid has the primary responsibility for compliance and implementation of these regulatory requirements.

The institution will identify students enrolled for the summer session that are eligible for Title IV Aid.

- Pell eligible students are identified
- Students with summer loans are identified
- The period of enrollment and enrollment status will be identified for each student

All Leave/ Withdrawal Forms processed by the University Registrar's Office will be reviewed for the summer sessions to record the Withdrawal Date and Date of Determination to identify any student receiving federal funding.

The Student Financial Aid Office will identify any students that drop courses in the summer sessions.

- During Summer I this is standard procedure
- During Summer II this is reviewed after 10th day reporting
- Any additional dropped courses will be reviewed through the 60% enrollment period

Students who are identified as official withdrawals or that officially drop all courses in a session will be reviewed to determine the amount of federal financial aid earned. If a Return of Title IV aid is required, existing institutional procedures will be followed.

At the end of the enrollment period the institution will determine if any students are identified as 'unofficial withdrawals.' If a Return of Title IV aid is required, existing institutional procedures will be followed.

If a student does not begin courses in all sessions, a Return of Title IV aid may not be required, but other regulatory provisions concerning recalculation may apply.

If a student completes both courses in module one, but officially drops courses in module two while attending module one the student is not a withdrawal.

Since the enrollment is less than half time, the student is no longer eligible for the loan and the funds must be returned.

The following information obtained from the Federal Student Aid Handbook, Chapter 2, Withdrawals and the Return of Title IV Funds, will be used to determine whether a student enrolled in a series of modules is a withdrawal.

<u>How to determine whether a student in a program offered in modules has withdrawn</u>

Schools can determine whether a student enrolled in a series of modules is a withdrawal by asking the following questions.

1. *After beginning attendance in the payment period or period of enrollment, did the student cease to attend or fail to begin attendance in a course he or she was scheduled to attend?*

If the answer is no, this is not a withdrawal.

If the answer is yes, go to question 2.

2. *When the student ceased to attend or failed to begin attendance in a course he or she was scheduled to attend, was the student still attending any other courses?*

If the answer is yes, this is not a withdrawal; however other regulatory provisions concerning recalculation may apply.

If the answer is no, go to question 3.

3. *Did the student confirm attendance in a course in a module beginning later in the period (for non-term and nonstandard term programs, this must be no later than 45 calendar days after the end of the module the student ceased attending)?*

If the answer is yes, this is not a withdrawal, unless the student does not return.

If the answer is no, this is a withdrawal and the Return of Title IV Funds requirements apply.

Contact

Questions regarding this policy or its intent should be directed to the Student Financial Aid Office at 412-268-1353.

Satisfactory Academic Progress Policy and Procedural Statement

To be eligible for federal, state, and institutional financial aid, all students are required to maintain Satisfactory Academic Progress toward the completion of a degree. Each university determines its own policy in accordance with federal regulations set forth by the U. S. Department of Education regarding satisfactory progress standards to ensure student success. To maintain Satisfactory Academic Progress at Carnegie Mellon University, students must meet the following minimum standards for both of the qualitative (QPA) and quantitative (completion rate) measures:

Student Type	QPA (Qualitative)	Completion Rate (Quantitative)*
First Year Undergraduate	1.75	80%
Undergraduate Upper-class	2.00	80%
Heinz Graduate	3.00	80%
Other Graduate (excluding Tepper)	2.00	80%

**To calculate the completion rate, the cumulative number of completed units is divided by the cumulative number of units attempted. Advance Placement credits are excluded from both figures.*

In addition to the above mentioned Financial Aid Satisfactory Academic Progress standards, federal regulations require a student to complete their degree within a specified amount of time. The maximum timeframe cannot exceed 150 percent of the time published as needed for completion of the program.

Scope:

This policy applies to Federal aid including Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Work-Study, Federal Direct Loans, and Federal Direct PLUS Loan programs; state grant aid; and Carnegie Mellon institutional aid including grants, loans, and scholarships.

Federal regulations can be found at:

Federal Student Aid Handbook, Volume 1

Chapter 1 School Determined Requirements

34 CFR 668.16(e)

34 CFR 668.32(f)

34 CFR 668.34

Evaluation:

Carnegie Mellon evaluates all students for Financial Aid Satisfactory Academic Progress annually, at the end of the spring semester. Students that are included in the review are undergraduates, graduates, both full-time and part-time.

Courses that do not count toward a student's degree cannot be used to determine enrollment status for financial aid purposes. Carnegie Mellon will count transfer credit hours that are accepted toward a student's educational program as both attempted hours and completed hours. Advanced Placement Non-Degree and Non-Credit courses are not counted as units passed or attempted. When a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student's QPA. For financial aid eligibility, only one repeat per course is permitted in the determination of enrollment status for courses previously passed.

If the student withdraws and is not assigned a W grade, then it will not be counted in the number of units attempted or completed. If the W grade is assigned, the units will be counted in the number of units attempted and will be counted as zero in the number of units completed.

If the student has incomplete units, the units will be counted as attempted and will be counted as zero in the number of units completed.

The Financial Aid Satisfactory Academic Progress evaluation is a cumulative review of all semesters, regardless of whether or not the student received financial aid during the academic year.

If the minimum requirements are not achieved, the student is ineligible to receive financial aid. In such a case, the student is notified and given an option to appeal their financial aid status. More information about the appeal process can be found at www.cmu.edu/sfs/docs/federal-title-iv.pdf.

A financial aid package will not be completed unless an appeal is received, approved and processed accordingly. If by chance a financial aid package is processed and released to the student, it is conditional and subjected to financial aid removal until an appeal is received, approved and processed accordingly.

Contact:

Accountable Department: Enrollment Services, Student Financial Aid. Questions regarding this policy or its intent should be directed to the Student Financial Aid Office, phone: 412-268-1353.

Student Body Diversity

For Information about the diversity of the university student body, contact the Institutional Research and Analysis Office, https://www.cmu.edu/ira/index.html.

For information about the University's Diversity, Equity and Inclusion initiative, visit the Center for Student Diversity and Inclusion's website at https://www.cmu.edu/student-diversity/.

Written Arrangement Information

A U.S. Department of Education regulation requires disclosure of specific information to prospective and current students regarding written arrangements between Carnegie Mellon University (CMU) and any institution(s) that provides a portion of an educational program to students enrolled at CMU. CMU enters into such arrangements to enrich the educational experiences offered to its students. In accordance with the regulation, CMU provides this information at http://www.cmu.edu/hub/consumer-information/docs/written-arrangement.pdf.

Student Complaints & Consumer Information by State

As required for compliance with U.S. Federal Program Integrity Regulations, state official/agency contact information for each U.S. state/territory that could handle a student's complaint is provided at https://www.cmu.edu/hub/consumer-information/docs/complaints.pdf.

Gainful Employment Disclosures

As required by U.S. Department of Education regulations Gainful Employment Disclosures (Disclosures about CMU certificate programs that prepare students for specific occupations) can be found at https://www.cmu.edu/hub/consumer-information/.

Information about Student Financial Aid:

Meeting the cost of higher education is a significant investment. We are committed to providing a comprehensive financial aid program that makes it possible for admitted students to attend Carnegie Mellon.

Application Process & Timeline:

Graduate Students: **To apply for financial aid for the 2019-2020 academic year, follow the steps below.**

Free Application for Federal Student Aid (FAFSA)

The FAFSA is required if applying for federal financial aid programs. There are now two ways to complete the *Free Application for Federal Student Aid (FAFSA)* form: a redesigned https://studentaid.ed.gov/sa/fafsa website or a mobile app (available through Google Play, https://play.google.com/store/apps/details?id=com.fsa.mystudentaid or the Apple App Store, https://itunes.apple.com/us/app/mystudentaid/id1414539145.

We recommend using the IRS Data Retrieval Tool (DRT) (https://studentaid.ed.gov/sa/resources/irs-drt-text) to complete the FAFSA. The DRT transfer process has been improved to include stronger security and privacy protections; therefore, tax information transferred will not display on the form or Student Aid Report. Instead, the phrase "Transferred from the IRS" will appear in the fields.

Those selected for federal verification after FAFSA completion or those unable to use the IRS DRT will need to request an IRS Tax Return Transcript (https://www.irs.gov/individuals/get-transcript).

Additional information:

Apply as soon as possible after October 1.

Carnegie Mellon's federal code is 003242.

Use 2018 tax information to complete the FAFSA.

A Department of Education Federal Student Aid (FSA) ID is required. View FSA ID instructions at https://fsaid.ed.gov/npas/index.htm.

Students must complete the FAFSA's electronic signature requirement.

MPN & Entrance Counseling

All first-time Federal Direct Loan borrowers are required to complete entrance counseling. The entrance counseling session provides information about borrower rights and responsibilities. CMU will be notified when a student has completed online entrance counseling. Funds will not be disbursed until the entrance counseling session has been completed. Students who completed a federal entrance counseling session while at CMU, do not have to complete another session.

Additional information:

View entrance counseling instructions (https://www.cmu.edu/sfs/financial-aid/types/federal-loans/direct/mpn-entrance-counseling.html).

Complete entrance counseling session at https://studentloans.gov.

Grad PLUS Loan

If you plan on borrowing a Federal Direct Graduate PLUS Loan, this is a two-part process and both parts must be completed in order for your loan to be originated. If you borrowed a Grad PLUS Loan last academic year, you are only required to complete the application portion of the process. The application portion of the process cannot be completed before June 1, 2019.

Additional information:

View detailed Grad PLUS Loan instructions at https://www.cmu.edu/sfs/financial-aid/types/federal-loans/plus/instructions.html.

The two-part process may be completed at https://studentloans.gov.

Financial Aid Eligibility Notification

Once a student completes all of the steps above, a financial aid package will be determined. The Student Financial Aid Office will notify the student by email that a financial aid award letter has been posted to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home). The letter contains information and further instructions regarding the student's eligibility and awards. If a student's circumstances change, then financial aid eligibility will be re-evaluated and the student will receive notification that a revised award letter is available in SIO.

Missing Documents

If we are unable to process a student's financial aid package due to missing documents, a Financial Aid Alert email will be sent to the student requesting the required documents by a specified date. Until the entire application process is completed and all required documents are submitted, our office may be unable to complete a student's financial aid package. Students may log in to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home) to view documents that have been received by our office. View instructions for submitting missing documents at https://www.cmu.edu/sfs/financial-aid/missing-documents/index.html.

Teacher Certification

Teacher certification students at the graduate level should be aware that federal regulations classify them as a grade level 5 undergraduate student for Federal Direct Student Loan purposes. Teacher certification students are, however, considered a graduate student by Carnegie Mellon for academic purposes.

Available Financial Aid

Scholarships & Grants

Graduate Students:

Graduate students interested in scholarships and grants may contact their program of interest or department. View more information on the Graduate Education Office website, http://www.cmu.edu/graduate/prospective-students/index.html. In addition, the Fellowships & Scholarships Office (http://www.cmu.edu/fso/) provides support to graduate students interesting in pursing certain external scholarships, like Fulbright and UK Awards.

Federal Work-Study

Federal Work-Study (FWS) is a need-based self-help award. If a student has been awarded FWS, the FWS award is the total that can be earned during the academic year as a work-study student.

Federal Loans

For many students and families, educational loans are a necessary part of the process of paying for college. Student Financial Aid certifies loans for students, as well as Federal Direct Parent PLUS Loans for parents of undergraduates and Federal Direct Grad PLUS Loans for graduate students.

Federal Direct Student Loan

The Federal Direct Student Loan is the most widely-used loan for college students and is available to both undergraduate and graduate students. There are two types of Federal Direct Student Loans, subsidized and unsubsidized, and eligibility for both is determined by completing the FAFSA.

Grad PLUS Loan

Eligible graduate students may borrow a Federal Direct Grad PLUS Loan to assist with educational expenses. Students may borrow any amount up to their calculated cost of attendance minus any other aid received.

Private Loans

Private loan programs offer competitive interest rates and borrower benefits. To increase chances of approval and possibly improve the rate you receive, students are strongly recommended to apply with a creditworthy co-signer.

Student Outcomes

Retention and Graduation Rates

Institutional Research and Analysis Office offers up-to-date data on degrees conferred, enrollment reports, freshmen retention rates and race and ethnicity reports for annual degrees. Retention and Graduation rates can be found at https://www.cmu.edu/ira/retentiongradrates.html.

Intercollegiate Athletic Program Participation Rates and Financial Support Data (Equity in Athletics Disclosure Act)

Please visit the U.S. Department of Education's site, The Equity in Athletics Data Analysis (http://ope.ed.gov/athletics/#/) and select the "Get data for one schools" option. Enter "Carnegie Mellon University" in the "Name" field and select the "Continue" button at the bottom of the page.

A printed copy of the report can be requested by calling the Department of Athletics, Physical Education, and Recreation at 412-268-8054 or by sending an email to Josh Centor, Associate Vice President for Student Affairs and Director of Athletics, Physical Education & Recreation, at jcentor@andrew.cmu.edu.

Health and Safety

Drug and Alcohol Abuse Prevention Program

Under the Drug Free Workplace Act of 1988 and the Drug Free Schools and Campuses Act of 1989, the Carnegie Mellon University is required to have an alcohol and other drug policy outlining prevention, education and intervention efforts and consequences for policy violations. The policy can be found at https://www.cmu.edu/policies/administrative-and-governance/alcohol-and-drug-policy.html.

CMU Annual Security and Fire Safety Report

A printed copy of the report can be requested by contacting University Police at 412-268-6232 or campuspd@andrew.cmu.edu.

The annual security and fire safety report (Carnegie Mellon University Police Department Annual Reports) is also available online at http://www.cmu.edu/police/security-fire-reports/index.html.

Vaccination Policies

CMU Prematriculation Immunization Policy can be found at http://www.cmu.edu/policies/student-and-student-life/immunizations.html.

CMU University Health Services Health Requirements for Incoming Students can be found at https://www.cmu.edu/health-services/new-students/.

Other Information

Voter Registration

Please visit http://www.usa.gov/Citizen/Topics/Voting/Register.shtml.

Carnegie Mellon Ethics Hotline

The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to financial matters, academic and student life, human relations, health and campus safety or research.

Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net (user name: tartans; password: plaid). All submissions will be reported to appropriate university personnel.

The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state, or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the vice president for campus affairs, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Obtain general information about Carnegie Mellon University by calling 412-268-2000.

APPENDIX E: ADDITIONAL INFORMATION ON COVID-19 EXCEPTIONS AND UPDATES

COVID-19 Related Updates

Pass/No Pass Policy – For Spring 2020 the university instituted a Pass/No Pass policy to allow passing grades to be converted to P/NP and still count towards degree requirements. All passing grades from Spring 2020 will be counted towards the ECE MS degree, but will not be factored into the students QPA.

Remote Courses – Due to the COVID-19 pandemic the rule where only one online class is allowed per semester was suspended for the 2020-2021 academic year.

Program Changes – Fall 2020 students were not required to elect their new program until after the semester began, though once they chose an ECE program, students are not allowed to switch to a new program at any time.

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5000 Forbes Avenue

Pittsburgh, PA 15213

www.ece.cmu.edu

@CMU_ECE

Electrical & Computer ENGINEERING

Electrical & Computer Engineering

2021-2022 Ph.D. Catalog/Handbook

ECE Office of Academic Affairs

 This handbook is posted to the ECE Ph.D. webpage prior to the start of each academic year and is updated as needed. This handbook is effective August 1, 2021 through July 31, 2022.

Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
(412) 268-2000
www.cmu.edu

Carnegie Mellon University – Silicon Valley
NASA Ames Research Park
Bldg. 23
P.O. Box 98
Moffett Field, CA 94035-0001
(650) 603-7032
www.cmu.edu/silicon-valley

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WELCOME TO ELECTRICAL AND COMPUTER ENGINEERING

Welcome to the Department of Electrical and Computer Engineering at Carnegie Mellon University. Since offering our first course in electrical engineering in 1908, our research and teaching has expanded to cover areas as broad as device sciences and nanotechnology, computer systems, data science, energy, control, communications, and circuits. The 2021 *US News and World Report* ranked our graduate programs in electrical engineering and computer engineering 8th and 5th in the nation, respectively, and we offer programs in Pittsburgh, Silicon Valley, Portugal, Thailand, and Africa.

Our distinguished faculty work closely with students to push the boundaries of technology and to shape the future of energy systems, bio-electronics, computing, data storage, and much more.

While this handbook and your CIT graduate student handbook are specific to your academic experience in the department, there are several other resources and offices graduate students are encouraged to consult during their tenure at Carnegie Mellon University. Information about The Word, the student handbook, the Office of Graduate and Postdoc Affairs, the Office of the Dean of Student Affairs and others are included in Appendix A of this handbook.

Please don't hesitate to contact us if you have any questions or comments.

Sincerely,

Larry Pileggi
Tanoto Professor and Department Head
Electrical and Computer Engineering

Core Values

The ECE Department has been a leader in both research and education for years; it is known for its innovative qualities, boldness of ideas, and unbridled enthusiasm. Our strategic plan is guided by our core values.

> **We value scientific truth, creativity, quality, innovation, and engineering solutions, all within a diverse and inclusive community guided by respect and joy of doing.**

Our core values form the foundation for what we do; we hold them to be intrinsically true. We believe in solving problems that have large societal impact; we also believe that to be successful, we must work within an environment of enthusiasm and openness, respect and integrity, and freedom to express and explore a variety of ideas.

Vision

Our vision is our guiding light; it informs and propels us in the right direction. The strategies of following that path change over time; the vision does not.

> **To be a creative driving force within the university and worldwide of highest scholarly and entrepreneurial quality.**

Mission and Objectives

The Carnegie Mellon University mission is:

To create a transformative educational experience for students focused on deep disciplinary knowledge; problem-solving; leadership, communication and interpersonal skills; and personal health and well-being.

To cultivate a transformative university community committed to (a) attracting and retaining diverse, world-class talent; (b) creating a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish; and (c) ensuring individuals can achieve their full potential.

To impact society in a transformative way - regionally, nationally and globally - by engaging with partners outside the traditional borders of the university campus.

The ECE Department mission is our “what, who, how”; it explains what we do, who we do it for, and how we do it so we engage the “hearts, heads, and hands” of our faculty, students, and staff in achieving our objectives.

> **To inspire, educate, and produce electrical and computer engineers capable of tackling fundamental scientific problems and important societal challenges, and to do so with the highest commitment to quality, integrity, and respect for others.**

We aim to be the best at what we do, to apply all our skills and knowledge to execute our vision. We educate young people to become engineers sought after by industry and academia alike; we do so in an environment imbued by enthusiasm and love for what we do, with respect and willingness to listen to each other, with freedom to express our ideas and look at challenges from different points of view. We strive to be the ECE department of choice for those who are willing to step off the beaten path, for the visionaries and dreamers.

Students in the ECE Ph.D. Program are provided a research-intensive study of the fundamentals of electrical or computer engineering. Students will create and disseminate knowledge of electrical and computer systems during the course of obtaining the Ph.D. degree. Upon enrollment in the department, students, with the help of a faculty advisor, define an education and research program that is consistent with their background and is best suited to their own academic goals.

INTRODUCTION

Graduate Degrees and Programs Offered

Master of Science in Electrical and Computer Engineering

- Pittsburgh
- Silicon Valley
- Africa

Master of Science in Software Engineering

- Silicon Valley

Doctor of Philosophy in Electrical and Computer Engineering

- Pittsburgh
- Silicon Valley
- Portugal

Please note: The instruction for all degrees and programs will occur in English.

Graduate Student Catalog/Handbook

This catalog/handbook is intended to set guidelines and expectations for new and current doctoral students in Electrical and Computer Engineering at Carnegie Mellon University. This catalog/handbook is not exhaustive and is subject to revision at any time by the ECE department. It covers Ph.D. students in Silicon Valley.

It is the responsibility of each student to read and understand the contents of this catalog/handbook.

This catalog/handbook, along with any revisions, will be posted and announced annually to the ECE website. Students with disabilities may request this catalog/handbook in other formats by contacting the Graduate Affairs Office.

CARNEGIE MELLON POLICIES, EXPECTATIONS, STATEMENT OF ASSURANCE, AND CODE

Carnegie Mellon Policies & Expectations

It is the responsibility of each member of the Carnegie Mellon community to be familiar with university policies and guidelines. In addition to this departmental graduate student catalog the following resources are available to assist you in understanding community expectations:

- The Word/Student Catalog
- Academic Integrity Website
- University Policies Website
- Graduate Education Website
- College of Engineering Website

- Please see Appendix A for additional information about The Word and University resources.

Carnegie Mellon Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the university ombudsman, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-1018. Obtain general information about Carnegie Mellon University by calling 412-268-2000.

Carnegie Mellon University publishes an annual campus security and fire safety report describing the university's security, alcohol and drug, sexual assault and fire safety policies, and containing statistics about the number and type of crimes committed on the campus, and the number and cause of fires in campus residence facilities during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The annual security and fire safety report also is available online at www.cmu.edu/police/annualreports.

Information regarding the application of Title IX, including to admission and employment decisions, the sexual misconduct grievance procedures and process, including how to file a report or a complaint of sex discrimination, how to file a report of sexual harassment, and how the university responds to such reports is available at www.cmu.edu/title-ix. The Title IX coordinator may be reached at 5000 Forbes Ave., 140 Cyert Hall, Pittsburgh, PA 15213; 412-268-7125; or tix@cmu.edu.

Carnegie Mellon Code

Students at Carnegie Mellon, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical and moral conduct possible. These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

As members of the Carnegie Mellon community, individuals are expected to uphold the standards of the community in addition to holding others accountable for said standards. It is rare that the life of a student in an academic community can be so private that it will not affect the community as a whole or that the above standards do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist. The commitment of its faculty, staff and students to these standards contributes to the high respect in which the Carnegie Mellon degree is held. Students must not destroy that respect

by their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from the University.

The Carnegie Mellon Code can also be found online.

Carnegie Mellon Child Protection Requirements

Carnegie Mellon is committed to providing a safe and secure environment for all minors involved in any programs or activities conducted on university premises, as well as any off-campus programs or activities sponsored by the university. Details are available through Leonard Gelfand Center Child Protection Operations.

If you have questions regarding Act 153 or encounter a situation when you would need to have the clearances, please contact Meighan at meighan.harding@ece.cmu.edu.

DEPARTMENTAL INFORMATION

University Personnel

Throughout your time in the M.S. program, you will encounter a variety of faculty and staff who will help you on your way to completing your degree. You may view a list of faculty (https://www.ece.cmu.edu/directory/faculty.html) and a list of staff (https://www.ece.cmu.edu/directory/staff.html) affiliated with ECE online. Below is a list of faculty and staff whom you are likely to encounter during your time in the M.S. program.

- Dean of the College of Engineering: Bill Sanders
- Associate Dean of Graduate and Faculty Affairs: Professor Shelley Anna
- Department Head: Professor Larry Pileggi
- Executive Assistant to the Department Head: Kimmy Nguyen
- Director, CMU Africa: Professor Vijayakumar Bhagavatula
- Associate Department Head for Research: Professor Shawn Blanton
- Associate Department Head for Academic Affairs: Professor James A. Bain
- Associate Department Head for Students: Professor Dave O'Halloran
- Director of Finance and Sponsored Research: Charlotte Ambrass
- Academic Services Manager: Megan Oliver
- Director of Graduate Affairs: Tara Moe
- Student Organizations Advisor in Silicon Valley: Brittany Bristoll
- Ph.D./M.S. Academic Program Advisor in Silicon Valley: Brittany Bristoll

A general list of contacts (https://www.ece.cmu.edu/about/contact.html) can also be found on the ECE website.

University Resources

Stellic Degree Audit

Each student has access to Stellic Degree Audit Application which includes degree planning tools can show how courses taken or registered for meet the degree requirements. Students should

also meet with their academic advisor to review how their courses have been applied to the degree requirements.

University Resource Websites

Several pertinent university policies are included in this handbook, primarily found in the University Policies section. The complete university policies are available online at the following link: http://www.cmu.edu/policies.

Additional assistance is available in understanding community expectations, with the following resources being particularly relevant to ECE students:

- The Office of the Assistant Vice Provost for Graduate Education. Website: www.cmu.edu/graduate. Email: grad-ed@cmu.edu
- The Office of the Dean of Student Affairs. Website: www.cmu.edu/student-affairs/index.html
- Student Services in Silicon Valley. Website: http://sv.cmu.edu/student-services/index.html.
- Assistance for Individuals with Disabilities. Contact Larry Powell, Equal Opportunity Services, 412-268-2013, lpowell@andrew.cmu.edu
- Eberly Center for Teaching Excellence. Website: www.cmu.edu/teaching
- Graduate Student Assembly. Website: http://www.cmu.edu/stugov/gsa/index.html
- Intercultural Communication Center. Website: www.cmu.edu/icc
- Office of International Education. Website: https://www.cmu.edu/oie/
- Counseling & Psychological Service (CaPS). Website: https://www.cmu.edu/counseling/
- University Health Services. Website: www.cmu.edu/HealthServices
- University Police. Website: www.cmu.edu/police
- The Word (student online handbook). Website: http://www.cmu.edu/student-affairs/theword
- Academic Integrity Website: https://www.cmu.edu/student-affairs/ocsi/academic-integrity/index.html
- University Policies Website: www.cmu.edu/policies/

Please refer to Appendix A for additional information about each of the above-cited resources.

University Library

Pittsburgh campus

Students in Pittsburgh have access to several on-campus libraries. More information about the libraries can be found on the CMU Library website: https://www.library.cmu.edu

Silicon Valley campus

Library and Resources CMU-SV does not operate a library on campus, but we do have specialized library resources available for students, faculty, and staff. Resources include:

1. Interlibrary Loan
2. e-book developments
3. University Libraries Quick Links

Through the Interlibrary loan, students can request books, articles from journals and conferences, technical reports, or other materials to be sent to you. The materials may be from Carnegie Mellon libraries in the U.S. or other institutions worldwide. Electronic delivery for many articles is available. ILLiad is the system that our students use to request these items. What ILLiad can be used for:

- To request to borrow a book, a tech report, a thesis, copy of an article, etc.
- Check status of requests
- Edit requests
- Cancel requests
- Update your contact information or delivery preferences
- Request to renew an interlibrary loan

The ILLiad link can be found at https://illiad.library.cmu.edu/illiad/illiad.dll.

The first time you use the link you need to provide information about yourself. You only need to do this once. When completing the form, choose these options:

- For Mailing Address, state: Silicon Valley campus
- For Delivery Location, state: E&S Library

E-book developments can be found on our website at http://guides.library.cmu.edu/svc.

Since we have students, staff, and faculty in Pittsburgh, Qatar, Africa, and Silicon Valley, we're making a concerted effort to collect whatever e-Books we can so that all of our community can use them. You'll find them in CAMEO - our online catalog.

University Quick Links can also be found on the website at http://guides.library.cmu.edu/svc.

For additional questions regarding library resources, please contact Matt Marsteller, Head, CMU Science Libraries at matthewm@andrew.cmu.edu or by phone: 412-268-7212

Department Resources

Course Instructors

ECE courses are taught by world-renown educators and researchers.

Anupam Datta, Professor
Ph.D., Computer Science, Stanford University
Hakan Erdogmus, Teaching Professor
Ph.D., Telecommunications, Université du Québec
Manish Pandey, Adjunct Instructor/Professor
Ph.D., Computer Science, Carnegie Mellon University
Cecile Peraire, Associate Teaching Professor
Ph.D., Computer Science, Swiss Federal Institute of Technology
John Shen, Professor
Ph.D., Electrical Engineering, University of Southern California
Patrick Tague, Associate Research Professor
Ph.D., Electrical Engineering, University of Washington
Leonardo da Silva Souza, Assistant Teaching Professor
Ph.D., Computer Science, Pontifícia Universidade Católica do Rio de Janeiro
Pei Zhang, Associate Research Professor
Ph.D., Computer Engineering, Princeton University

Academic Advisors

Your academic advisor is a resource for having any university paperwork signed, asking questions regarding registration or the curriculum, and guiding you to other important resources. Nathan Snizaski and Brittany Reyes serve as the academic advisors for Ph.D. students.

Academic advising is done through the Graduate Affairs Office. In Pittsburgh this is in Hamerschlag Hall 1113; in Silicon Valley this is in B23 123. The Ph.D. Academic Program Advisor administratively advises all ECE Ph.D. students throughout the entire duration of the Ph.D. program. While this advisor does not provide content-specific expertise in ECE, he/she helps students navigate through the program by tracking milestones, meeting one on one and in groups with students for questions related to registration or the curriculum, guiding students to other important resources, completing enrollment and university-related paperwork, and answering questions for students who may not know where else to turn. Nathan Snizaski and Brittany Bristoll are the Academic Advisors for Ph.D. students.

Nathan can be reached by email: nathanedward@cmu.edu, by phone: (412) 268-3200, or in person in 1113 Hamerschlag Hall. To guarantee availability, you are encouraged to schedule an appointment with him by accessing his calendar in the signature block of his e-mail. Nathan advises Pittsburgh based Ph.D. and Portugal based students.

Brittany can be reached by email: bjreyes@andrew.cmu.edu, or by phone: (650) 603-0934. To guarantee availability, you are encouraged to schedule an appointment with her by accessing her calendar in the signature block of her e-mail. Brittany advises all Silicon Valley based Ph.D. students.

Faculty Advisors

Students also receive a faculty advisor. Faculty advisors help guide Ph.D. students through the program by ensuring that all students receive the necessary support and mentoring to succeed.

Faculty Credentials

For all faculty please visit the ECE faculty directory.

Faculty based in Silicon Valley and teaching in Silicon Valley:

Anupam Datta, Professor
Ph.D., Computer Science, Stanford University

Hakan Erdogmus, Teaching Professor
Ph.D., Telecommunications, Université du Québec

Manish Pandey, Adjunct Instructor/Professor
Ph.D., Computer Science, Carnegie Mellon University

Cecile Peraire, Associate Teaching Professor
Ph.D., Computer Science, Swiss Federal Institute of Technology

John Shen, Professor
Ph.D., Electrical Engineering, University of Southern California

Patrick Tague, Associate Research Professor
Ph.D., Electrical Engineering, University of Washington

Leonardo da Silva Souza, Assistant Teaching Professor
Ph.D., Computer Science, Pontifícia Universidade Católica do Rio de Janeiro

Pei Zhang, Associate Research Professor
Ph.D., Computer Engineering, Princeton University

Faculty based in Pittsburgh and broadcasting courses to Silicon Valley:

Lujo Bauer, Associate Professor
Ph.D., Computer Science, Princeton University

Franz Franchetti, Professor
Ph.D., Computational Mathematics, Vienna University of Technology

Saugata Ghose, Special Faculty Systems Scientist

Ph.D., Computer Systems, Cornell University

Virgil Gligor, Professor
Ph.D., Electrical Engineering and Computer Science, University of California at Berkeley

Limin Jia, Associate Research Professor
Ph.D., Computer Science, Princeton University

Diana Marculescu, Professor
Ph.D., Computer Engineering, University of Southern California

Bill Nace, Teaching Professor
Ph.D., Electrical and Computer Engineering, Carnegie Mellon University

Aswin Sankarayaranan, Associate Professor
Ph.D., Electrical and Computer Engineering, University of Maryland

Vyas Sekar, Associate Professor
Ph.D., Computer Science, Carnegie Mellon University

Osman Yagan, Associate Research Professor
Ph.D., Electrical and Computer Engineering, University of Maryland

Matching

Within the first few weeks of entering ECE, most students are matched with faculty advisors using a "mutual match" process. During orientation, faculty from ECE's four areas give an overview of available research projects in order to help students find an advisor who aligns with his or her research interests. ECE's four research areas are:

- Circuits/CAD/VLSI
- Computer Systems
- Device Sciences and Nanofabrication
- Signals, Communications, and Controls

After the area overview, students are required to meet with all the faculty listed on their admission letter and are also welcome to meet with any other faculty member with an ECE affiliation. In addition to attending the orientation presentations, students can learn about an individual faculty member's research interests by viewing the faculty's member Curriculum Vitae and website (if available) and from meeting individually with different faculty members during the matching period.

Matching is done through a mutual matching process: students rank their top three [3] faculty preferences and faculty discusses their student preferences. A committee then matches each student with a faculty member, taking into consideration each of their preferences and other factors. Final matches will be communicated to students by the end of the first full month of enrollment.

Some programs have different matching processes. These variations are listed below.

Program	Matching Process
CMU | Portugal Dual Degree Program	CMU | Portugal dual degree students typically enter the program pre-matched based on recommendations from the Program Directors. One advisor will be from CMU and one advisor will be from the student's home institution in Portugal.
Silicon Valley	Silicon Valley students are generally directly matched with the faculty advisor listed on the admission letter. Silicon Valley students will still be expected to formalize this relationship by filling out the matching process survey.

Expectations

Faculty advisors are expected to help guide Ph.D. students through the program by ensuring that all students receive the necessary support and mentoring to succeed. Each relationship between a student and his or her faculty advisor is unique and tends to evolve over the course of the student's time in the Ph.D. program. It is the responsibility of both the student and his or her advisor to identify goals, plans, and criteria for success in the Ph.D. program.

Occasionally, students request to switch advisors. While this request must be approved by the Graduate Affairs Office, it is generally viewed as routine and is almost always granted. It is recommended that students pursue such switches early in the Ph.D. program so that their academic progress can continue as it is expected. To switch an advisor, a student must complete the Change of Advisor form.

Faculty advisors must have an ECE affiliation and be able to financially support the student for the duration of their studies.

Co-advisors

It is possible for students to have more than one advisor at the same time. Usually, co-advising is done when a student is pursuing a topic that is interdisciplinary in nature or that would benefit from the expertise of two faculty members. Both advisors must have an ECE affiliation to co-advise an ECE student.

Advisor Departure

In case of advisor departure from CMU, Ph.D. students have the following options:

- Remain with advisor as a CMU student; physically located at CMU

- Remain with advisor as an enrolled CMU student, but work with advisor at his/her new institution
- Remain with advisor and transfer to advisor's new institution
- Find a new advisor at CMU and remain a CMU student

When an advisor leaves the ECE Department, the department will hold an information session for that faculty member's students to discuss this transition and their options.

Graduate Studies Committee (GSC)

The Graduate Studies Committee is a committee consisting of ECE faculty and ex-officio administrators from the Graduate Affairs Office. The Graduate Studies Committee meets throughout the academic year to address student petitions, discuss program policies, and to approve and assign qualifying exams.

The GSC Chair for the 2021-2022 academic year is Professor L.R. Carley. The dates for the GSC meetings will be posted on the GSC Petitions Procedures website (requires Andrew ID log in) before the start of each semester.

Bulletin Boards

Silicon Valley campus

- Students in Silicon Valley can find bulletin boards located in Buildings 23. Bulletin boards will be cleared on a regular basis.

Tech & Receiving

Silicon Valley campus

- Students on the Silicon Valley campus should work with their instructor if supplies are needed.

Computer Clusters

There are not computer clusters available in Silicon Valley.

Printers

Printers are provided for student academic use.

Silicon Valley campus

- Printers are for use in Building 23 (B23) Room 123 and the hallway in B23 outside of 109/110. Instructions for adding printers and policies are posted next to each printer.

Keys

Silicon Valley campus – you must use your CMU ID to enter building 23 every time.

Lab & Office Space

Lab and office space for both campuses will be assigned to students once they have been formally matched with a faculty advisor. Lab and office assignments may be modified at the discretion of

the students' faculty advisor or the department. Students may not re-locate without prior permission from the department.

Silicon Valley campus

- There are two labs on the Silicon Valley campus that are attached to Building 23. The Carnegie Mellon Innovations Lab (CMIL) is the larger general-use lab. Bench space is shared. Lab access is a privilege, not a right. It requires training, respect for access controls, and adherence to/signature on the written lab policies. CMIL contains the following equipment for personal and course projects: Ultimaker 2+ 3D printer, Oscilloscopes (40 MHz and 200 MHz,) regulated DC power supplies, 5MHz Function Generator, Agilent digital multimeter, ESD safe electronics work area, soldering irons, Weller rework station, Various hand tools.

Graduate Student Lounges

Silicon Valley campus

- There are several spaces for students in Silicon Valley to use. The main student lounges can be found in B23, downstairs Room 129 and upstairs Room 227.

Department Office/Building Security, Repairs and Services

Silicon Valley campus

- Any damages, repairs, or security concerns should be reported to Stacy Marshall, Facilities and Events Manager, by emailing facilities@sv.cmu.edu. In an emergency, please contact NASA Police at 650-604-5555.

General Silicon Valley campus facilities description

The Silicon Valley campus is located in the historic Shenandoah Plaza on the NASA Ames Research Park. We occupy one building, building 23. Building 23 is a 20,111 sq. ft. two-story historic building and is our main administrative and teaching building. It largely houses our academic space: 5 classrooms, 31 faculty and staff offices, 6 conference rooms, 2 kitchen/break rooms, 1 cafe lounge, and 1 multi-function lounge & event space. Located in the annex of Building 23 is the Carnegie Mellon Innovations Lab (CMIL), a 1,247 sq. ft. multi-use lab space.

Graduate Student Organizations

- EGO (ECE Graduate Student Organization) organizes academic and social events throughout the academic year.
- WinECE (Women in Electrical and Computer Engineering) provides academic and social events to women in ECE throughout the year.
- HKN (Eta Kappa Nu) is the honor society for Electrical and Computer Engineering students. HKN members engage in community service, professional engagement, and social activities. Ph.D. students are invited by the board of HKN to join based on academic performance.

For more information on graduate student organizations and opportunities for future involvement in the ECE department, please contact Brittany Bristoll.

Press & Media Relations

ECE's Assistant Director of Communications is the point-of-contact between news media and the ECE, including faculty, students, and staff.

If any student, staff or faculty member of ECE is contacted by a media representative, they are required to immediately inform either the Communication Manager and/or the Director of Operations. Members of the ECE community are not required to answer any questions from the media without first seeking information from ECE's Communication Manager and/or the Director of Operations.

Persons interested in publicizing a program, project, event, or other activity affiliated within ECE should contact the Communications Manager Krista Burns who can provide guidance on internal and external communications.

Electrical & Computer Engineering Brand & Logos

The Information Technology Services (ITS) website contains information regarding the department's branding and identity standards.

PRE-MATRICULATION

Admissions Policies

For information about ECE's admission policies, including application requirements, application deadlines, and a link to apply, please visit these webpages:

- https://www.ece.cmu.edu/admissions/graduate-application-deadlines.html
- https://www.ece.cmu.edu/admissions/graduate-faq.html

TOEFL Requirements and Language Proficiency

Admission to Carnegie Mellon University graduate programs requires demonstration of completed, relevant undergraduate degree programs, as demonstrated by an original transcript from the degree-granting institution during the admission process. Domestic students who graduate from an accredited college or university in the US have demonstrated their English language facility and skill by their success and graduation from competitive undergraduate US institutions.

The TOEFL test is required of all international applicants whose native language is not English. Native language is defined as first language, or language spoken from birth. The TOEFL is not required if the applicant has graduated from a U.S. university, or if the applicant is a CMU student or alum.

The Admissions Committee prefers the TOEFL to the IELTS. While you are encouraged to take the TOEFL, if you are unable to do so, we look for a minimum overall score of 7 on the IELTS, with minimum sub-scores of Reading-6.5, Listening-6.5, Speaking-6, and Writing-6.

Nonnative English speakers may utilize the Intercultural Communication Center (ICC) for language support: https://www.cmu.edu/icc/. The Silicon Valley campus also has a Communications and Language Services Office for additional language support for nonnative English speakers: http://sv.cmu.edu/student-services/communication-language-services.html

Deferral

ECE generally does not allow admission deferrals because admission decisions are based on the current applicant pool. Therefore, students are offered admission into the program for a particular semester only. If a student wishes to attend in a future semester, the student must reapply to the ECE program.

Final Undergraduate Transcripts

Applicants admitted to any ECE program must submit final official transcripts, properly sealed, upon completion of their undergraduate program from the institution conferring their degree as a condition of enrollment at Carnegie Mellon. Certificates of graduation and/or degree certificates should also be submitted if provided by the institution. Failure to provide such documents that confirm the completion of undergraduate requirements by the end of the first semester of study at Carnegie Mellon may prevent the Ph.D. degree from being certified.

Responsible Conduct of Research (RCR) Education

The Office of Research Integrity and Compliance website describes the university's position on ethical research: "Carnegie Mellon University promotes the responsible conduct of research through high standards of ethics and accountability in planning, conducting and reporting research. The responsible conduct of research is demonstrated through behavior that meets generally accepted standards. These standards are set forth by state and federal regulations, institutional policies, professional codes of conduct and personal convictions."

In support of the university's position, ECE requires **all incoming students** to take the appropriate online training offered by the Collaborative Institutional Training Initiative (CITI). The CITI physical science module package is recommended rather than the module package for engineers, although both are acceptable. The courses are available at citiprogram.org. Select "Carnegie Mellon University" as your participating institution when you create your account.

The course(s) may take a few hours to complete but can be done over a period of time. Upon completion of the course(s), students will need to provide their certificate to the Graduate Affairs Office. Instructions on how to submit this certificate are communicated prior to the beginning of the semester.

ENROLLMENT AND REGISTRATION

Overview

After matriculating into ECE, students should create an academic plan and register for courses. Students should actively engage in their process by reviewing degree requirements on the website, connecting with their academic advisor, and conferring with their faculty advisor. Once plans are firm, students can proceed by accessing Student Information Online (SIO).

SIO is an important online tool to use during the registration process, as well as throughout graduate school. Students can access SIO with their Andrew ID at The HUB.

Within SIO, there is a Course Planning module that allows students to view and modify their proposed schedule before registering for courses. Once a schedule is developed, it is the

student's responsibility to register for courses using their SIO. Students must be registered for every course that they plan to take for the semester, even if it is not taken for credit (e.g., audited courses).

After the first semester, a student's assigned registration time is determined by the number of completed units and cannot be changed. If a student's tuition balance and/or fees are greater than $0.00, the student will not be able to register until the balance is cleared.

Degree Progress and Planning

Student Responsibility

It is the sole responsibility of the student to manage the academic progression of their program. Students are expected to ensure that they are taking the necessary prerequisites and courses to complete degree requirements on time. Students have the ability to add courses, drop courses, and select units for variable unit courses through SIO. It is the students' responsibility to be aware of all academic deadlines, including the add deadline, the drop deadline, the pass/fail deadline, and the audit deadline. Academic deadline information can be found within The HUB's Academic Calendar.

If a student is not progressing as expected, they are expected to seek advice and counsel from their academic advisor and faculty advisor. If the student is concerned that they may be unable to complete degree requirements, they should contact their academic advisor and faculty advisor for assistance.

Degree Timeframe and Residency Requirement

Completion of the Ph.D. degree usually takes about four to six years of study (depending on if the student enters with a B.S. degree or an M.S. degree). At least one calendar year of full-time graduate study in residence is required by CIT (see 'Ph.D. degree' section). This requirement may be waived for part-time students via a petition to the Department Head and the Associate Dean for Graduate and Faculty Affairs.

The total time allowed to complete the Ph.D. degree requirements is six years following the successful completion of the Ph.D. Qualifying Examination milestone. A minimum of 144 units is required beyond the bachelor's degree. In calculating these 144 units, a student's master's degree from another institution can be factored towards the 144 units. Please see the Full-time and Part-time Requirements section for additional information.

Students are encouraged to register as soon as possible for each semester to avoid waitlists and ensure that tuition and stipend support continues smoothly.

Students must be physically present and attend class at the start of the semester. If extenuating circumstances exist that prevent a student from attending class, a student must notify the academic advisor and instructors immediately. Not attending class from the start of the semester will have a detrimental effect on a student's progress in the program. ECE will make an effort to verify all students have arrived to begin their program and will consider a student as "withdrawn from the university" if he or she is not here by the tenth day of class as defined by the academic calendar.

International students must consult with CMU's Office of International Education (OIE) for questions on extension of their visa documents or if they complete their degree requirements prior to the end date on their I-20. Please see details and relevant forms on OIE's website under Maintaining Legal Status.

Summer Registration Process & Procedures

Students are expected to continue their research over the summer or pursue an internship that is relevant to their Ph.D. research. Any deviation from this expectation must be approved by the student's faculty advisor prior to the beginning of the summer semester.

Students who are performing full-time research with their faculty advisor should register themselves for 18990-R Reading and Research for 36 units during the Summer 1/All semester.

International students who are completing an internship in the United States must complete the paperwork for Curricular Practical Training (CPT). For more information about internships and CPT, see the Internship Course section outlined in this handbook. Academic and OIE advisors will provide students with information about CPT during the spring semester.

Vacations & Time-Off

Students with graduate assistantships are expected to continue with their research during academic breaks (including summer months) with the exception of official University holidays. Paid time off for personal business or vacations generally is not included as part of a graduate's financial support.

A supported graduate student who wants to take a short break (up to two weeks) must get approval for that break from his/her advisor in writing and, if required by the terms of the student's support package, must make up the work. Supported graduate students wishing to take longer periods of personal time off must do so without financial support and must receive written approval from their faculty advisor at least three weeks prior to the requested time off. International students should pay particular attention to the rules governing their visa in relation to time off. The student's faculty advisor will notify the Department's Business Office of any such arrangements so that an appropriate adjustment in the student's support package can be processed.

University holidays include:

- New Year's Day
- Martin Luther King Day
- Memorial Day
- Independence Day
- Labor Day
- Thanksgiving Day
- Day After Thanksgiving
- Day Before Christmas
- Christmas Day
- Day Before New Year's Day

Full-time and Part-time Requirements

Full-time Requirements

Full-time students must be enrolled for a minimum of 36 units each semester – fall, spring, and summer.

Moreover, international students must be enrolled in a full course load (minimum 36 units) each semester to maintain their immigration status. Enrollment less than full time may be applicable at certain periods of the Ph.D. program (e.g., self-supporting in the final semester). See your academic advisor for more information.

Part-time Requirements

Occasionally, employment constraints may result in a student being enrolled part-time (less than 36 units per semester) in the Ph.D. program while they continue to work full-time elsewhere. Students planning to enroll in the Ph.D. part-time should discuss their part-time status with their faculty advisor and academic advisor and create a plan that will ensure their timely and comprehensive fulfillment of the Ph.D. program. Part-time students should note that the Ph.D. program is rigorous and that students should think carefully about embarking upon a part-time program while continuing to work full-time.

Part-time students are subject to CIT's residency requirement (see 'Part-Time graduate programs' section) and requires that student spend at least one academic year (fall and spring) on campus over the course of the Ph.D. program. Any deviation from this requirement must be petitioned for by the student and his advisor prior to his or her enrollment in the Ph.D. program. The petition must be approved by the Department Head and the Associate Dean for Graduate and Faculty Affairs.

Part-time students should be enrolled for less than 36 units each fall and spring semester. Most part-time students take 12 or 24 units per semester.

Statute of Limitations

ECE adheres to CIT's policy on Ph.D. completion timelines. The CIT policy is as follows: "Passing the Ph.D. qualifying examination admits a student to candidacy for the Ph.D. degree for a period of no longer than six calendar years. If, at the end of this six-year period, the Ph.D. has not been awarded, the student must reapply for admission to the graduate program and will be judged competitively with other students applying at the same time." Former ECE students who did not fulfill graduation requirements and would like to return to complete a degree should refer to the statute of limitations in CIT's graduate student policies for more information.

Under extraordinary circumstances, such as leave of absence, military or public service, family or parental leave, or temporary disability, a school or college may, upon the relevant department's recommendation and with the written approval of the dean, defer the lapse of All But Dissertation status for a period commensurate with the duration of that interruption. Students, who are pursuing the Ph.D. degree as part-time students for all semesters of their program, as approved by their program, may also appeal to their program or department for extension of the time to degree limit. Requests for extensions to the statute of limitations must be submitted to

the Graduate Studies Committee at least one semester prior to the statute of limitations expiration.

Students wishing to obtain an extension due to special circumstances must to submit a formal petition at least one semester prior to his or her defense timeline expiring. The time clock will stop for students who have not taken the qualifying exam prior to the leave of absence.

Campus Location Tracking & Reporting Requirements

Students who are not based in Pittsburgh will be required to report their expected location for the future semester by responding to an online poll disseminated by the Graduate Affairs Office. This information is critical in ensuring that students are billed properly and, if they are traveling to the United States from abroad, receive their visa in a timely fashion. Additionally, some programs regulate on how long a student can be in Pittsburgh over the course of the program.

Any deviations from the location requirements outlined by the program must be approved by the student's faculty advisor. Additional information regarding funding may also be requested by the Business Office in order to facilitate the students' deviation from traditional location requirements.

Information on location requirements can be found in the table below:

Program	Location Details
CMU | Portugal Dual Degree Program	CMU | Portugal dual degree students receive funding for a total of two years on the Pittsburgh Campus. Students and their advisors should work together to determine where the student will be physically located each semester. Three years will be spent in Portugal.
Silicon Valley	Students and their faculty advisors should work together to determine where the student will be physically located each semester.

Once students have reported their location to the Graduate Affairs Office, any change in plans should be communicated immediately and directly to the Graduate Affairs Office. It is the responsibility of the student and his or her advisor to communicate location information to the Graduate Affairs Office. Late or inaccurate reporting of future locations may limit a student's ability to travel to the United States and may result in inaccurate financial charges to the student's account.

Obtaining an M.S. on the Way to the Ph.D.

Many Ph.D. students wish to obtain an M.S. on the way to the Ph.D. in order to demonstrate their academic progress in the program and to have a milestone to show on their curriculum vitae/resume. Ph.D. students have two M.S. options: a course M.S. or a project M.S.

Course M.S.

The course M.S. requires 96 units of coursework, 12 units of which can be research. Of the 96 units, 60 units are restricted (including 12 units of research) and 36 are less-restricted.

Project M.S.

The project M.S. is only open to ECE Ph.D. students. This option also requires 96 units of coursework, 36 units of which can be research in exchange for writing a 40 page or less research paper. This paper will need to be approved by both the student's faculty advisor and a second reader who must be an ECE faculty member. Twelve of the 36 units will be allocated to the restricted 60 units, and 24 of the 36 units will be allocated to the less-restricted units.

Both types of M.S. degrees require the completion of a Request for an M.S. Degree form. This form must be completed at least two weeks before the final grades deadline if a student is requesting an MS at the end of a given semester.

Change of Degree Program

Sometimes students begin the Ph.D. program and realize that they do not want to continue as a Ph.D. student. When this occurs, students may have the option of switching to the M.S. program. Switches to the M.S. program should be discussed with the student's advisor prior to filling out the switch to M.S. form to formalize the switch.

Please note that this switch must be done prior to or within the first 10 days of classes in the semester in which a student would like to switch to the M.S. program via the switch to M.S. form. After the 10th day of class, the switch will not be permitted until the following semester and the student will be expected to continue with Ph.D. research until the end of the semester.

Students who switch to the M.S. program will become financially self-supporting, meaning that they will no longer receive tuition or stipend support from the department. Prior to switching to the M.S. program, international students should consult with OIE.

Center for the Neural Basis of Cognition (CNBC) Program

ECE Ph.D. students interested in the neural basis of cognition can apply to the Center for the Neural Basis of Cognition (CNBC) Graduate Training Program, which allows students to combine neuroscience and engineering in an interdisciplinary training program.

The CNBC program offers a certificate graduate training program in collaboration with ECE and several other affiliated doctoral programs at Carnegie Mellon University and the University of Pittsburgh. The program trains interdisciplinary scientists interested in understanding how cognitive processes arise from neural mechanisms in the brain. Students combine intensive training in their chosen specialty with broad exposure to other disciplines that touch on neural computation and problems of higher brain function.

Students who have been accepted to the ECE Ph.D. program can apply to participate in the CNBC graduate training program. The program requires four core courses in the areas of cellular and molecular neuroscience, systems neuroscience, cognitive neuroscience, and computational

neuroscience. The CNBC program also includes several colloquium/seminar series, student-run journal clubs, research ethics training, and a variety of optional elective courses. Students in the CNBC program receive travel support and possible computer equipment support.

The following describes how the CNBC course requirements can be integrated with the ECE Ph.D. course requirements:

For incoming Ph.D. students with a B.S. degree

Students entering the ECE Ph.D. program with a B.S. degree will be able to complete the CNBC course requirements entirely within the framework of the ECE course requirements. In other words, these students will be able to complete the CNBC course requirements without taking units above and beyond the 96 units required for an ECE Ph.D.

For incoming Ph.D. students with a M.S. degree

Students entering the ECE Ph.D. program with a M.S. degree may petition the GSC for one CNBC course to be counted towards fulfillment of an ECE breadth area and course requirements. One other CNBC course will be allowed to count as an ECE-related course with no GSC petition required. The student will then need to take four more courses: two more to satisfy the CNBC requirements, and two more to satisfy the ECE breadth requirement and the 48 units required for an ECE Ph.D.

All students who are planning to complete the CNBC graduate training program along with an ECE Ph.D. are required to meet with their faculty advisor to discuss their course plans. The course plan must then be discussed with the Graduate Affairs Office.

Joint Degree Programs

Joint degrees are when two departments come together to create one program and award one degree. The College of Engineering has a joint degree program with the Department of Engineering and Public Policy (under 'Joint Degrees with EPP').

Courses Outside of Degree Requirements

Courses that do not satisfy degree requirements include StuCo courses (98), Physical Education course (69), audited courses, and pass/fail courses. Similar to courses taken for degree requirements, students must register for these other courses, and the units will count towards their course load for the semester. Students should confer with their faculty advisor for approval prior to registration.

Double Counting Courses

ECE follows the CIT Policy on double counting courses. Students are required to notify the Graduate Affairs Office prior to declaring a degree outside of ECE as this may have repercussions for your units and coursework to date.

The same course taken two separate times will not count towards the ECE Ph.D. If a student takes the same course twice, the course with the higher grade will be counted towards the ECE Ph.D. course requirements.

Retaking Courses

If students do not pass a course, they should take a different course that will fulfill the requirement. Retaking a course is not recommended. Students who wish to retake a prerequisite course in which they did not receive the minimum grade required should first confer with their faculty advisor for approval. Should a student choose to retake a course, only the course with the higher final grade will be counted towards the ECE Ph.D., provided the student receives a "B-" or better.

All grades are recorded on the transcript and factored into the cumulative QPA. Depending on previous education (entering Ph.D. program with or without M.S. degree) approved courses will be factored into the 48 or 96 units that fulfill degree requirements are factored into the required 3.0 graduation QPA.

Auditing Courses

Auditing a course is being present in a classroom without receiving academic credit or a letter grade. An audited course will appear on a student's transcript. Students are permitted to audit courses in consultation with their faculty advisor. Please note that audited courses cannot count towards the Ph.D. Course or Breadth Area requirements. Students who are present in a classroom and who are not receiving academic credit or a letter grade must complete audit the class to continue to attend regularly.

A student who wants to audit a course is required to:

1. Register for the course in SIO.
2. Obtain permission from the instructor and ask the instructor to sign the course audit approval form.
3. Submit the form to their academic advisor for approval.
4. If approved, the academic advisor will send the form to the HUB for processing.

Once a course audit approval form is submitted to the HUB, a letter grade ('A'-'R') will not be assigned for the course and the declaration cannot be reversed. You can find the deadline for submitting this form on the Academic Calendar. After the deadline, students will not be able to request the option to audit a course.

The extent of the student's participation must be arranged and approved by the course instructor. Typically, auditors are expected to attend class as though they are regular class members. Those who do not attend the class regularly or prepare themselves for class will receive a blank grade. Otherwise, the student receives the grade 'O', indicating an audit.

The units of audited courses count toward the maximum course load units, but do not count toward the degree requirements. Any student may audit a course. For billing, an audited course is considered the same as the traditional courses under the tuition charges. If a part-time student audits a course, he/she will be charged part-time tuition based on the per-unit tuition rate for the course.

Pass/No Pass Courses

Students are permitted to take courses pass/no pass in consultation with their faculty advisor. Students interested in taking a course pass/no pass should register for the course, then complete the Pass/No Pass Approval form. The form should be signed by the academic advisor. Courses taken pass/no pass cannot count towards the course or breadth requirements for the ECE Ph.D.

Once a Pass/Fail Audit Approval form is submitted to the HUB, a letter grade ('A'-'R') will not be assigned for the course and the declaration cannot be reversed. Passing work (letter grade 'A'-'C-') is recorded as 'P' (passing grade) or 'S' (satisfactory) on the student's academic record, with both grades meaning the same; work with a grade at or lower than 'D+' will not receive credit and will be recorded as 'N' (not passing grade) on the student's academic record. No quality points will be assigned to 'P'/'S' or 'N' grades; the units of 'P'/'S' or 'N' grades will not be factored into the student's QPA.

The units of pass/no pass courses count toward the maximum course load units, but do not count toward the degree requirements. You can find the deadline for submitting this form on the Academic Calendar. After the deadline, students will not be able to request the option to pass/fail a course.

Any student may take a course pass/fail. For billing, the pass/fail course is considered the same as the traditional courses under the tuition charges. If a part-time student takes a course pass/fail, he/she will be charged part-time tuition based on the per-unit tuition rate for the course.

Petition Process

Petitions are approved by the GSC. Petitions to the GSC may include program transfers, breadth area substitutions, Ph.D. milestone extensions, increase in units, course substitutions and any other changes that are outside of the policies stated in the student handbook. Students are advised to discuss their petitions with their academic advisors.

The petitions process is as follows:

1. Student completes the appropriate petition form and submits it to their academic advisor in the Graduate Affairs Office no later than 5pm ET on the Friday before the GSC meeting.
2. The academic advisor presents the petition to the GSC.
3. Students are notified of the outcome of their petition via an email from the M.S. Academic Advisor after the GSC has met. Generally, all GSC decisions are final.
4. Due to time constraints, some petitions may be tabled until the following GSC meeting. When this occurs, students will be notified via email.
5. The academic advisor saves a finalized version of the petition in the student's academic file.

Course Transfer Request Policy and Process

Only one graduate-level course, or the equivalent of 12 units, can be transferred from another university as credit toward the M.S. degree. As a guideline, three-credit courses from other universities equate to 9-unit CMU courses; a four-credit course equates to a 12-unit CMU course.

The course being transferred in must:

- Fulfill an ECE degree course requirement and is equivalent to a CMU course
- Be considered a graduate level course at the university where it was taken (unless requesting transfer credit for the one allowed undergraduate course)
- Have not been used to fulfill requirements for any previously earned degree

Please note that this policy is more restrictive than the CIT transfer credit policy (under 'Transfer Credit and Special Students'). A grade of 'B' or better must be earned for the course to transferred. The transfer credits will appear on the student's transcript and will not be factored into the QPA.

Transfer credit is not granted prior to admission and must be approved by the Graduate Studies Committee and CIT Dean's Office. Courses can only be requested for transfer after the student has successfully completed 36 units of coursework at Carnegie Mellon. After matriculating to Carnegie Mellon, ECE students should consult with their academic advisor before taking a course at another university.

Transfer courses will be reviewed for academic rigor and alignment with courses offered in ECE. The course description and syllabus, learning outcomes, delivery mode, and institutional accreditation will be considered when evaluating the course for transfer.

If a course has previously counted towards a degree, you may still request that the course count towards the Breadth Area requirement.

The process for petitioning to transfer a course is as follows:

1. Meet with academic advisor and faculty advisor to discuss the course transfer
2. Complete and collect the following mandatory documents:
    a. Petition for Graduate Studies Committee approval
    b. Official transcript from previous institution
    c. Detailed course description/syllabus (should include grading scale, assignments required, mandatory books, and time required in class) of the course you wish to transfer
    d. Letter from the previous institution's registrar or academic advisor stating the course intended for transfer was not used towards a degree
    e. E-mail endorsement from the instructor of the CMU course you believe your transfer course is most equivalent to
    f. CIT Graduate Transfer Credit Request form
3. Submit the completed packet to the academic advisor
4. The academic advisor will present the transfer request to the CIT Dean's office and notify the student of the result.
5. Once the petition is approved, the Graduate Affairs Office will work with the student to complete the transfer request.

ECE has not entered into an articulation or transfer agreement with any specific college or university. The transfer of credits from any college or university must follow the above policy and process. Additionally, ECE does not award credit for prior experiential learning.

Pittsburgh Council on Higher Education (PCHE) Cross-Registration Program

Full-time Carnegie Mellon students may take subjects for credit through the Pittsburgh Council on Higher Education (PCHE). The purpose is to provide opportunities for enriched educational programs by permitting *full-time* paying undergraduate and graduate students to cross-register for **one** course at any of the ten PCHE institutions. Please refer to The HUB website for additional details.

Registering for Courses

Academic Calendar

ECE adheres to the official CMU Academic Calendar. The Heinz College and the Tepper School follow their own calendars with dates that may differ from the University's calendar for the add, drop and pass/fail/audit deadlines. ECE students must adhere to the deadlines of the courses they are taking if the courses are in Heinz or Tepper.

Course Load

Prior to registering each semester, it is strongly recommended that students consult with their faculty advisor in order to ensure that their course load is balanced and relevant to the student's Ph.D. research.

Some programs have specific registration requirements. These requirements are outlined in the table below.

Program	Registration Details
CMU | Portugal Dual Degree Program	CMU | Portugal dual degree students should register for at least 37 units in their first semester in Pittsburgh and 36 units during each semester before or afterward, regardless if they are in located in Portugal or Pittsburgh.
Silicon Valley	Silicon Valley students should register for at least 37 units in their first semester and 36 units each semester thereafter whether they are in Silicon Valley or Pittsburgh.

Adding Courses

Students have the option of adding courses to their schedule starting at their assigned registration time until the add/drop deadline through SIO. If a student wishes to be added to a course after the add/drop deadline, the Course Add Request Form must be completed and signed by the course instructor. Then, the student must submit the form to their academic advisor for approval. If approved, the academic advisor will send the form to the HUB for processing.

In the event that an ECE course (18-XXX) is cross-listed with a course from another department, ECE students must register for the ECE course number.

Courses in the Tepper School of Business may be taken and can be registered for through a site outside the SIO. Tepper will publish a list of available MBA courses, and in order to register for Tepper courses, students should visit the Tepper registration site.

Course Locations

Courses will take place at various buildings and room locations across CMU campuses as assigned by the University Registrar's office each academic semester. Each course location is tied to a section and has a final assignment that is linked to the final grade. It could be in the form of a final exam, final project, or research as stated in the syllabus on the first day of classes. Students should register for sections of their courses according to their physical campus location. Please refer to the schedule of classes available on your campus.

Dropping Courses

Students have the option of dropping courses from their schedule starting at their assigned registration time until the add/drop deadline through SIO. When a course is dropped before the drop deadline, it does not appear on the transcript. As a courtesy to others, students should drop a course as soon as they decide not to take it. This will allow a waitlisted student to be enrolled and will limit the disruption to any team-based projects.

Withdrawing from Courses

Students should remove themselves from a course before the drop deadline each semester. If a student chooses to withdraw from a course after the drop deadline, the student must officially withdraw from the course and should consult with their academic advisor and faculty advisor to discuss the withdrawal. Withdrawals take place after the drop deadline but before the last day of the semester. Students must complete and submit the Course Withdrawal Request form with their academic advisor in order to withdraw from a course. More information on withdrawal grades can be found on the CMU policy website under the grading policy. Withdrawals receive a "W" grade for the course on a transcript; this "W" grade is not factored into the QPA but the course does count towards the maximum units.

Waitlists

It is typical to be waitlisted from the time of registration up until the tenth day of class. This is common practice across the university to ensure that students within the department have the opportunity to take the courses they need in order to graduate. To determine the likelihood that you will be registered from a waitlist for an ECE course, students should send an email to Academic Services Manager, Megan Oliver at mvoliver@andrew.cmu.edu. You should only attend courses for which you are waitlisted if you have permission from the instructor. Students may only be waitlisted for a maximum of 5 courses.

As a courtesy, students should remove themselves from the waitlist and/or drop a course in a timely fashion so as to allow other students the opportunity to be removed from the waitlist and enrolled in a course.

Students should check their schedules frequently on SIO as they may be enrolled from a waitlist without being notified. In addition, during the registration process, the Registrar's Office will require students to "tag up" on their waitlists in order to confirm the desire to remain on the waitlist for a course. Failure to confirm their waitlists will result in being dropped from the waitlist.

It is strongly recommended that students have a back-up plan in case they are not removed from a waitlist by the tenth day of class.

Technology Enhanced Courses

The ECE department offers courses that are taught exclusively online, and some have a live recitation component. ECE refers to them as "Technology Enhanced" courses and can be identified by the section code that includes "T". Other departments with online courses may list their technology enhanced courses in a different format, so be sure to check with the instructor if it is unclear whether a course is online. International students on a US residential campus (Pittsburgh, Silicon Valley) may take a maximum of one online course per semester that does not have a required in-person component, per F1 regulations.

Courses with Time Conflicts

Students are not permitted to register for two courses that conflict in time. Registration may be possible with consent from an instructor, allowing the conflict or attendance at an alternate time. Students should forward permissions from instructors to their academic advisor in order to register for conflicting courses.

Prerequisites

While SIO may allow you to register for courses without the published prerequisite, it is the student's responsibility to have adequate background knowledge to be successful in the subsequent course. This background knowledge may come in the form of an introductory course taken at Carnegie Mellon, your undergraduate institution, or other work/research experience. We recommend that you consult with the instructor as it is at the discretion of the instructor to decide if a prerequisite course or knowledge can be waived.

For ECE courses that require 18-600/15-213/15-513/18-213 as a prerequisite, students will not be permitted to enroll in the subsequent course without credit for 18-600/15-513. 18-600 and 15-513 are the only courses available to graduate students that satisfy the prerequisite requirement. Students attending Pittsburgh campus can plan to take 15-513 in the summer prior to their matriculation in the fall semester. Tuition will apply at a per unit rate.

Graduate courses that require 18-600/15-213/15-513/18-213 anywhere in their prerequisite tree include:

- 18-640 – Foundations of Computer Architecture
- 18-648 – Embedded Real-Time Systems
- 18-649 – Distributed Embedded Systems
- 18-656 – Data Intensive Workflow Development for Software Engineers
- 18-725 – Advanced Digital Integrated Circuit Design
- 18-740 – Computer Architecture
- 18-742 – Parallel Computer Architecture
- 18-745 – Rapid Prototyping of Computer Systems
- 18-746 – Advanced Storage Systems
- 18-748 – Wireless Sensor Networks
- 18-756 – Packet Switching and Computer Networks

- 18-759 – Wireless Networks
- 18-842 – Distributed Systems
- 18-845 – Internet Services
- 18-848 – Special Topics in Embedded Systems

Ph.D. Program Course List

See Appendix C.

Final Exams

All ECE students must attend final exams as scheduled by the university and individual course instructors. If a student believes that a final exam presents a scheduling conflict, he or she must discuss the issue with the course instructor. ECE administration does not have control over the university exam schedule. Please keep this in mind when arranging travel at the end of a semester; having purchased airline tickets is not a proper excuse for missing a final exam. Please refer to Carnegie Mellon University Policies on Examinations for additional information.

Enrollment Verifications

The HUB is the primary contact for students or alumni who would like to request a transcript, enrollment verification, or other information related to their time in ECE.

ECE may verify some limited information in the form of a letter, which may be suitable for some purposes, such as the verification of skills students acquired through the ECE programs. Please contact your academic advisor for more information. Please note that the ECE department is only able to verify information on ECE and Computer Science courses. Information on courses offered in other departments can only be verified by the other department. To obtain a verification letter, the student or alumni should contact the Graduate Affairs Office.

Leave of Absence

Occasionally, students must pause their degree program due to personal, professional, or academic reasons. A student who is considering a leave of absence should speak to his or her academic advisor prior to taking a leave of absence in order to ensure his or her understanding of the leave of absence policy and its ramifications.

Leaves of absences are capped at two calendar years' time maximum throughout the Ph.D. program, accrued either as a 2-year leave or amount to 2 years accrued through various leaves. In extreme cases, a student may request additional leave time via a petition to the GSC. If they do not return within two academic years, they will be administratively withdrawn from the graduate program. Students are not eligible to complete departmental milestones while on a leave of absence and must return from a leave of absence in order to complete any program requirements, including the Course requirement, Breadth Area requirement, Teaching Internships (TI), Qualifying Exam, Prospectus, and thesis or dissertation defense.

Students who intend to return to the Ph.D. program beyond or after the two-year leave cap must re-apply to the graduate program. Questions can be addressed to the Ph.D. Academic Program Advisor.

Once a student decides to take a leave of absence, he or she should complete the Leave of Absence form and bring it to their academic advisor for additional processing. Please note that the student's advisor must sign the leave of absence form. The student and his or her faculty advisor are expected to have a conversation about the requirements for the student's return. ECE faculty are not required to hold spaces in their research group for students who are on leaves of absences. As a result, a student may need to be prepared to find a new faculty advisor and new funding in order to return from a leave.

Returning from a Leave of Absence

To return from a leave of absence, the student must have financial support and an ECE faculty advisor's approval. A student intending to return from leave must submit the Petition to Return from Leave of Absence form to their academic advisor at least 30 days prior to the start of the semester in which he/she plans to return. A student's return must coincide with the start of a new semester (fall, spring, or summer). Students cannot return from a leave of absence in mid-semester, with the exception of summers.

Per university policy on student leaves, "Students on leave are not permitted to live in university housing, attend classes or maintain employment as students at Carnegie Mellon while their leave is in effect."

More information about the University's Leave of Absence and Withdrawal policies can be found in the University Policies section of this handbook.

Degree Certification Process & Commencement

Ph.D. degrees will be certified after students successfully defend their dissertation and submit all required paperwork, including publication permissions and contact information. In addition, students must have provided a final copy of their undergraduate transcript(s) and must have a tuition balance of $0.00 to receive a diploma. Students will be notified of their degree certification via email once the certification has been completed by the Graduate Affairs Office.

Before graduation, students should update their contact information, such as mailing address and e-mail address, within SIO. Also, students should review a proxy of their diploma in SIO to verify the information displayed there, such as the spelling of their name.

Students who are certified in the summer or fall semesters will be invited to attend the following spring commencement ceremony. Spring graduates will be invited to the spring commencement ceremony. Students are not eligible to participate in the Doctoral Hooding Ceremony or the ECE Diploma Ceremony unless their degree has been certified by the Graduate Affairs Office.

The title of the degree students receive is Doctor of Philosophy in Electrical and Computer Engineering.

ACADEMIC STANDARDS

Grades

Below are the policies surrounding grades for students in the Department of Electrical and Computer Engineering.

University Policy on Grades

The university policy on grading offers details concerning university grading principles for students taking courses and covers the specifics of assigning and changing grades, grading options, drop/withdrawals and course repeats. It also defines the undergraduate and graduate grading standards.

CIT Grading Policy

ECE follows the CIT letter grade scale. The letter grade scale is 'A' (highest for CIT students), 'A-', 'B+', 'B', 'B-', 'C+', 'C', 'C-', 'D+', 'D', and 'R' (lowest). CIT students cannot receive an 'A+' grade on their transcript, even if a course is taken from another college where 'A+' is given. Grades lower than 'C', meaning C- or below, are considered failure in CIT and will not count toward degree requirements.

Students must receive a "B-" grade or better in both the graduate and undergraduate courses for the course to count towards the Ph.D. requirements.

Incomplete Grade

Incomplete grades will be assigned at the discretion of the course instructor, per the university grading policy.

Withdrawal Grade/Withdrawing from Courses

Students can withdraw from a course after the add/drop deadline until the last day of classes. This will result in a 'W' on the transcript, which is not factored into the QPA. To withdraw, the Course Withdrawal request form must be completed and submitted to the academic advisor for approval. If approved, the academic advisor will send the form to the HUB for processing. Students should confer with their faculty advisors before withdrawing from a course.

Academic Performance

Quality Point Average

In order to graduate, each student must have a Quality Point Average (QPA) of at least 3.0 in the courses being used towards the required units for the Ph.D. program. Coursework or graduate project units with a grade lower than 'C' will not be considered toward graduate degree requirements; however, they will be calculated into the student's cumulative QPA.

Probation

In the event that a student's semester or cumulative QPA falls below a 3.0, that student is on academic probation and will receive a letter from the department alerting them. While on probation, students must meet with their academic advisor and comply with their recommendations. Once a student's semester and cumulative QPA increase above 3.0, the student is automatically removed from probation.

Satisfactory Progress & Program Dismissal

Students are expected to make satisfactory academic progress each semester of the Ph.D. program. "Satisfactory" progress may be defined differently for each student. Students should

work together with their faculty advisor to determine what satisfactory progress entails and to improve performance when a student receives feedback that progress has been unsatisfactory.

Occasionally, students fail to meet their advisor's expectations for satisfactory progress for one or more semesters, despite attempts to remediate substandard progress. When this situation occurs, faculty may issue a dismissal letter to students. Such letters must be issued no later than the end of the first week of the semester in which a dismissal is taking place. For example, dismissal letters for the Fall 2019 semester must be sent to students by the Department by the end of the first week of classes in the Fall 2019 semester. This timing affords impacted students adequate time to make other arrangements to continue in the Ph.D. program.

Dismissal letters are drafted by the student's faculty advisor, and then sent to the Department Head and Graduate Affairs Office for review and approval. Once the letter has been approved, the letter will be distributed to the student via email. The letter will outline the causes for dismissal and possible options for the student. Students who receive dismissal letters should schedule an appointment to meet with the Graduate Affairs Office to discuss their options. International students should also schedule an appointment with OIE to discuss the potential visa ramifications of a program dismissal.

Faculty may rescind a dismissal letter in writing and must notify the Department Head and Graduate Affairs Office of any such action. Dismissal from a program will result in the loss of the student's affiliation with CMU and their student status.

Academic Integrity

Students at Carnegie Mellon are engaged in preparation for professional activity of the highest standards. Each profession constrains its members with both ethical responsibilities and disciplinary limits. To assure the validity of the learning experience a university establishes clear standards for student work.

In any presentation, creative, artistic, or research, it is the ethical responsibility of each student to identify the conceptual sources of the work submitted. Failure to do so is dishonest and is the basis for a charge of cheating or plagiarism, which is subject to disciplinary action.

ECE adheres to Carnegie Mellon's policy on academic integrity and all students are expected to review the policies prior to their arrival at CMU. ECE also adheres to CIT's policy on graduate student academic integrity violations.

Please review the University Policy on Academic Integrity (https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html). The policy includes the University expectations around academic integrity and provides definitions of cheating, plagiarism, and unauthorized assistance.

A review of the University's Academic Disciplinary Actions procedures (https://www.cmu.edu/student-affairs/theword/academic-discipline/index.html) is also recommended. These procedures outline the process for investigating, reporting, and adjudicating violations of the University Policy on Academic Integrity. The procedures also outline the appeal process.

Instructors are responsible for defining academic integrity for students in their courses, including student performance expectations and attendance requirements. Students are responsible for understanding and abiding by the instructor's academic integrity policies. Policies may vary from instructor to instructor and students should seek further guidance from a faculty member if they have specific questions about a course's academic integrity policy.

Penalties for Violating Academic Integrity

Instructors are responsible for defining academic integrity for students in their courses, including student performance expectations and attendance requirements. Students are responsible for understanding and abiding by the instructor's academic integrity policies. Policies may vary from instructor to instructor, and students should seek further guidance from a faculty member if they have specific questions about a course's academic integrity policy.

Instructors who suspect that an academic integrity violation has occurred should consult with the Office of the Dean of Student Affairs, who will assist the faculty member in handling a possible academic integrity violation and determine possible sanctions, if appropriate. In accordance with the university's policy, a student who violates the academic integrity policy will not be permitted to drop the course in which the offense occurred to avoid penalty. If the student attempts to drop the course, he/she will be reenrolled.

If a student is found to have violated the academic integrity policy for a second time, the student will be dropped from the Department of Electrical and Computer Engineering effective at the end of the semester in which the infraction has occurred. Students have the right to appeal an academic integrity decision.

PH.D. DEGREE REQUIREMENTS

Overview

ECE Ph.D. students must satisfy multiple milestones before the doctoral degree is certified. These milestones addressed in this section include:

- Coursework
- Breadth Area Requirements
- Qualifying Exam
- Research
- Teaching Internships
- Prospectus
- Thesis
- Dissertation defense

Below is an example of a student's plan of study over the duration of the ECE Ph.D. program. Please note that this plan is an example and may vary based on whether the student has an MS degree prior to enrolling, on conversations between the student and his or her advisor, and which ECE Ph.D. program the student is enrolled in.

	Semester									
Milestones	F1	S1	F2	S2	F3	S3	F4	S4	F5	S5
Research	X	X	X	X	X	X	X	X	X	X
Courses & Breadth	2 classes	2 classes	2 classes	2 classes						
Qualifying Exam				X students incoming F15	X students enrolled prior to F15					
Teaching Internship			X			X				
Prospectus								X		
Thesis and Defense										X

Coursework

Students must receive a "B-" grade or better in both the graduate and undergraduate courses in order for the course to count towards the Ph.D. requirements.

Prior to registering each semester, students should consult with their faculty advisor to ensure that their semester course load is balanced and relevant to their Ph.D. research.

Required course total

- Students in the Ph.D. program without a M.S. degree, and students in the Ph.D. program who have an ECE M.S. degree from Carnegie Mellon, must take a total of eight [8] ECE or related courses (totaling 96 units) at Carnegie Mellon. At least six of these eight courses must be approved graduate-level courses. In addition, students must also successfully complete a 1-unit Introduction to Graduate Studies course during their first semester in the Ph.D. program.
- Students in the Ph.D. program who have earned a M.S. degree elsewhere (outside of CMU's ECE Department) must take a total of four [4] ECE or related courses (totaling 48 units) at Carnegie Mellon. At least three of these four courses must be approved graduate-level courses. In addition, students must also successfully complete a 1-unit Introduction to Graduate Studies course during their first semester in the Ph.D. program.
- Students who received an M.S. in ECE from Carnegie Mellon may use their M.S. courses to count toward Ph.D. requirements.
    - Students who have received an M.S. from Carnegie Mellon in ECE are strongly encouraged to schedule an appointment with the Ph.D. Academic Program Advisor to discuss their M.S. courses and which will count towards the Ph.D. degree requirement. In addition, students must also successfully complete a 1-unit Introduction to Graduate Studies course during their first semester in the Ph.D. program.

A comprehensive list of graduate courses that have been approved for the ECE Ph.D. can be found on the Ph.D. Breadth Area website. In addition to this list, any 12-unit ECE course at the 18-600 level or higher is approved to count towards the ECE Ph.D. degree, except for any project, seminar and independent study courses. Courses in the Computer Science Department (CSD) that are 15-700 or higher and are non-project, non-seminar or non-independent study courses are also approved.

Undergraduate courses that are pre-approved to count towards the ECE Ph.D. include ECE undergraduate courses 300 or above (18-3XX) and CSD courses 300 or above (15-3XX).

Professional Development coursework

Up to twelve (12) units total of professional development coursework in ECE may be counted towards the ECE Ph.D. Course requirement, in any combination of the following course list:

- 18-601 (12 units)
- 18-603 (12 units)
- 18-605 (12 units)
- 18-606 (12 units)
- 18-700 (12 units)
- 18-703 (12 units)
- 15-894 (12 units)
- 18-701 (6 units)
- 18-702 (6 units)
- 18-996 (3 units)
- 18-997 (3 units)
- 18-998 (3 units)

Course Restrictions

Students are responsible for checking the syllabi for classes to ensure their courses are not deemed as a restricted course by the following criteria:

- Courses where more than 50% of the course grade is based on a group project or more than 20% is based on attendance are restricted.
- Mini courses worth 12 units are restricted.
- No more than 12 units of professional development coursework can be applied toward the Course requirement.

Petitioning to Count a Course Not on the Pre-approved List

Students wishing to count a graduate course at Carnegie Mellon not listed in the approved graduate course list, or an undergraduate course offered by another department at Carnegie Mellon, must formally petition the Graduate Studies Committee. Please see the section in this handbook on petitions and schedule an appointment with your academic advisor for more information.

Breadth Area Requirement

The ECE Department has defined 7 technical areas (plus an 'Other' area) as Breadth Areas for the Ph.D. degree. These areas are:

- Algorithms/Complexity/Programming Languages
- Applied Physics (Solid State/Magnetics/Fields)
- Artificial Intelligence, Robotics and Control
- Circuits
- Computer Hardware Engineering
- Signal Processing and Communications
- Software Systems and Computer Networking
- Other (by petition)

Each Ph.D. candidate must take at least one [1] graduate class from at least three of these areas to fulfill the breadth requirement. Students must receive a "B-" grade or better in these courses.

By petition to ECE's Graduate Studies Committee, students may be able to count one course that they have taken during a previous degree toward the breadth course requirement. If the petition is accepted, only two more breadth areas must be satisfied. However, students will still be held to the same course requirements.

Qualifying Exam Requirement

Students who are working towards a Ph.D. degree are required to take the Ph.D. Qualifying Examination. The Ph.D. Qualifying Examination tests the student's ability to think, speak, and write. Students must read and understand three technical papers that define the examination topical area. Students then write a review paper as well as orally present this review to a faculty examining committee. This committee includes three faculty from the ECE department whose research focus is in the area the student wants to be tested on. The student must answer detailed questions from the faculty committee. These questions can be about the review paper and presentation, the reference papers, and obvious undergraduate-level technical background for the material in the review and reference papers.

Timeline

Students matriculating in the Fall 2015 semester or afterwards must take the Ph.D. Qualifying Exam for the first time no later than the fourth semester after being admitted to the Ph.D. program, and must pass the exam no later than the fifth semester after being admitted to the Ph.D. program. Summer semesters are not included in this qualifying exam timetable.

Students matriculating prior to Fall 2015 must take the Ph.D. Qualifying Exam for the first time no later than the fifth semester after being admitted to the Ph.D. program, and must pass the exam no later than the sixth semester after being admitted to the Ph.D. program. Summer semesters are not included in this qualifying exam timetable. Students are encouraged to take the Ph.D. qualifying exam as soon as possible.

Each student should determine with her or his advisor when to take the qualifying exam the first time.

The time clock determining when a student must take the qualifying exam is stopped for one semester if the student is engaged in a full-time industrial internship during an academic year semester (fall or spring). This policy applies for up to one semester of internship experience. Students engaged in internships for more than one academic semester must petition to ECE's Graduate Studies Committee to request a deferment of the qualifying exam timeline beyond one semester. Please note that there is no guarantee that such petitions will be approved.

Fall exams generally occur in the month of November. Spring exams generally occur in the month of April.

Mechanics

Declaration, Abstract, and Technical Papers (due in September or February)

With faculty advisor input, the student will complete a qualifying exam declaration, write a presentation abstract, and submit three technical papers. The declaration will allow students to rank order between seven [7] and ten [10] ECE faculty that the student and his or her advisor feel would be the best fit for the examination committee. The three technical papers provide context to the faculty examining committee regarding the student's area of focus.

Students can choose no more than two papers that may have authors who are currently faculty at Carnegie Mellon. Students can choose no more than one paper that the student has co-authored. The total length of all three papers may not exceed 50 pages.

The Graduate Studies Committee reviews the declaration packets and recommends a three-person faculty examination committee. While every attempt is made to choose faculty from the student's declaration submission, these preferences cannot always be accommodated due to faculty availability and committee balancing. This committee is subject to approval by the student's faculty advisor.

Review paper (due in October or March)

The qualifying examination tests your written communication skills through a short review paper. This paper defines the focus of your qualifying examination topic. You should explain your technical area; your work and the relationship between your work and the content of the student's three technical papers. This paper must not exceed four pages and must be in a 2-column format.

Exam (occurs in November or April)

Prior to the start of the qualifying exam, the Graduate Affairs Office will communicate each student's exam date, time, committee, and location via email.

The Qualifying Examination tests a student's oral communication skills by having the student present a short, conference-style talk during the first 30 minutes of a Qualifying Exam. The examining faculty will typically ask the student's questions to help clarify the presentation immediately following your presentation.

Once the clarification question and answers are completed, the examining committee will ask the student questions about the student's research area, technical papers, review paper, and electrical and computer engineering fundamentals that relate to your research area.

Outcomes

At the conclusion of the qualifying exam, the faculty examiners will consult with each other and grade the qualifying exam. All qualifying exams will be discussed at the faculty qualifying exam review meeting, which occurs on the Friday of the second week of qualifying exams. Final outcomes will be determined by the faculty at this meeting, not by the three-person faculty examination committee.

All students will be notified of their qualifying exam outcome and provided with feedback after the faculty has convened.

Students failing the qualifying exam the first time can take it a second time, no later than the sixth semester after being admitted to the Ph.D. program if the student started prior to Fall 2015 or the fifth semester if the student started in the Fall 2015 semester or afterwards. One faculty member from the first exam committee will serve on the second committee. A student who fails the exam twice must leave the Ph.D. program at the end of the semester in which the second failure occurs.

Students who pass the qualifying exam will officially be recognized as candidates for the Ph.D. degree.

Research

All full-time Ph.D. students are required to complete research every semester they are enrolled in the program. The completion of research is represented by the student's enrollment in *18990 Reading and Research* each semester. Expectations for research and productivity vary greatly throughout the department and should be discussed regularly with the student's faculty advisor.

Each fall and spring semester, students should register for *18990 Reading and Research* in the section that represents their physical location.

18990 Reading & Research sections:

- Section A: For students studying in Pittsburgh
- Section PP: For all CMU Portugal students studying in Portugal. (CMU Portugal students in Pittsburgh will register for section A.)
- Section SV: For all Silicon Valley students studying in Silicon Valley. (SV students in Pittsburgh will register for section A.)

Resources and Regulations Governing Research at Carnegie Mellon that may be of interest to Ph.D. students include the following:

- Office of Sponsored programs
- Office of Research Integrity & Compliance

Students are expected to abide by the university's position on ethical research as posted on the Office of Research Integrity and Compliance website. See the Responsible Conduct of Research Education section in this handbook for more information.

Teaching Internship Requirements

All ECE Ph.D. students are required to complete two Teaching Internships ("TI") over the course of the Ph.D. program. These Teaching Internships are unpaid and students will receive a letter grade reflecting their performance. Students must receive a "B" or better in the TI course to receive credit for completing the teaching internship.

The TI program is coordinated through the Academic Services Office. All students must complete a teaching assistant application for the TI to be formally recognized by the department. The Academic Services Office will work with the student to enroll him or her in the correct course representing their work as a TI prior to the start of the semester.

Students may complete a TI for a course outside of ECE or during the summer semester, though it must be approved by the Associate Department Head for Academic Affairs and recorded by the Associate Director of Student and Academic Affairs prior to the student starting the TI. Students should contact the Graduate Affairs office to facilitate this process.

Programs that are not based in Pittsburgh may have requirements pertaining to where each TI is completed. More information on location-specific requirements can be found below:

Program	Teaching Requirements
CMU | Portugal Dual Degree Program	CMU | Portugal dual degree students will complete one TI in Pittsburgh and one TI in Portugal.

Students are expected to support the course instructor and establish mutual expectations while providing excellent academic support to students. Depending on a student's area of expertise and English proficiency, he or she may be assigned to a variety of tasks that can range from grading to leading recitations.

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990.

Evaluation and Certification of English Fluency for Instructors

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990. For more information about requirements, see the "Evaluation & Certification of English Fluency for Instructors" section in the University Policies of this handbook.

Prospectus

All Ph.D. students are required to prepare a thesis prospectus (also known as a proposal) within four semesters following the successful completion of the Ph.D. Qualifying Examination. This time

clock begins with the semester following the Qualifying Examination. If a student leaves for a semester to return to industry, this four-semester clock is stopped. The Ph.D. prospectus clock stops when the student leaves and resumes at the start of the semester when the student returns. Students who have not met their Ph.D. prospectus requirement within the four-semester time limit must discuss a revised timeline with their advisor prior to the semester's Graduate Progress Review faculty meeting.

Regarding time clocks, it is important to note the following:

- A calendar year has three semesters: spring, summer, and fall.
- While the prospectus clock may stop during an industry internship, the time clock for the overall Ph.D. program does not stop.

Prospectus Description

The prospectus is both 1.) an informal written description of the problem to be investigated and the expected accomplishments of that investigation and 2.) an oral presentation to the Prospectus Committee for its review and recommendations. Both prospectus requirements must be completed at least one semester prior to the final defense.

Prospectus Format

The Ph.D. prospectus write up should be no more than 25 double-spaced pages in length, although prospectuses that are on the order of five to ten pages are encouraged. The prospectus should include the following:

- An explanation of the basic idea of the dissertation topic;
- An explanation as to why this topic is interesting;
- A statement as to what kind of results are expected, and;
- A convincing argument as to why these results are attainable in a reasonable amount of time

Furthermore, the prospectus should not be:

- A summary or abstract of the dissertation;
- The first chapter or part of the dissertation;
- A technical report;
- A survey of the field, or;
- An annotated bibliography

Students should discuss the presentation format of their prospectus with their faculty advisor. Typically, a student is expected to provide a 45-60 minute presentation on his/her prospectus, and then participate in a question-and-answer-based discussion with his/her committee.

Prospectus Committee

The Prospectus Committee consists of at least four members, including the student's faculty advisor. At least two members of this committee must be ECE faculty and at least one member must be from outside the department. Faculty members from other departments who hold courtesy appointments in ECE are considered to be "inside" the department. Faculty members

who hold an adjunct appointment are considered to be “outside” members. All committee members must hold a doctoral degree.

All four committee members must actively participate in both the prospectus meeting and defense and at least three committee members must be physically present. It is desirable to have all committee members participate in person; however, a student is allowed to have one committee member of four participate by teleconferencing. Any deviation from this teleconferencing policy is exceptional and additional information must be provided on the Prospectus form. Because of the nature of the ICTI dual-degree program, teleconferencing requests by ICTI students will be approved by default.

It is expected that any committee members participating remotely will have full audio and visual access to the presentation via teleconferencing equipment. It is the responsibility of the student to provide teleconferencing access to committee members participating remotely. Students can email help@ece.cmu.edu for assistance in setting up teleconferencing equipment.

Prospectus Procedure

Once the date, time and place of the prospectus have been confirmed, the student should email the completed Prospectus Declaration form to the Graduate Affairs Office at least one week before the presentation. An electronic copy of the proposal paper should be submitted to the Ph.D. Academic Program Advisor on or after the presentation date.

Students will be notified by the Graduate Affairs Office of the approval of their committee. Once the committee has been approved, the student will meet with his or her committee to present the prospectus to them. To encourage open and frank dialogue, this presentation is attended only by the student, the committee, and any other interested ECE faculty members. Other attendees must be approved by the committee chair.

The outcome of this meeting will be either that the prospectus is accepted or not accepted. If the prospectus is not accepted, the student will be asked to revise it and meet again with the committee for approval. If the prospectus is accepted, then students should continue to move forward with his or her thesis.

Milestone Review

Upon completion of the prospectus proposal, students should make an appointment to meet with the Ph.D. Academic Program Advisor to review the fulfillment of Course and Breadth Area requirements, as well as Teaching Internship (TI) requirements. Provided that the student has satisfied the aforementioned program milestones, he/she may be informed of their eligibility for All But Dissertation (ABD) status.

All But Dissertation Status

Once a student has completed all program requirements, with the exception of the thesis and defense, the student is required to go on All But Dissertation (ABD) status. Two ABD options are available to students:

- ABD in Residence (ABD): students continue enrolling for 36 units each semester and will continue to receive stipend support.

- ABD in Absentia (ABS): students stop enrolling at CMU and no longer receive tuition or stipend support. The student will be responsible for paying the technology fee each semester he/she is ABS. When the student is ready to come back and defend, he/she will notify the Graduate Affairs Office, which will work with the student to re-enroll him or her in ECE. The student will be responsible for registering for and paying for 5 units of *18990 Reading and Research* as well as all fees. Please note that international students may face additional constraints before going ABS and should consult with the Graduate Affairs Office to obtain more information.

The full university Policy for Doctoral Status is a series of policies that set forth a definition of All But Dissertation (ABD), time limits on doctoral candidacy status, a definition of *in residence* and *in absentia* status for ABD candidates and the tuition charged for candidates in each status.

The ABD status agreement form and ABD status change form can be found on The HUB's Forms & Guides website under the 'Student Records' section.

Ph.D. Dissertation

Once the Ph.D. thesis is written, the student must submit the Defense Declaration form to the Graduate Affairs Office at least two weeks before the student's defense date. The Thesis Committee is usually the same as the Prospectus Committee. If there is any change in the committee, the student must submit a biographical description of any new committee member from outside Carnegie Mellon for approval. Additionally, students are expected to adhere to Carnegie Institute of Technology (CIT) guidelines on providing defense committees with a copy of the thesis prior to the defense. CIT recommends that students provide their committee with a copy of the thesis at least 1.5 months prior to the defense.

The oral defense is a public examination open to all members of the Carnegie Mellon community. All the members of the student's Prospectus Committee must actively participate in the defense meeting. It is desirable to have all committee members participate in person; however, a student is allowed to have one committee member participate remotely by teleconferencing. Any deviation from this teleconferencing policy must be requested via the Defense Declaration Form. Due to the nature of the ICTI dual-degree program, teleconferencing requests by ICTI students will be approved by default.

It is expected that any committee members participating remotely will have full audio and visual access to the presentation via teleconferencing equipment. It is the responsibility of the student to provide teleconferencing access to committee members participating remotely. Students can email help@ece.cmu.edu for assistance in setting up teleconferencing equipment.

In addition to these ECE requirements, CIT has its own requirements pertaining to the thesis and defense process. This site includes instructions for the document standards and format. Students should pay particular attention to the format of the thesis title page and the required content of the acknowledgements section.

Per CIT requirements, all defenses should be completed at least two weeks prior to the final grade deadline of a given semester. Doing so should grant students sufficient time to make necessary revisions and complete all post-defense paperwork prior to the end of the semester. Any

deviation from this timeline is discouraged and may hinder a student's ability to graduate on time. Such deviation from the cited timeline may be subject to additional departmental approval and should be discussed with the Graduate Affairs Office well in advance of the planned defense.

Please note: Students who **do not** successfully complete the dissertation, defense, and all defense-related paperwork prior to the final grades deadline of a given semester may be required to register for the following semester, and thus the faculty advisor will be responsible for supporting the student for an additional semester with tuition and stipend.

After the defense, the Graduate Affairs Office will review additional paperwork that will need to be completed prior to a student's degree certification with the student.

Departmental Progress Reviews

All students working towards a Ph.D. degree must regularly demonstrate progress towards meeting the ECE Ph.D. requirements by completing a Graduate Progress Review Statement each fall and spring semester.

In this statement, the student must describe his or her:

- Activities as a graduate student researcher;
- Research goals and achievements;
- Activities as a member of the ECE community;
- Courses taken since enrollment as a graduate student in ECE, and;
- Plans for the following semester

These statements are typically due during the first week of November (fall semester) and April (spring semester). Students are encouraged to discuss the completed statement with their advisor.

Students who have passed the qualifying exam will also be asked to create a single-slide summary of his or her progress towards the ECE Ph.D. degree.

The Graduate Progress Review Statement and slide summary inform faculty discussions during each semester's Graduate Progress Review meeting. The outcome of this review is a grade that characterizes the student's progress towards the Ph.D.: satisfactory ("S") and unsatisfactory or not passing ("N"). Students who receive an "N" grade for the first time must meet with their advisor and define a course of action to achieve a satisfactory grade in the next semester. Students who continue to make inadequate progress towards the ECE Ph.D. may be subject to dismissal.

Ph.D. students do not receive a letter grade for their research each semester with one exception: students will receive a letter grade in their final semester as a graduate student in the ECE Department or prior to receiving an MS degree on the way to the Ph.D.

All students who have passed the qualifying exam will receive a letter from their faculty advisor each fall and spring semester summarizing their progress and offering suggestions for improvement or continued success. This letter is typically distributed by the final grade deadline of the fall and spring semesters.

Internships Course Option

ECE students may wish to participate in paid internships at off-campus organizations during the summer months.

ECE will enroll all students who are pursuing an internship for a 3-unit credit bearing internship course (18-996, 18-997, & 19-998) Internship for Electrical and Computer Engineering Graduate Students), which can each be taken once each throughout the student's ECE Ph.D. degree program of study. This internship will appear on a student's transcript. Ph.D. students typically are not charged summer tuition, including the Internship course. However, in the event that a student takes another summer class, summer tuition may be assessed for the summer internship course as well. Please contact your academic advisor and reference CIT's current cost of attendance website. The work for the internship must be appropriate to the goals of the academic program and units can be applied toward the Ph.D. Course Requirement.

Eligible international students who are interested in pursuing off-campus internships must meet with departmental and OIE representatives. For additional information, please refer to OIE's website on Employment Options for international students. Academic and OIE advisors will provide students with information about CPT during the spring semester.

POST-MATRICULATION GUIDELINES

Return of University Property

ECE students must return all borrowed ECE and university materials—such as software, manuals, library books/materials, or any other Carnegie Mellon University property—prior to their departure from the program.

Career Services Employment Outcomes

ECE students are asked to complete and return a survey for Career Services updating CMU on their employment outcomes after graduation. Information about the survey is communicated in the students' final semester.

"Grandfather" Clause

When policies are changed, it is because the department believes the new rules offer an improvement; any such changes will be communicated to students. In case degree requirements are changed and certain courses are no longer offered, the department will try to find some compromise that allows those students to satisfy the original requirements.

TUITION, FEES, FINANCES, AND FINANCIAL SUPPORT

Purchasing & Reimbursements

At ECE, most purchasing actions, including airline tickets, are conducted by administrative departmental employees rather than a central purchasing authority. Buyers are encouraged to purchase goods and services from the administrative coordinators and not use their own funds. If you use your own funds and they charge tax, you will not be reimbursed for the tax applied to

the purchase. All purchases including travel which are done on CMU's behalf need to have the direct approval of the faculty member or PI of the project.

The preferred method of making travel arrangements is through one of the university's preferred travel agencies with which the administrative coordinator can provide assistance. By purchasing the tickets through these agencies, the cost of the tickets is charged directly to the university instead of the student or employee paying the cost personally and needing to be reimbursed. The administrative coordinators also will complete a reimbursement for any items or travel accrued.

Please keep in mind that you must provide transaction-supporting documentation in accordance with Carnegie Mellon requirements and government policies on reimbursements. Expense reports must be submitted within 90 days after completing the travel or incurring the expense, otherwise, the reimbursement will be treated as taxable income to the individual. Please see the administrative coordinator to arrange for travel and purchasing, as well as reimbursements.

All purchases of goods, services, and equipment using University funds by charging directly to an account string, including restricted accounts and research grants and contracts, should be made at the direction of a CMU faculty or staff member. Only certain department staff members are able to confirm an order with an outside vendor. Please plan ahead. Rush orders for pick-up or delivery and orders of over $1,000 are difficult to accommodate.

Basic office supplies are purchased by the Administrative Coordinators for general use by ECE students, faculty, and staff. Teaching Assistants should speak to an Academic Services Assistant for research- and teaching-related supplies.

Questions should be directed to the ECE Finance Office, located in HH 1116. Please visit CMU's Procurement Services website for more information.

Graduate Student Reimbursement Policy

Business Expenses

As an educational institution, CMU is exempt from Pennsylvania state sales tax. Whenever possible, business purchases should be made by your faculty advisor's Administrative Coordinator or by another faculty or staff member with a tax-exempt purchasing card.

If it is necessary to make a purchase using personal funds, legitimate business expenses can be reimbursed by the department. Your faculty advisor's Administrative Coordinator will help you claim reimbursement provided you have the following:

- Receipt indicating item purchased and proof of payment
- Business purpose for purchasing item
- Account to be charged for reimbursement
- Faculty or staff approval

Please consult with the appropriate Administrative Coordinator prior to incurring the expense for additional instruction. Software purchases in particular should only be made after consulting with a departmental staff member, as the purchase will often require approval from the University Contracts office due to the popularity of Click-Through Agreements ("CTA"). If

personal funds are used to make a business purchase requiring a CTA without prior approval from Contracts, it is possible that the expense in question will not be reimbursable.

Travel Expenses

If agreed on in advance with your advisor or with another departmental staff member, legitimate travel expenses can be reimbursed by the department. Your advisor's Administrative Coordinator will help you claim reimbursement once you provide the following:

- Hotel receipts must show a zero balance with proof of payment and your name
- Receipts for meals must be collected, unless you claim per diem meals; both daily meals and per diem meals cannot be claimed for the same travel expense report. Current per diem rates can be verified on the GSA website.
- Personal car mileage for business purposes; standard mileage reimbursement rates for gas/fuel but not tolls
- Business purpose for travel
- A program or agenda, when available
- Account to be charged for reimbursement
- Approval by an ECE faculty or staff member

Conditions

Tax will be reimbursed for expenses incurred due to normal business related travel (hotel, airfare, meals) but **not** for miscellaneous expenses, such as the purchase of a replacement mouse for a department laptop, poster board for a presentation, etc., purchased while traveling or preparing for travel. These items should have been purchased through a department approved buyer thus not incurring tax expense.

Academic Year Tuition & Stipend

Research assistantships are provided by research projects which are funded by government agencies, private industries, and consortia. Students who are research assistants will be expected to conduct appropriate research under the direction and guidance of their faculty advisor(s). Tuition and stipend support is renewable based on a student's acceptable performance in course work and research and the faculty advisor's funding availability.

In most situations, as long as the student is in good academic standing (with regard to grade average, progress in the program, and length of time in the program), full tuition remission will be given.

For the academic year 2021-2022, this tuition is valued at approximately $45,300. Students are responsible for the costs of purchasing their own books and miscellaneous supplies. A listing of estimated cost of attendance is provided for student use, with tuition increasing approximately 3% per academic year to account for inflation. Total charges for a period of attendance and estimated schedule of total charges for entire educational program can be found at the following website: https://www.cmu.edu/sfs/tuition/graduate/cit.html

Estimated charges for ECE Ph.D. degree:

			entire program	first semester
		semesters	*12*	
Type	***FY19 $***	***Frequency***		
Application Fee*	$75	one time	$75	$75
Registration Fee	$0	n/a	$0	$0
Enrollment Deposit	$0	n/a	$0	$0
Ph.D. Tuition	$22,650	per semester	$271,800	$22,650
Activity Fee	$108	per semester	$1,296	$108
Technology Fee	$210	per semester	$2,520	$210
Transportation Fee	$108	per semester	$1,296	$108
Books and Supplies	$1,106	per semester	$13,272	$1,106
Student Tuition Recovery (STRF)	$0	n/a	$0	$0
			$290,259	**$23,322**

Unless noted otherwise, stipend payments will be disbursed twice a month (semi-monthly) following the academic year cycle (August 16th through August 15th each year). Payment occurs once in the middle of the month and once on the last working weekday of the month. Exact pay dates are available on the CMUWorks Payroll Resources website (see Graduate Student - Semi-Monthly - Pay Date).

The stipend for Silicon Valley Ph.D. students is equal to $3,216 per month for the 2021-2022 academic year to allow for the increased cost of living in the Silicon Valley area. Silicon Valley Ph.D. students can apply for up to $1,000 of travel reimbursement from the ECE Department for the Qualifying Exam. More details about the reimbursement procedure will be communicated upon the submission of the Qualifying Exam Declaration.

Stipend amounts are reviewed each year and augmented according to increases in the cost of living. Such increases will be communicated to students prior to the following academic year. When deciding on the stipend amount, The department takes into consideration personal expenses, such as rent/utilities, health insurance, other insurance, childcare, etc.

Summer Semester Tuition & Stipend

Students supported by the ECE department are expected to continue working over the summer in some capacity, either via research on campus or through an off-campus internship. Students will continue to be compensated at the same stipend rate paid during the academic year if they are working on campus. Stipend payments will be suspended if the student is doing an off-campus internship or has failed to register for the summer semester.

Tuition is not assessed during the summer semester if the student is registered for *18990 Reading and Research*. Registration for other courses may trigger a tuition charge for which the student will be responsible to pay unless prior arrangements have been made with the student's faculty advisor. It is the student's responsibility to understand the financial repercussions of his or her summer registration.

Losing, Reducing, or Changing Funding

If a student is supported by the department through an external grant or contract, and this funding is lost, reduced, or changed, the advisor will notify the student accordingly. All efforts will be made to facilitate the student's continuation in his/her degree program, if he or she is progressing satisfactorily in the program. Students who are not progressing satisfactorily may receive a dismissal letter. The dismissal process is outlined in the "Satisfactory Progress and Program Dismissal" of this handbook. More information about becoming self-supporting is contained in the following section.

Self-Supporting Students

With few exceptions, almost all Ph.D. students in the ECE department are funded through the department or a third party entity. Students are typically not allowed to self-support. One exception to this requirement is that, occasionally, students who are in All But Dissertation (ABD) status must become self-supporting due to a change in an advisor's funding situation and/or because of other factors.

Per CIT's In Residence Status for ABD Candidates policy (under 'All but dissertation status' section):

"Under exceptional circumstances, ABD students who are self-supported, and who can demonstrate financial hardship, may petition the College through the departments for permission to register for 5 units of thesis research per semester." The exceptional circumstances for such approval include:

- Self-supporting with demonstrated financial hardship
- At least three years of full time student status
- Good standing and progress towards a degree
- No more than two semesters of required work; ABD with In Residence status and 5 units of tuition per term will not be allowed for more than two semesters of work, where a summer is considered to be one semester."

Students should submit a fully-endorsed self-supporting application to the Graduate Affairs Office prior to the 10th day of class in the semester in which they are becoming self-supporting.

If the student has not completed the degree program after two self-supporting semesters, and no additional funding from the faculty advisor is available, the student will have the option of going ABD in absentia, taking a leave of absence, or withdrawing from the ECE Ph.D. program.

Fees

ECE will pay for each student's technology fee as long as the student is enrolled as a full-time student or is under All But Dissertation in Residence (ABD) status. If a student moves into ABS absentia status, the student will be responsible for paying for the technology fee each semester while under absentia status, including the semester in which the student returns to defend his/her dissertation. **When a student returns from ABD in absentia to defend, he or she will be responsible for paying for all fees and tuition assessed.**

Students are responsible for paying the Student Activities Fee, the PAT Transit Fee, and for health insurance. Students are encouraged to check their SIO regularly to ensure that all outstanding balances are addressed. Many students pay for their Carnegie Mellon health insurance and other charges directly from their stipend.

The technology fee and tuition are paid over eighteen monthly installments (August 16th -May 15th). The process decreases the student account balance incrementally over the academic year such that the tuition balance reaches zero in the middle of May.

Taxes

The deadline for local, state, and federal taxes is April 15. You can obtain tax forms in the mail, at the post office, or at the Carnegie Library. Questions about your tax status should be addressed to the IRSTeleTax at 412-261-1040, or the Pennsylvania Department of Revenue at 412-565-7540. Although subject to federal taxes, student stipends are generally not assessed local or state taxes.

Conference & Travel Funding

As a department, ECE does not provide centralized travel or conference funding. However, students are encouraged to talk to their faculty advisor(s) about travel or conference funding. The Office of the Assistant Vice Provost for Graduate Education does provide some conference funding via an application process. Conference funding is provided by GSA and the Provost's Office for students, student work groups, or groups to attend a conference, whether as a participant or as a presenter. Students can find more information about the application process and deadlines at www.cmu.edu/graduate.

Additional Sources for Financial Support

University Financial Aid

Graduate students should consult the graduate student financial aid information found on the HUB's Student Financial Aid website. Students will find the Graduate Financial Aid Guide, information about funding options and how to apply for financial aid and other helpful links.

Additional information on federal and state aid, and financial aid policies, may be found in APPENDIX D.

Emergency Loans

The Office of the Dean of Student Affairs offers short-term emergency loans for supplies, medication, food or other unexpected circumstances. The loans are interest-free and for short periods of time (not longer than a month). Graduate students who find themselves in need of immediate funds for emergency situations should contact the Office of the Dean of Student Affairs to inquire about an Emergency Student Loan (see Appendix A).

Fellowships

Students who are interested in applying for external fellowships should see their advisor or check the online information provided by the Office of Scholarships and Fellowships website. The website is an excellent resource for locating an abundance of information regarding available funding for students.

Additionally, fellowship opportunities will be announced periodically over the course of the academic year by the department. While students can apply directly to some of these fellowships, most require an internal competition to identify top students for nomination. Students are encouraged to monitor the ECE Fellowship Opportunities website for active fellowships.

GuSH Funding

GuSH Research Funding is a source of small research grant funds provided by GSA and the Provost's Office and managed by the Office of the Assistant Vice Provost for Graduate Education.

Teaching Assistantships

Once an ECE Ph.D. student has completed the two required Teaching Internships (TIs), he or she can continue to teaching assistant for courses for hourly pay instead of receiving academic credit. Students must fill out the teaching assistant application to formally be matched to a course.

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990. For more information about requirements, see Evaluation & Certification of English Fluency for Instructors in the University Policies of this handbook.

Payroll

Other questions concerning payment options should be addressed to the ECE Finance Office in HH 1116.

Outside Employment

ECE follows CIT guidelines on outside employment (under 'Graduate Student Consulting'). Full-time students in ECE are expected to devote their full-time to research, teaching, and coursework per the compensation students are receiving via the stipend during the academic year.

Occasionally, there are employment opportunities offered to students that will enrich their research, coursework, and teaching. In these situations, students should consult with their faculty advisor regarding the opportunity and how it may impact their academic progress. Prior to accepting a position, students must receive written permission from both the faculty advisor and Department Head. Full-time students will be expected to keep up with their full-time research commitments even while employed outside of CMU. Students may consider taking a leave of absence to pursue full-time employment; however, this should be discussed with the student's advisor(s) and the Graduate Affairs Office prior to the student deciding to take a leave.

Please note that international students have additional constraints on their eligibility to pursue employment outside of CMU. OIE provides additional information on employment options for international students on their website. International students are responsible for ensuring that their work authorization is valid and up to date.

CAREER SERVICES

The Career and Professional Development Services Center (CPDC) serves to provide students with guidance during their job and internship searches. The services available to students include

resume reviews, mock interviewing, salary negotiation, career exploration consultation, internship and job consultation, workshops/events and employer relations. The CPDC is also heavily involved in organizing campus-wide job fairs and bringing employers to campus.

Carnegie Mellon's Silicon Valley campus hosts programming through our Student Affairs team: Lauren Schachar, Assistant Dean of Student Affairs; Leigh Mason, Assistant Director of Career Services; and Jennifer Wolfeld, Language and Communication Specialist.

Handshake is Carnegie Mellon's online recruiting system. Through Handshake, employers can request accounts to post jobs, request interviews and information sessions, and review student resumes. Students and alumni can apply to positions, sign up for interviews and find contact information for thousands of recruiters. Handshake can be accessed through the CPDC website.

Career Consultants

CMU Silicon valley has career consultants who provide guidance through one-on-one appointments. Students in Silicon Valley can meet with Assistant Dean of Student Affairs Lauren Schachar or Leigh Mason, Assistant Director of Career Services. Appointments with Lauren and Leigh can be made through Handshake. They will each also hold open office hours, which will be communicated at the beginning of each semester.

Job Search Guidelines

ECE strives to play a supportive role in the career pursuits of students, but maintains academics as a priority. It is not acceptable for students to skip classes or assignments in order to attend job interviews. Students should conduct job searched in a manner that does not impede the academic progress through their graduate program.

It is also important for students to have an understanding of how to conduct a job search. When applying for jobs, students are expected to exhibit certain ethical behavior, such as arriving on time for interviews, being truthful about their qualifications, and to honor their agreements with recruiters. Further, students should not continue looking and interviewing for a position after they have accepted an offer.

The CPDC reserves the right to limit access for any users that do not follow CMU's ethical job/internship search policy. Students who do not follow such guidelines may forfeit their on-campus interviewing and/or resume submission privileges.

Job Classification and Salary Disclosure

The job classification(s) the ECE MS and PhD programs prepares its graduates for can be accessed online via CMU Box.

UNIVERSITY POLICIES

Academic Integrity

Students at Carnegie Mellon are engaged in intellectual activity consistent with the highest standards of the academy. The relationship between students and instructors and their shared

commitment to overarching standards of respect, honor and transparency determine the integrity of our community of scholars. The actions of our students, faculty and staff are a representation of our university community and of the professional and personal communities that we lead. Therefore, a deep and abiding commitment to academic integrity is fundamental to a Carnegie Mellon education. For more information on these standards, please visit the link below: http://www.cmu.edu/policies/student-and-student-life/academic-integrity.html

Assistance for Individuals with Disabilities

Students with disabilities are encouraged to self-identify with Office of Disability Resources by contacting Catherine Getchell, 412-268-6121, to access the services available at the University.

Evaluation & Certification of English Fluency for Instructors

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990. Teaching Assistant English Fluency is managed through the International Teaching Assistant testing process administered by CMU's Intercultural Communication Center. For details please visit the links below:

- http://www.cmu.edu/policies/faculty/evaluation-certification-english-fluency-instructors.html
- http://www.cmu.edu/icc/

Leave of Absence & Withdrawal Policies

"Leave of absence" means leaving the university temporarily, with the firm and stated intention to return. "Withdrawal" means leaving the university with no intention to return. Withdrawals or leaves taken on or before the university deadline to drop classes without receiving a 'W' (withdrawal) grade will result in all courses or grades being removed. Withdrawals or leaves taken after the university deadline to drop classes but before the last day of classes will result in 'W' grades assigned to all classes. Withdrawals or leaves taken after the last day of classes will result in permanent grades assigned by the instructors for each class. After the last day of class, courses cannot be removed from a student's transcript.

International students should consult with the Office of International Education (OIE) prior to taking a leave of absence or withdraw from their program.

Further information about Carnegie Mellon's policy on student leave is available at the following link: http://www.cmu.edu/policies/student-and-student-life/student-leave.html

Students who would like to take a leave of absence or withdraw must complete the appropriate form at the following link: http://www.cmu.edu/hub/forms.html

Please see "Preparing an Academic Plan" section (under Administrative and Program Policies) of this handbook for ECE's policy on leave of absence and withdrawals.

Tuition Refund Policy

If an ECE student withdraws or takes a leave of absence, the HUB will determine if a student should receive a tuition refund, as this is governed by CMU policy (not ECE). Additional

information is available at the following link:
https://www.cmu.edu/sfs/tuition/adjustment/index.html.

Returning to Carnegie Mellon

When a student plans to return to CMU after a leave of absence, he/she must complete the Petition for Return from Leave of Absence form at least one month prior to the start of the semester. We recommend doing so prior to the registration period for the upcoming semester (for Fall, April and for Spring, November). The student must also meet any conditions that were set by ECE or the university at the time of leave was granted. Further information about Carnegie Mellon's policy on student return is available at the following link: https://www.cmu.edu/hub/registrar/leaves-and-withdrawals/index.html.

Retention of Student Records

The policy of Carnegie Mellon University is to ensure the safety, accessibility, confidentiality, and good condition of the permanent record of every Carnegie Mellon student, past and present.

Carnegie Mellon University (CMU), established in 1900, holds all permanent records of our students (current and former) in the University Registrar's Office. We maintain original paper records in an offsite secure climate-controlled underground storage facility along with a microfilmed copy of each record. In addition, a copy of microfilmed records also resides in the University Registrar's Office in Pittsburgh, PA. This includes all students globally, include those students studying at our California teaching location and instructional sites. CMU has established the University Registrar's Office as the official data steward of all student records.

Historical Records 1906-1989

For every student enrolled at Carnegie Mellon University as a new or continuing student prior to the fall semester, 1989, and dating back to 1906, the University Registrar's Office of Carnegie Mellon University maintains a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not within the student's official transcript. The official transcript provides brief personal information to identify the student as unique. It contains courses, units and grades; semester and cumulative grade point averages; all degrees earned; transfer credit or advanced placement and dean's list indications.

The University Registrar's Office has established and maintains within a microfiche copy of good, readable, and reproducible quality of the student's permanent record in a secured records unit. A secondary permanent microfilm copy of all records will be maintained in good condition in the climate-controlled, fire-proof, limited-access security at an offsite facility.

Modern Records 1989-Current

For every student enrolling at Carnegie Mellon University as a new or continuing student beginning in fall semester, 1989, the University Registrar's Office of Carnegie Mellon University will establish and maintain within an electronic data file in the University Student Services Suite (S3, our student information system) a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not. The University Registrar's Office staff will, under the direction of the University Registrar, add to the electronic record such new information as pertains to the student's demographic and academic record as

it becomes available, semester-by-semester, and as the student progresses in his/her career at Carnegie Mellon University.

Daily, the Carnegie Mellon University Computing Services Division will perform a backup of all databases that have been altered during that day. Weekly, the Computing Services Division will perform a complete backup of all records within the student data file. The Computing Services Division staff will store the daily backups in the climate-controlled, fire-proof, limited-access security facility in the Computer Operations center in Cyert Hall on the Carnegie Mellon University campus. Upon successful completion of the monthly backup, the Computing Services Division staff will securely transfer the weekly and monthly backups from the preceding month to climate-controlled, fire-proof, secured vault at an offsite facility.

Cessation of Operations

In the unlikely event that CMU (which has existed for more than 100 years) ceases to exist, it will make appropriate arrangements to comply with clauses (1) and (2) for all its students consistent with the Commonwealth of Pennsylvania statutes and law. I have an informal plan and agreement with the University of Pittsburgh's University Registrar's Office, that should either school cease, we would exchange student records.

Safeguarding Educational Equity – Sexual Harassment and Sexual Assault Policy

The University prohibits sex-based discrimination, sexual harassment, sexual assault, dating/ domestic violence and stalking. The University also prohibits retaliation against individuals who bring forward such concerns or allegations in good faith. The University's Sexual Misconduct Policy is available at https://www.cmu.edu/policies/administrative-and-governance/sexual-misconduct/index.html. The University's Policy Against Retaliation is available at https://www.cmu.edu/policies/administrative-and-governance/whistleblower.html. If you have been impacted by any of these issues, you are encouraged to make contact with any of the following resources:

- Office of Title IX Initiatives, https://www.cmu.edu/title-ix/ 412-268-7125, tix@cmu.edu
- University Police, 412-268-2323

Additional resources and information can be found at: https://www.cmu.edu/title-ix/resources-and-information/resources.html.

Suspension/Required Withdrawal Policy

University suspension is a forced, temporary leave from the university. A student may be suspended for academic, disciplinary, or administrative reasons. Additional information is available at the following link: http://www.cmu.edu/policies/student-and-student-life/suspension-required-withdrawal-policy.html

Withdrawal of a Degree

The university reserves the right to withdraw a degree even though it has been granted should there be discovery granted that the work which it was based or the academic records in support of it had been falsified. The complete reference to this university

policy is available at: http://www.cmu.edu/policies/student-and-student-life/withdrawal-of-a-degree.html

University Grievances

Students are encouraged to discuss any concerns or grievances informally within ECE. If a student is not satisfied with the results of informal discussion or formal appeal at the department level, he or she may follow the guidelines on Graduate Student Appeal and Grievance Procedures. Students are likewise encouraged to speak directly to their graduate student's representatives and to the president of the Graduate Student Assembly (GSA). The complete reference to this policy is available at: http://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

Student Maternity Accommodation Protocol

Female students seeking Maternity Accommodations should visit the following link from the Graduate Education's website: http://www.cmu.edu/graduate/programs-services/maternity-accommodation-protocol.html

Verification of Employment

Carnegie Mellon University employees or former employees are required to use Employment Verification Request Form to request employment verification. Vendors, such as mortgage companies, may continue to use standard formats with a signed authorization. Details and forms are available at https://www.cmu.edu/hr/resources/hr-partners/hr-services/.

Employment with ECE Department

Eligible international students who qualify for pre- or post-completion Optional Practical Training (OPT) work authorization should note that the ECE department (as an employer) does not offer unpaid positions for OPT work authorization. While off-campus employment or volunteer opportunities under OPT work authorization do not have to be paid positions, ECE will only offer paid positions to eligible students.

Appendix A

2021-2022

Highlighted University Resources for Graduate Students
and
The WORD, Student Handbook

Key Offices for Graduate Student Support

Graduate Education Office
www.cmu.edu/graduate; grad-ed@cmu.edu
The Graduate Education Office provides central support for all Master's and Doctoral students with a focus on their academic experience at Carnegie Mellon. The Graduate Education Office serves as a hub for connecting graduate students to relevant campus experts and resources to support their academic success, understanding of university level policies and practices and to assist them in advancing their personal and professional development.

Examples of resources offered through the Graduate Education Office include- but are not limited to:

- Website with university resources, contact information for CMU programs and services, calendar of events related to graduate students
- Bi-monthly email to all graduate students with information on activities, resources and opportunities
- Professional Development Seminars and Workshops
- GSA/Provost Conference Funding Grants
- GSA/Provost Small Research Grants (GuSH)
- Consultations on issues related to the graduate student experience

The Graduate Education Office also works with the colleges and departments by informing and assisting in developing policy and procedures relevant to graduate students and working with departments on issues related to graduate students. Additionally we partner with many other offices and organizations, such as the Graduate Student Assembly, to support the holistic graduate student educational experience.

Office of the Dean of Students
https://www.cmu.edu/student-affairs/dean

The Office of the Dean of Students provides central leadership of the metacurricular experience at Carnegie Mellon including the coordination of student support. Vice President of Student Affairs and Dean of Students Gina Casalegno leads the Division of Student Affairs which includes the offices and departments listed below (not an exhaustive list).

Graduate students will find the enrollment information for Domestic Partner Registration and Maternity Accommodations in the Office of the Dean of Students or on their website. This

Office also manages the Emergency Student Loan (ESLs) process. Emergency Student Loans are made available through generous gifts of alumni and friends of the university. The Emergency Student Loan is an interest-free, emergency-based loan repayable to the university within 30 days. Loans are available to enrolled students for academic supplies, medication, food or other expenses not able to be met due to unforeseeable circumstances.

Additional resources for graduate students include College Liaisons and the Student Support Resources team. College Liaisons are senior members of the Division of Student Affairs who work with departments and colleges addressing student concerns across a wide range of issues. College Liaisons are identified on the student SIO page in the Important Contacts list. The Student Support Resources team offers an additional level of support for students who are navigating any of a wide range of life events. Student Support Resources staff members work in partnership with campus and community resources to provide coordination of care and support appropriate to each student's situation.

The Division of Student Affairs includes (not an exhaustive list):

- Athletics, Physical Education and Recreation
- Career and Professional Development Center (CPDC)
- Center for Student Diversity and Inclusion
- Cohon University Center
- Counseling & Psychological Services (CaPS)
- Dining Services
- Office of Community Standards and Integrity (OCSI)
- Office of Student Leadership, Involvement, and Civic Engagement (SLICE)
- University Health Services (UHS)
- Wellness Initiatives

Center for Student Diversity & Inclusion
https://www.cmu.edu/student-diversity/
Diversity and inclusion have a singular place among the values of Carnegie Mellon University. The Center for Student Diversity & Inclusion actively cultivates a strong, diverse and inclusive community capable of living out these values and advancing research, creativity, learning and development that changes the world.

The Center offers resources to enhance an inclusive and transformative student experience in dimensions such as access, success, campus climate and intergroup dialogue. Additionally, the Center supports and connects historically underrepresented students and those who are first in their family to attend college in a setting where students' differences and talents are appreciated and reinforced, both at the graduate and undergraduate level. Initiatives coordinated by the Center include, but are not limited to:

- First generation/first in family to attend college programs
- LGBTQ+ Initiatives

- Race and ethnically-focused programs, including Inter-University Graduate Students of Color Series (SOC) and PhD SOC Network
- Women's empowerment programs, including Graduate Women's Gatherings (GWGs)
- Transgender and non-binary student programs

Assistance for Individuals with Disabilities

http://www.cmu.edu/disability-resources/

The Office of Disability Resources at Carnegie Mellon University has a continued mission to provide physical, digital, and programmatic access to ensure that students with disabilities have equal access to their educational experience. We work to ensure that qualified individuals receive reasonable accommodations as guaranteed by the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973. Students who would like to receive accommodations can begin the process through Disability Resources' secure online portal or email access@andrew.cmu.edu to begin the interactive accommodation process.

Students with physical, sensory, cognitive, or emotional disabilities are encouraged to self-identify with the Office of Disability Resources and request needed accommodations. Any questions about the process can be directed to access@andrew.cmu.edu, or call (412) 268-6121.

Eberly Center for Teaching Excellence & Educational Innovation

www.cmu.edu/teaching

We offer a wide variety of confidential, consultation services and professional development programs to support graduate students as teaching assistants or instructors of record during their time at Carnegie Mellon University and as future faculty members at other institutions. Regardless of one's current or future teaching context and duties, our goal is to disseminate evidence-based teaching strategies in ways that are accessible and actionable. Programs and services include campus-wide Graduate Student Instructor Orientation events and our Future Faculty Program, both of which are designed to help participants be effective and efficient in their teaching roles. The Eberly Center also assists departments in creating and conducting customized programs to meet the specific needs of their graduate student instructors. Specific information about Eberly Center support for graduate students is found at www.cmu.edu/teaching/graduatestudentsupport/index.html.

Graduate Student Assembly

www.cmu.edu/stugov/gsa/index.html

The Graduate Student Assembly (GSA) is the branch of Carnegie Mellon Student Government that represents, and advocates for the diverse interests of all graduate students at CMU. GSA is composed of representatives from the different graduate programs and departments who want to improve the graduate student experience at the different levels of the university. GSA is funded by the Student Activities Fee from all graduate students. GSA passes legislation, allocates student activities funding, advocates for legislative action locally and in Washington D.C. on behalf of graduate student issues and needs, and otherwise acts on behalf of all graduate student interests. Our recent accomplishments are a testament to GSA making a difference, and steps to implementing the vision laid out by the strategic plan. https://www.cmu.edu/stugov/gsa/About-the-GSA/Strategic-Plan.html.

GSA offers an expanding suite of social programming on and off-campus to bring graduate students from different departments together and build a sense of community. GSA is the host of the Graduate Student Lounge on the 3rd floor of the Cohon University Center- a great place to study or meet up with friends. GSA also maintains a website of graduate student resources on and off-campus. Through GSA's continued funding for professional development and research conferences, the GSA/Provost Conference Funding Program and GSA/Provost GuSH Research Grants are able to run, as managed by the Graduate Education Office. As we move forward, GSA will continue to rely on your feedback to improve the graduate student experience at CMU. Feel free to contact us at <gsa@cmu.edu> to get involved, stop by our office in the Cohon University Center Room 304 or become a representative for your department.

Office of International Education (OIE)
http://www.cmu.edu/oie/

Carnegie Mellon hosts international graduate and undergraduate students who come from more than 90 countries. The Office of International Education (OIE) is the liaison to the University for all non-immigrant students and scholars, as well the repository for study abroad opportunities and advisement. OIE provides many services including: advising on personal, immigration, study abroad, academic, and social and acculturation issues; presenting programs of interest such as international career workshops, tax workshops, and cross-cultural and immigration workshops; international education and statistics on international students in the United States; posting pertinent information to students through email and the OIE website, and conducting orientation and pre-departure programs.

Veterans and Military Community
http://www.cmu.edu/veterans/
Military veterans are a vital part of the Carnegie Mellon University community. Graduate students can find information on applying for veteran education benefits, campus services, veteran's groups at CMU, and non-educational resources through the Veterans and Military Community website. There are also links and connections to veteran resource in the Pittsburgh community. The ROTC and Veteran Affairs Coordinator can be reached at uro-vaedbenefits@andrew.cmu.edu or 412-268-8747.

Carnegie Mellon Ethics Hotline
https://www.cmu.edu/hr/resources/ethics-hotline.html
The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to areas below:

- Academic and Student Life
- Bias Reporting
- Environmental Health and Safety
- Financial Matters
- High-Risk Incident
- Human Resource Related
- Information Systems

- Research
- Threat of Business Interruption
- Threat of Violence or Physical Harm
- Title IX

Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net(user name: tartans; password: plaid). All submissions are reported to appropriate university personnel.
The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

Policy Against Retaliation
It is the policy of Carnegie Mellon University to protect from retaliation any individual who makes a good faith report of a suspected violation of any applicable law or regulation, university Policy or procedure, any contractual obligation of the university, and any report made pursuant to the Carnegie Mellon University Code of Business Ethics and Conduct.

Additional details regarding the Policy Against Retaliation are available at https://www.cmu.edu/policies/administrative-and-governance/whistleblower.html

Key Offices for Academic & Research Support

Computing and Information Resources
www.cmu.edu/computing
Computing Services maintains and supports computing resources for the campus community, including the campus wired and wireless networks, printing, computer labs, file storage, email and software catalog. As members of this community, we are all responsible for the security of these shared resources. Be sure to review the Safe Computing (https://www.cmu.edu/computing/safe/) section and the University Computing Policy (https://www.cmu.edu/policies/information-technology/computing.html)

Visit the Computing Services website (https://www.cmu.edu/computing/) to learn more. For assistance the Computing Services Help Center is available at 412-268-4357 (HELP) or it-help@cmu.edu.

Student Academic Success Center
https://www.cmu.edu/student-success/
Student Academic Support Programs

Tartan Scholars
- The Tartan Scholars program was created to provide support for limited resourced students through an intentional first year undergraduate experience with the goals of enhancing the cohort's skill and community building through a lens of self -authorship,

growth mindset, and a sense of belonging. As part of the Student Academic Success Center, Tartan Scholars are invited to join the University and participate in summer initiatives and pre-orientation activities prior to their first year at the University.

- There are opportunities for graduate students to serve as accountability, learning, or development partners, workshop facilitators, and presenters. Contact Diane Hightower at ddhighto@andrew.cmu.edu for more details.

Learning Support

- **Supplemental Instruction:** Supplemental Instruction (SI) is an academic support model that utilizes peer-assisted study sessions. The SI program provides regularly scheduled review sessions on course materials outside the classroom. SI is a non-remedial approach to learning as the program targets high-risk courses and is available in select courses based on data related to past student performance and feasibility.
- **Peer Tutoring:** Weekly Tutoring Appointments are offered in a one-on-one and small group format to students from any discipline who need assistance with a course that may not be supported by our other services. Weekly appointments give students the opportunity to interact regularly with the same tutor to facilitate deeper understanding of concepts. Students can register online through the Student Academic Success website.
- **Academic Coaching:** Academic Coaching provides holistic one-on-one peer support and group workshops to help students find and implement their conditions for success. We assist students in improving time management, productive habits, organization, stress management, and study skills. Students will request support through the Academic Success Center website and attend in-person meetings or meet using video and audio conferencing technology to provide all students with support.
- **"Just in Time" Workshops:** The Student Academic Success team is available to partner with instructors and departments to identify skills or concepts that would benefit from supplemental offerings (workshops, boot camps) to support students' academic success and learning. We are eager to help convene and coordinate outside of the classroom skill-building opportunities that can be open to any student interested in building skill or reinforcing course concept mastery.
- **Study Partners:** Support for students to create and benefit from their own study groups: The Student Academic Success team assists students in forming and benefiting from peer study groups, whereby all students can reap the benefits of peer-to-peer learning, student agency, and collaboration skill development. Staff from the Student Academic Success Center will be made available to instructors and students to assist with the formation of peer-led study groups. This level of support is open to any course where the instructor requests or agrees such support is appropriate and students are interested in both leading and participating.

Language and Cross-cultural Support

More than 60% of graduate students at Carnegie Mellon are international students, and others

are nonnative speakers of English who have attended high school or undergraduate programs in the US. Many of these students want to hone their language and cross-cultural skills for academic and professional success. Students can choose from sessions on

- how to give a strong presentation,
- writing academic emails,
- expectations and strategies for clear academic writing,
- how to talk about yourself as a professional in the U.S.,
- developing clearer pronunciation,
- using accurate grammar,
- building fluency, and more.
- Students can make an appointment with a Language Development Specialist to get individualized coaching on language or cross-cultural issues.

The Student Academic Success Center is also charged with certifying the language of International Teaching Assistants (ITAs), ensuring that nonnative English speakers have the language proficiency needed to succeed as teaching assistants in the Carnegie Mellon classroom. Students preparing to do an ITA Certification should plan to take classes offered by the language support team at the SASC from the beginning of their first semester. Start by contacting the language support team at the SASC website or attend a Language Support Orientation at the SASC or in your department.

University Libraries

www.library.cmu.edu

The University Libraries offers a wide range of information resources and services supporting graduate students in course-work, research, teaching, and publishing. The library licenses and purchases books, journals, media and other needed materials in various formats. Library liaisons, consultants and information specialists provide in-depth and professional assistance and advice in all-things information - including locating and obtaining specific resources, providing specialized research support, advanced training in the use and management of data. Sign up for workshops and hands-on topic-specific sessions such as data visualization with Tableau, cleaning data with OpenRefine, and getting started with Zotero. Weekly drop-in hours for Digital Humanities and for Research Data Research Management are scheduled during the academic year. Start at the library home page to find the books, journals and databases you need; to identify and reach out to the library liaison in your field; to sign up for scheduled workshops; and to connect with consultants in scholarly publishing, research data management, and digital humanities.

Research at CMU

www.cmu.edu/research/index.shtml

The primary purpose of research at the university is the advancement of knowledge in all fields in which the university is active. Research is regarded as one of the university's major contributions to society and as an essential element in education, particularly at the graduate level and in faculty development. Research activities are governed by several university policies.

Guidance and more general information is found by visiting the Research at Carnegie Mellon website.

Office of Research Integrity & Compliance
www.cmu.edu/research-compliance/index.html
The Office of Research Integrity & Compliance (ORIC) is designed to support research at Carnegie Mellon University. The staff work with researchers to ensure research is conducted with integrity and in accordance with federal and Pennsylvania regulation. ORIC assists researchers with human subject research, conflicts of interest, responsible conduct of research, export controls, and institutional animal care & use. ORIC also provides consultation, advice, and review of allegations of research misconduct.

Key Offices for Health, Wellness & Safety

Counseling & Psychological Services
https://www.cmu.edu/counseling/
Counseling & Psychological Services (CaPS) affords the opportunity for students to talk privately about academic and personal concerns in a safe, confidential setting. An initial consultation at CaPS can help clarify the nature of the concern, provide immediate support, and explore further options if needed. These may include a referral for counseling within CaPS, to another resource at Carnegie Mellon, or to another resource within the larger Pittsburgh community. CaPS also provides workshops and group sessions on mental health related topics specifically for graduate students on campus. CaPS services are provided at no cost. Appointments can be made in person, or by telephone at 412-268-2922.

Health Services
www.cmu.edu/HealthServices/
University Health Services (UHS) is staffed by physicians, advanced practice clinicians and registered nurses who provide general medical care, allergy injections, first aid, gynecological care and contraception as well as on-site pharmaceuticals. The CMU Student Insurance Plan covers most visit fees to see the physicians and advanced practice clinicians & nurse visits. Fees for prescription medications, laboratory tests, diagnostic procedures and referral to the emergency room or specialists are the student's responsibility and students should review the UHS website and their insurance plan for detailed information about the university health insurance requirement and fees.

UHS also has a registered dietician and health promotion specialists on staff to assist students in addressing nutrition, drug and alcohol and other healthy lifestyle issues. In addition to providing direct health care, UHS administers the Student Health Insurance Program. The Student Health Insurance plan offers a high level of coverage in a wide network of health care providers and hospitals. Appointments can be made by visiting UHS's website, walk-in, or by telephone, 412-268-2157.

Campus Wellness

https://www.cmu.edu/wellness/

At Carnegie Mellon, we believe our individual and collective well-being is rooted in healthy connections to each other and to campus resources. The university provides a wide variety of wellness, mindfulness and connectedness initiatives and resources designed to help students thrive inside and outside the classroom. The BeWell@CMU e-newsletter seeks to be a comprehensive resource for CMU regarding all wellness-inspired events, announcements and professional and personal development opportunities. Sign up for the Be Well monthly newsletter via https://bit.ly/BeWellNewsletter or by contacting the Program Director for Student Affairs Wellness Initiatives, at alusk@andrew.cmu.edu.

Religious and Spiritual Life Initiatives (RSLI)

www.cmu.edu/student-affairs/spirituality

Carnegie Mellon is committed to the holistic growth of our students, including creating opportunities for spiritual and religious practice and exploration. We have relationships with local houses of worship from various traditions and many of these groups are members of CMU's Council of Religious Advisors. We also offer programs and initiatives that cross traditional religious boundaries in order to increase knowledge of and appreciation for the full diversity of the worldview traditions. Our RSLI staff are here to support students across the spectrum of religious and spiritual practice and would be more than happy to help you make a connection into a community of faith during your time at CMU.

University Police

http://www.cmu.edu/police/

412-268-2323 (emergency only), 412-268-6232 (non-emergency)

The University Police Department is located at 300 South Craig Street (entrance is on Filmore Street). The department's services include police patrols and call response, criminal investigations, fixed officer and foot officer patrols, event security, and crime prevention and education programming as well as bicycle and laptop registration. Visit the department's website for additional information about the staff, emergency phone locations, crime prevention, lost and found, finger print services, and annual statistic reports.

Carnegie Mellon University publishes an annual campus security and fire safety report describing the university's security, alcohol and drug, sexual assault, and fire safety policies and containing statistics about the number and type of crimes committed on the campus and the number and cause of fires in campus residence facilities during the preceding three years. Graduate students can obtain a copy by contacting the University Police Department at 412-268-6232. The annual security and fire safety report is also available online at https://www.cmu.edu/police/annualreports/.

Shuttle and Escort Services

Parking and Transportation coordinates the Shuttle Service and Escort Service provided for CMU students, faculty, and community. The Shuttle & Escort website has full information about these services, stops, routes, tracking and schedules.

The WORD

http://www.cmu.edu/student-affairs/theword//

The WORD is Carnegie Mellon University's student on-line handbook and is considered a supplement to the department (and sometimes college) handbook. The WORD contains campus resources and opportunities, academic policy information and resources, community standards information and resources. It is designed to provide all students with the tools, guidance, and insights to help you achieve your full potential as a member of the Carnegie Mellon community. Information about the following is included in The WORD (not an exhaustive list) and graduate students are encouraged to bookmark this site and refer to it often. University policies can also be found in full text at: http://www.cmu.edu/policies/.

Carnegie Mellon Vision, Mission
Statement of Assurance
Carnegie Code

Academic Standards, Policies and Procedures
- Educational Goals
- Academic and Individual Freedom
- Statement on Academic Integrity Standards for Academic & Creative Life
- Assistance for Individuals with Disabilities
- Master's Student Statute of Limitations
- Conduct of Classes
- Copyright Policy
- Cross-college & University Registration
- Doctoral Student Status Policy
- Evaluation & Certification of English Fluency for Instructors
- Final Exams for Graduate Courses
- Grading Policies
- Intellectual Property Policy
- Privacy Rights of Students
- Student's Rights

Research
- Human Subjects in Research
- Office of Research Integrity & Compliance
- Office of Sponsored Programs
- Policy for Handling Alleged Misconduct of Research
- Policy on Restricted Research

Tax Status of Graduate Student Awards

Campus Resources & Opportunities

- Alumni Relations
- Assistance for Individuals with Disabilities
- Athletics, Physical Fitness & Recreation
- Carnegie Mellon ID Cards and Services
- Cohon University Center
- Copying, Printing & Mailing
- Division of Student Affairs
- Domestic Partner Registration
- Emergency Student Loan Program
- Gender Programs & Resources
- Health Services
- Dining Services
- The HUB Student Services Center
- ID Card Services
- Leonard Gelfand Center
- LGBTQ Resources
- Multicultural and Diversity Initiatives
- Opportunities for Involvement
- Parking and Transportation Services
- Shuttle and Escort Services
- Spiritual Development
- University Police
- Student Activities
- University Stores

Community Standards, Policies and Procedures

- Alcohol and Drugs Policy
- AIDS Policy
- Bicycle/Wheeled Transportation Policy
- Damage to Carnegie Mellon Property
- Deadly Weapons
- Discriminatory Harassment
- Disorderly Conduct
- Equal Opportunity/Affirmative Action Policy
- Freedom of Expression Policy
- Health Insurance Policy Immunization Policy
- Missing Student Protocol
- Non-Discrimination Policy
- On-Campus Emergencies
- Pets
- Political Activities
- Recycling Policy
- Riotous and Disorderly Behavior

Safety Hazards
Scheduling and Use of University Facilities
Sexual Harassment and Sexual Assault Policy
Smoking Policy
Student Accounts Receivable and Collection Policy and Procedures
Student Activities Fee
Student Enterprises
Workplace Threats and Violence Policy

APPENDIX B: ADDITIONAL INFORMATION FOR CALIFORNIA PROGRAMS

Carnegie Mellon University is a private, non-profit institution, approved to operate in California by the California Bureau for Private Post-Secondary Education. Approval to operate means compliance with state standards as set forth in the California Private Postsecondary Education Act of 2009.

Any questions a student may have regarding this catalog that have not been satisfactorily answered by the institution may be directed to the Bureau for Private Postsecondary Education at 1747 North Market Blvd, Suite 225, Sacramento, CA 95834, www.bppe.ca.gov, toll-free telephone number (916) 574-8900 or by fax (916) 263-1897.

As a prospective student, you are encouraged to review this catalog prior to signing an enrollment agreement. You are also encouraged to review the School Performance Fact Sheet, which must be provided to you prior to signing an enrollment agreement.

A student or any member of the public may file a complaint about this institution with the Bureau for Private Postsecondary Education by calling (888) 370-7589 toll-free or by completing a complaint form, which can be obtained on the bureau's internet website, at www.bppe.ca.gov.

Class session will be held:

Carnegie Mellon University
NASA Ames Research Park
Bldg. 23
P.O. Box 98
Moffett Field, CA 94035-0001
(650) 603-7032
www.cmu.edu/silicon-valley

STUDENT'S RIGHT TO CANCEL (WITHDRAWAL/LEAVES OF ABSENCE)

A student has the right to cancel the student's Enrollment Agreement by either taking a leave of absence from the Program (leaving Carnegie Mellon University temporarily with the firm and stated intention of returning) or by withdrawing from the Program (leaving Carnegie Mellon University with no intention of returning). If the student withdraws or take a leave of absence from Carnegie Mellon University, the student may be eligible for a tuition adjustment or a refund of certain fees (excluding any Application Fee, Registration Fee and Enrollment Deposit).

To cancel the student's Enrollment Agreement and take a leave of absence or withdraw, the student must complete Carnegie Mellon University's Leave of Absence or Withdrawal form, as applicable, and return it to Carnegie Mellon University's Registrar's Office, at 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213. The Leave of Absence and Withdrawal forms, and additional information about leaves of absence and withdrawal, can be found on Carnegie Mellon University's website at https://www.cmu.edu/hub/registrar/leaves-and-withdrawals/.

If the student notifies Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is the earliest of:

- The date the student began the student's withdrawal or leave of absence process at Carnegie Mellon University;
- The date the student notified the student's home department at Carnegie Mellon University;
- The date the student notified the associate dean of the student's College at Carnegie Mellon University; or
- The date the student notified the Carnegie Mellon University Dean of Student Affairs.

If the student does not notify Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is:

- The midpoint of the relevant semester in which the student withdraws or takes a leave of absence;
- The last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day the student turned in a class assignment.

REFUND POLICY

1. Refunds in General. Students who withdraw from the Program or take a leave of absence after having paid the current semester's tuition and fees or receiving financial aid are subject to the following refund and repayment policies. No other charges are refundable.

2. Exit Counseling. All borrowers of Federal student loans must complete a Federally mandated exit counseling session when graduating or dropping to less than half-time enrollment status, including by withdrawing or taking a leave of absence. Exit counseling prepares students for repayment. Students must complete an exit counseling session in its entirety, with complete and correct information; otherwise, the student's degree, diploma and official transcripts may be withheld. Information about exit counseling sessions can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/financial-aid/exit-counseling.html.

3. Withdrawals/Leaves On or Before 10th Class Day (during the Cancellation Period). Students who withdraw or take a leave of absence on or before the 10th class day of the relevant semester will receive a refund of 100% of tuition and fees (excluding any Application Fee or Registration Fee and Enrollment Deposit).

4. Withdrawals/Leaves after 10th Class Day (after the Cancellation Period). Students who withdraw or take a leave of absence after the 10th class day of the relevant semester but before completing 60% of the semester will be assessed tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. STRF will be adjusted accordingly with any adjustment of tuition. There is no tuition adjustment after 60% of the semester is completed. There is no refund of University fees after the 10th class day of the relevant semester.

5. Tuition Adjustment Appeals. Students may appeal to have tuition adjustments for their leave of absence or withdrawal if they feel that they have extenuating circumstances. These appeals will be reviewed in the context of Carnegie Mellon University's tuition adjustment policy, as stated above. These appeals must be made in writing to Carnegie Mellon University's Registrar using Carnegie Mellon University's Tuition Appeal Adjustment form. Information about Carnegie Mellon University's tuition adjustment policy and tuition adjustment appeals can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/tuition/adjustment.

6. Repayment to Lenders/Third Parties. If any portion of refundable tuition and/or fees was paid from the proceeds of a loan or third party, the refund may be sent to the lender, third party or, if appropriate, to the Federal or state agency that guaranteed or reinsured the loan, as required by law and/or Carnegie Mellon University policy. Any amount of the refund in excess of the unpaid balance of the loan shall be first used to repay any student financial aid programs from which the student received benefits, in proportion to the amount of the benefits received, and any remaining amount shall be paid to the student.

7. Responsibility for Loan. If the student obtains a loan to pay for an educational program, the student will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If the student has received Federal student financial aid funds, the student is entitled to a refund of moneys not paid from Federal student financial aid program funds. If the student is eligible for a loan guaranteed by the Federal or state government and the student defaults on the loan, both of the following may occur: 1) The Federal or state government or a loan guarantee agency may take action against the student, including applying any income tax refund to which the person is entitled to reduce the balance owed on the loan. 2) The student may not be eligible for any other Federal student financial aid at another institution or other government assistance until the loan is repaid.

Meeting the cost of a graduate education is a significant investment. Carnegie Mellon University is committed to making it financially possible for graduate students to enhance educational development and reach their career goals. There are many financial aid resources available to students pursuing graduate studies at Carnegie Mellon University. Carnegie Mellon University participates in a number of Federal and state financial aid programs. Information about these financial aid programs can be found on Carnegie Mellon University's website, at http://www.cmu.edu/finaid/index.html.

If you obtain a loan to pay for the M.S. in Electrical and Computer Engineering or Software Engineering degree programs on the Silicon Valley campus, you will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If you have received federal student financial aid funds, you are entitled to a refund of moneys not paid from federal student financial aid program funds.

Carnegie Mellon University does not have a pending petition in bankruptcy, is not operating as a debtor in possession, and has not filed a petition in bankruptcy within the preceding 5 years, nor has Carnegie Mellon had a petition in bankruptcy filed against it within the preceding 5 years that resulted in re-organization under Chapter 11 of the United States Bankruptcy Code.

The State of California established the Student Tuition Recovery Fund (STRF) to relieve or mitigate economic loss suffered by a student in an educational program at a qualifying institution, who is or was a California resident while enrolled, or was enrolled in a residency program, if the student enrolled in the institution, prepaid tuition, and suffered an economic loss. Unless relieved of the obligation to do so, you must pay the state-imposed assessment for the STRF, or it must be paid on your behalf, if you are a student in an educational program, who is a California resident, or are enrolled in a residency program, and prepay all or part of your tuition.

You are not eligible for protection from the STRF and you are not required to pay the STRF assessment, if you are not a California resident, or are not enrolled in a residency program.

It is important that you keep copies of your enrollment agreement, financial aid documents, receipts, or any other information that documents the amount paid to the school. Questions regarding the STRF may be directed to the Bureau for Private Postsecondary Education, 1747 North Market Blvd, Suite 225, Sacramento, CA 95834, (916) 574-8900 or (888) 370-7589.

To be eligible for STRF, you must be a California resident or are enrolled in a residency program, prepaid tuition, paid or deemed to have paid the STRF assessment, and suffered an economic loss as a result of any of the following:

1. The institution, a location of the institution, or an educational program offered by the institution was closed or discontinued, and you did not choose to participate in a teach-out plan approved by the Bureau or did not complete a chosen teach-out plan approved by the Bureau.
2. You were enrolled at an institution or a location of the institution within the 120 day period before the closure of the institution or location of the institution, or were enrolled in an educational program within the 120 day period before the program was discontinued.
3. You were enrolled at an institution or a location of the institution more than 120 days before the closure of the institution or location of the institution, in an educational program

offered by the institution as to which the Bureau determined there was a significant decline in the quality or value of the program more than 120 days before closure.
4. The institution has been ordered to pay a refund by the Bureau but has failed to do so.
5. The institution has failed to pay or reimburse loan proceeds under a federal student loan program as required by law, or has failed to pay or reimburse proceeds received by the institution in excess of tuition and other costs.
6. You have been awarded restitution, a refund, or other monetary award by an arbitrator or court, based on a violation of this chapter by an institution or representative of an institution, but have been unable to collect the award from the institution.
7. You sought legal counsel that resulted in the cancellation of one or more of your student loans and have an invoice for services rendered and evidence of the cancellation of the student loan or loans.

To qualify for STRF reimbursement, the application must be received within four (4) years from the date of the action or event that made the student eligible for recovery from STRF.

A student whose loan is revived by a loan holder or debt collector after a period of noncollection may, at any time, file a written application for recovery from STRF for the debt that would have otherwise been eligible for recovery. If it has been more than four (4) years since the action or event that made the student eligible, the student must have filed a written application for recovery within the original four (4) year period, unless the period has been extended by another act of law.

However, no claim can be paid to any student without a social security number or a taxpayer identification number.

NOTICE CONCERNING TRANSFERABILITY OF CREDITS AND CREDENTIALS EARNED AT OUR INSTITUTION The transferability of credits you earn at Carnegie Mellon University is at the complete discretion of an institution to which you may seek to transfer. Acceptance of the M.S. degree you earn in Electrical and Computer Engineering or Software Engineering is also at the complete discretion of the institution to which you may seek to transfer. If the credits or degree that you earn at this institution are not accepted at the institution to which you seek to transfer, you may be required to repeat some or all of your coursework at that institution. For this reason you should make certain that your attendance at this institution will meet your educational goals. This may include contacting an institution to which you may seek to transfer after attending Carnegie Mellon University to determine if your credits or degree will transfer.

Meeting the cost of a graduate education is a significant investment. Carnegie Mellon University is committed to making it financially possible for graduate students to enhance educational development and reach their career goals. There are many financial aid resources available to students pursuing graduate studies at Carnegie Mellon University. Carnegie Mellon University participates in a number of Federal and state financial aid programs. Information about these financial aid programs can be found on Carnegie Mellon University's website, at http://www.cmu.edu/finaid/index.html.

Carnegie Mellon University is accredited through a voluntary, peer-review process coordinated by the Middle States Commission on Higher Education (MSCHE or Middle States). MSCHE is one of six regional accrediting agencies in the United States, each accrediting institutions of higher

education within a specific geographic region. Middle States is recognized by the U.S. Department of Education. This recognition enables MSCHE's member institutions to establish eligibility to participate in federal financial aid programs (e.g., federal loans, grants, and work-study) administered by the U.S. Department of Education. Carnegie Mellon University has been accredited by Middle States since 1921.

Please visit http://www.cmu.edu/middlestates/ to learn more about accreditation standards and processes and to view the University's reaccreditation reports.

The address and telephone number for the Middle States Commission on Higher Education is 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104, (267) 284-5000.

APPENDIX C: LIST OF PROGRAM COURSES

Entrepreneurship and Innovation in Technology (18-601) – 12 Units
Have an idea you want to bring to the world? Ever want to start a company?? Do you wonder what it takes to be an entrepreneur? Then this is the class for you. Entrepreneurship and Innovation in Technology is an introductory course in entrepreneurship for graduate students. The course targets non-business students and assumes no background in business. Students are exposed to fundamental concepts and issues around innovation and entrepreneurship. The course provides a foundation for starting a new venture and innovating new technologies and products within existing organizations. Topics covered will include: identifying a business opportunity, acquiring customers, building a team, developing a business model, understanding investment, managing risk, and achieving differentiation. Emphasis will be on team projects, including developing an investor pitch for an original idea.

Fundamentals of Modern CMOS Devices (18-610) – 12 Units
This course is intended to provide a foundation in device operation for circuit designers working in today's sub-micron CMOS. This course will also provide advanced understanding of CMOS technology for those interested in integrated circuit process technology and device physics. We review semiconductor device physics, including carrier dynamics and the basic equations of semiconductor device physics. The operation of the p-n junction diode is also reviewed. The course includes a description of integrated circuit fabrication technology and how it is used to fabricate CMOS devices. With this foundation, we then discuss the MOS capacitor (including its application as a varactor). The theory of the MOS transistor will then be developed, followed by a discussion of important phenomena in sub-micron devices such as: velocity saturation; breakdown; drain-induced barrier lowering; random dopant fluctuations, etc. The student will learn the relationship between device geometry, e.g. length, and fabrication, e.g. doping, and the corresponding circuit performance. The course will primarily be lecture-based, with some selected simulation exercises. Students are expected to be acquainted with the basic concepts of electrical circuits; electromagnetic fields at the level of a sophomore level physics course, and to have adequate preparation in mathematics (basic differential equations and MATLAB or similar applications). Prior coursework in device physics is helpful but not required for graduate students. Lecture: 4 hrs

Neural Technology: Sensing and Stimulation (18-612) – 12 Units
This course gives engineering insight into the operation of excitable cells, as well as circuitry for sensing and stimulation nerves. Initial background topics include diffusion, osmosis, drift, and mediated transport, culminating in the Nernst equation of cell potential. We will then explore models of the nerve, including electrical circuit models and the Hodgkin-Huxley mathematical model. Finally, we will explore aspects of inducing a nerve to fire artificially, and cover circuit topologies for sensing action potentials and for stimulating nerves. If time allows, we will discuss other aspects of medical device design. Students will complete a neural stimulator or sensor design project. Although students in 18-612 will share lectures and recitations with students in 18-412, students in 18-612 will receive distinct homework assignments, distinct design problems, and distinct exams from the ones given to students in 18-412 and will be graded on a separate curve from students taking 18-412.

Foundations of Computer Systems (18-613) – 12 Units
This course provides a programmer's view of how computer systems execute programs, store information, and communicate. It enables students to become more effective programmers, especially in dealing with issues of performance, portability and robustness. It also serves as a foundation for courses on compilers, networks, operating systems, and computer architecture, where a deeper understanding of systems-level issues is required. Topics covered include: machine-level code and its generation by optimizing compilers, performance evaluation and optimization, computer arithmetic, processor architecture, memory organization and management, networking technology and protocols, and supporting concurrent computation. This course is modeled after 15-213/18-213/15-513, and is intended for ECE MS students with expanded course contents presented at the graduate level. It prepares students for other graduate level computer systems courses as well as working in the industry. Anti-requisites: 15213, 18213, 15513

Microelectromechanical Systems (18-614) – 12 Units
This course introduces fabrication and design fundamentals for Microelectromechanical Systems (MEMS): on-chip sensor and actuator systems having micron-scale dimensions. Basic principles covered include microstructure fabrication, mechanics of silicon and thin-film materials, electrostatic force, capacitive motion detection, fluidic damping, piezoelectricity, piezoresistivity, and thermal micromechanics. Applications covered include pressure sensors, micromirror displays, accelerometers, and gas microsensors. Grades are based on exams and homework assignments. 4 hrs. lec.

Micro and Nano Systems Fabrication (18-615) – 12 Units
This is a new course intended to introduce students to the process flow and design methodology for integrated systems fabrication. The course will present this material through two paths. Lectures will be presented on the basic unit processes of micro and nanosystems fabrication: deposition, patterning, and etching. Lectures will draw on examples from: Semiconductor device fabrication; Microelectromechanical systems (MEMS) fabrication; Magnetic device fabrication; and Optical device fabrication. Problem sets will be given based on this lecture material to allow students to quantitatively analyze certain process steps in detail. The second path for material

presentation will be through a series of labs that allow students to design, fabricate and test an integrated device. These laboratories will be scheduled at regular meeting times, and will use research facilities within the ECE department. This is a PhD level course. MS or senior students must obtain permission from the instructor to be registered.

Nano-Bio-Photonics (18-616) – 12 Units

Light can penetrate biological tissues non-invasively. Most of the available bio-optic tools are bulky. With the advent of novel nanotechnologies, building on-chip integrated photonic devices for applications such as sensing, imaging, neural stimulation, and monitoring is now a possibility. These devices can be embedded in portable electronic devices such as cell phones for point of care diagnostics. This course is designed to convey the concepts of nano-bio-photonics in a practical way to prepare students to engage in emerging photonic technologies. The course starts with a review of electrodynamics of lightwaves. The appropriate choice of wavelength and material platform is the next topic. Then optical waveguides and resonators are discussed. Resonance-based sensing is introduced followed by a discussion of the Figure of Merits (FOMs) used to design on-chip sensors. Silicon photonics is introduced as an example of a CMOS-compatible platform. On-chip spectroscopy is the next topic. The second part covers nano-plasmonics for bio-detection and therapy. The design methods are discussed, followed by an overview of nanofabrication and chemical synthesis, and then a discussion of applications. The last part of this course will be dedicated to a review of recent applications such as Optogenetic neural stimulation, Calcium imaging, Cancer Imaging and Therapy. Senior or graduate standing required. This course is cross-listed with 18416. Although students in 18-616 and 18-416 will share the same lectures and recitations, students in 18-616 will receive distinct course projects. Students in 18-416 and 18-616 will be graded on separate curves.

Smart Grids and Future Electric Energy Systems (18-618) – 12 Units

The course offers an advanced presentation of modern electric power systems, starting from a brief review of their structure and their physical components, through modeling, analysis, computation, sensing and control concepts. Great care is taken to avoid presenting "practical" techniques built on dubious theoretical foundations and also to avoid building elaborate "mathematical" models whose physical validity and relevance may be questionable. Mastering both principles and relevant models is important for those who wish to seriously understand how today's electric power grids work and their challenging technical issues. This prepares students for working on applying many novel information processing concepts for designing and operating more reliable, secure, and efficient electric energy systems. Students interested in both applied physics and signals and systems should consider taking this subject. Once the fundamentals of today's power systems are understood, it becomes possible to consider the role of smart electric power grids in enabling evolution of future electric energy systems. Integration of intermittent energy resources into the existing grid by deploying distributed sensors and actuators at the key locations throughout the system (network, energy sources, consumers) and changes in today's Supervisory Control and Data Acquisition (SCADA) for better performance become well-posed problems of modeling, sensing and controlling complex dynamic systems. This opens opportunities to many innovations toward advanced sensing and actuation for enabling better physical performance. Modeling, sensing and control fundamentals for possible next generation

SCADA in support of highly distributed operations and design are presented. Prior knowledge in 18-418 or 18-771 is highly recommended.

Digital Integrated Circuit Design (18-622) – 12 Units
This course covers the design and implementation of digital circuits in a modern VLSI process technology. Topics will include logic gate design, functional unit design, latch/flip-flop design, system clocking, memory design, clock distribution, power supply distribution, design for test, and design for manufacturing. The lab component of the course will focus on using modern computer aided design (CAD) software to design, simulate, and lay out digital circuits. The final project for the course involves the design and implementation to the layout level of a small microprocessor. 18-240 and 18-320 or equivalent background material with permission of the instructor. Although students in 18-422 and 18-622 will share lectures, labs, and recitations, students in 18-422 and 18-622 will receive different homework assignments, design projects, and exams, and in some cases 18-622 students will also have different or additional lab sessions.

Analog Integrated Circuit Design (18-623) – 12 Units
Some form of analog circuit design is a critical step in the creation of every modern IC. First and foremost, analog circuits act as the interface between digital systems and the real world. They act to amplify and filter analog signals, and to convert signals from analog to digital and back again. In addition, high performance digital cell design (either high speed or low power) also invokes significant analog circuit design issues. The goal of this course is to teach students some of the methods used in the design and analysis of analog integrated circuits, to illustrate how one approaches design problems in general, and to expose students to a broad cross-section of important analog circuit topologies. The course will focus on learning design through carrying out design projects. Design and implementation details of wide-band amplifiers, operational amplifiers, filters and basic data converters will be covered. Example topics to be covered include transistor large- and small-signal device models, small-signal characteristics of transistor-based amplifiers, large-signal amplifier characteristics and nonidealities, operational amplifier design, basic feedback amplifier stability analysis and compensation, and comparator design. The course will focus primarily on analog CMOS, but some aspects of BJT design will be discussed. 18-290 and 18-320 or equivalent background material with permission of the instructor. Although students in 18-623 will share Lectures and Recitations with students in 18-421, students in 18-623 will receive distinct homework assignments, distinct design problems, and distinct exams from the ones given to students in 18-421 and will be graded on a separate curve from students taking 18-421.

ULSI Mobile Platform and Server Product Design (18-625) – 12 Units
The objective of this class is to design an ULSI (Ultra Large Scale Integrated) mobile platform and a server product in two scenarios: System on Chip (SoC) and System in Package (SiP). State-of-the-art 2016 technology nodes (28nm, 20nm or 14nm) will be assumed for the SoC scenario and full 3-D integration with Through Silicon Vias (TSV) will be pursued for the 2020 SiP scenario. Students will be given all the necessary technology data (device performance, interconnect

parasitics, wafer and TSV/packaging costs, and also the expected yield data). The design objective is to deliver a product competitive to the leading products available on the market or anticipated in 5 years. The complete product design will be carried out focusing on the processor cores, graphics and the embedded memories (including new generation memories in the 2020 scenarios). System performance and power will be estimated using provided simulators for specified benchmarks. The goal is to minimize the product cost by maximizing the number of good die per wafer while achieving competitive product performance and power objectives. Prerequisites: 18664 or instructor permission

Introduction to Information Security (18-631) – 12 Units

Our growing reliance on information systems for daily activities, ranging from remote communications to financial exchanges, has made information security a central issue of our critical infrastructure. The course introduces the technical and policy foundations of information security. The main objective of the course is to enable students to reason about information systems from a security engineering perspective, taking into account technical, economic and policy factors. Topics covered in the course include elementary cryptography; access control; common software vulnerabilities; common network vulnerabilities; policy and export control laws, in the U.S., Japan, and elsewhere; privacy; management and assurance; economics of security; and special topics in information security. Prerequisites: The course assumes a basic working knowledge of computers, networks, C and UNIX programming, as well as an elementary mathematics background, but does not assume any prior exposure to topics in computer or communications security. Students lacking technical background (e.g., students without any prior exposure to programming) are expected to catch up through self-study.

Introduction to Hardware Security (18-632) – 12 Units

This course covers basic concepts in the security of hardware systems. Topics covered include active and passive attacks, reverse engineering, counterfeiting, and design of hardware security primitives (e.g., random number generators, physical unclonable functions, crypto-processors). Lab sessions will give students hands on experience with performing attacks, developing countermeasures, and implementing secure hardware building blocks. Students are expected to have basic knowledge of digital logic and Register-Transfer Level (RTL) design, but no specific background in security/cryptography is necessary.

Browser Security (18-636) – 12 Units

The Web continues to grow in popularity as platform for retail transactions, financial services, and rapidly evolving forms of communication. It is becoming an increasingly attractive target for attackers who wish to compromise users' systems or steal data from other sites. Browser vendors must stay ahead of these attacks by providing features that support secure web applications. This course will study vulnerabilities in existing web browsers and the applications they render, as well as new technologies that enable web applications that were never before possible. The material will be largely based on current research problems, and students will be expected to criticize and improve existing defenses. Topics of study include (but are not limited to) browser encryption, JavaScript security, plug-in security, sandboxing, web mashups, and authentication. The course will involve an intensive group research project focusing on protocols/algorithms,

vulnerabilities, and attacks as well as several individual homework and programming tasks. Groups will perform a sequence of cumulative tasks (literature review, analysis, simulation, design, implementation) to address aspects of their chosen topic, occasionally reporting their results to the class through brief presentations, leading to a final report.

Wireless Security (18-637) – 12 Units

With the surge of mobile device use, embedded system deployment, and development of always-connected devices, the underlying wireless communication and network systems are becoming more critical for everyday use. Even though security and privacy have emerged as important focus areas for modern technology, the wireless links that connect our pervasive devices are still less understood from the perspectives of security and privacy than other system aspects. This course will focus on the challenges in providing secure communication and network services in a variety of wireless systems and current and past approaches to manage these challenges. Topic coverage will include vulnerabilities, attacks, security mechanisms, and trade-offs at various layers of the network protocol stack, from aspects of physical communication to application and service security issues; examples include jamming, MAC-layer misbehavior, selective packet dropping, decentralized trust and reputation, and cross-layer holistic attacks. Systems of interest include (but are not limited to) personal devices, connected vehicles, embedded and IoT systems, wireless infrastructure, and ad hoc networks. Class material will be largely based on recent and current research. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

Mobile and IoT Security (18-638) – 12 Units

For many people, mobile and embedded devices have become an essential part of life and work. As such devices represent many and varied combinations of technologies, they have unique security and privacy issues that potentially impact users, developers, service providers, manufacturers, and regulators. This course will focus on various aspects of security and privacy that are faced by mobile and Internet of Things devices, including aspects of wireless communication and networking, mobile computing, data analytics, security, and privacy. The course will include studies of security and privacy aspects of networking (including telecom, enterprise, personal, etc.), applications, and data analytics as relevant to mobile and embedded/IoT devices. One of the main goals of the course is to improve knowledge and awareness of security issues faced by mobile application developers, embedded system builders, and smart system designers. Material will cover standards, best practices, and research challenges in both deployed and emerging systems. Topics of study include (but are not limited to) telecom protocols and vulnerabilities; mobile/IoT network security; security and privacy in edge computing; mobile application security; and location and activity privacy. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

Policies of the Internet (18-639) – 12 Units

This course will address public policy issues related to the Internet. This may include policy issues such as network neutrality and the open Internet, Internet governance and the domain name system (and the role of the United Nations), copyright protection of online content, regulation of indecency and pornography, universal access to Internet and Internet as a "human right," government surveillance of the Internet, Internet privacy and security, and taxation of electronic commerce. It will also teach some fundamentals of Internet technology. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. Senior or graduate standing required.

Hardware Arithmetic for Machine Learning (18-640) – 12 Units

In this course, students explore the techniques for designing high-performance digital circuits for computation along with methods for evaluating their characteristics. We begin by reviewing number systems and digital arithmetic along with basic arithmetic circuits such as ripple-carry adders. From there, we move to more complex adders (carry-look-ahead, carry-skip, carry-bypass, etc.), multipliers, dividers, and floating-point units. For each circuit introduced, we will develop techniques and present theory for evaluating their functionality and speed. Other methods will be described for analyzing a circuit's power consumption, testability, silicon area requirements, correctness, and cost. In addition, we will utilize various CAD tools to evaluate the circuits described. Finally, advanced timing and clocking concepts will be investigated. For example, the notion of clock skew will be introduced and its impact on clock period for sequential circuits will be analyzed. We will also learn how to analyze and design asynchronous circuits, a class of sequential circuits that do not utilize a clock signal. Course projects focus on key arithmetic aspects of various machine learning algorithms including: K-nearest neighbors, neural networks, decision trees, and support vector machines.

*Note: Although students in 18-340 and 18-640 will share lectures, labs, and recitations, students in 18-340 and 18-640 will receive different homework assignments, design projects, and exams. In some cases 18-640 students will also have different or additional lab sessions. The homework assignments, design projects, and exams that are given to the students registered for 18-640 will be more challenging than those given to the students registered for 18-340 in that they will have more complex designs, involve additional theoretical analysis, and have more stringent specifications (e.g., in area, power, performance, and robustness).

Design Patterns for Smartphone Development (18-641) – 12 Units

This course provides an intensive exploration of computer programming by reviewing the basics of Object-Orientated programming and moving quickly to advanced programming using design patterns and a multi-tiered architecture. As part of the course work, students will learn smartphone development and how to apply the learned programming techniques to create extensible, reusable and quality software. It is intended for master's students who have had some prior, but perhaps limited, programming experience in Java or another object-oriented programming language; it is not intended as a first course in programming.

Embedded System Software Engineering (18-642) – 12 Units

In a very real sense, embedded software is what makes our everyday world function. From self-driving cars to chemical processing plant equipment, and from medical devices to the electric grid, embedded software is everywhere. You already know how to write code for a microcontroller. Now, learn software quality, safety, and security skills that are required to make embedded systems that can handle the messiness of the real world. This course provides in-depth coverage of the topics that are essential to the success of embedded software projects based on case studies of industry project teams that have suffered or failed. Students will learn about a variety of topics including: lightweight but high quality embedded software processes, technical best practices for embedded software, effective testing and validation, causes of software system failures, software for safety-critical systems, and embedded-specific aspects of software security. The material will generally be broken up into a set of four related topics each week, with one assignment per topic weekly, involving a combination of programming assignments, tool use experiences, and research questions to get hands-on experience at dealing with the types of problems that are encountered in industry embedded projects. We assume you already know how to code in C and understand the basics of microcontrollers. This course is about getting you ready to build industry-strength embedded projects. Undergraduate students are required to take 18349 prior to enrolling in this course. Graduate students are strongly encouraged to take 18-600/15-213/15-513/18-213 before or concurrently with this course.

Reconfigurable Logic: Technology, Architecture and Applications (18-643) – 12 Units
Three decades since its original inception as a lower-cost compromise to ASIC, modern Field Programmable Gate Arrays (FPGAs) are versatile and powerful systems-on-a-chip for many applications that need both hardware level efficiency and the flexibility of reprogrammability. More recently, FPGAs have also emerged as a formidable computing substrate with applications ranging from data centers and mobile devices. This course offers a comprehensive coverage of modern FPGAs in terms of technology, architecture and applications. The coverage will also extend into on-going research investigations of future directions. Students will take part in a substantial design projects applying the latest FPGA platforms to compute acceleration. Register-Transfer Level (RTL) hardware design experience is required.

Special Topics in Computer Systems (18-644) – 12 Units
This course covers applications of mobile hardware systems and the hardware associated with these systems. The course enables students 1) to analyze the implications of mobile hardware capabilities and restrictions in order to plan and develop mobile applications, 2) to propose and justify new ideas in the mobile space, and 3) to expose students to a range of mobile systems. Students will be able to devise and interface simple hardware additions to enable new applications. The course covers the elements of embedded systems development, such as hardware fundamentals, system development, as well mobile topics such as power management, machine-to-machine communication, and applications. Student teams will undertake small HW/SW interfacing projects on Arduino to sharpen their experience, and shape and build a novel application with the faculty. Unlike a conventional hardware course, the course would instead focus on the system and software implications, rather than the hardware components (i.e. CPU and radio). Prerequisites: Some understanding of basic electrical terminology; Java programming and C programming desired

How to Write Fast Code (18-645) – 12 Units
The fast evolution and increasing complexity of computing platforms pose a major challenge for developers of high performance software for engineering, science, and consumer applications: it becomes increasingly harder to harness the available computing power. Straightforward implementations may lose as much as one or two orders of magnitude in performance. On the other hand, creating optimal implementations requires the developer to have an understanding of algorithms, capabilities and limitations of compilers, and the target platform's architecture and microarchitecture. This interdisciplinary course introduces the student to the foundations and state-of-the-art techniques in high performance software development using important functionality such as linear algebra kernels, transforms, filters, and others as examples. The course will explain how to optimize for the memory hierarchy, take advantage of special instruction sets, and how to write parallel code for multicore, manycore, and cluster platforms, based on state-of-the-art research. Further, a general strategy for performance analysis and optimization is introduced that the students will apply in group projects that accompany the course. Finally, the course will introduce the students to the recent field of automatic performance tuning. Prerequiste: Senior ECE or CS undergraduate student or higher, solid C programming skills.

Low-Power System-on-Chip Architecture (18-646) – 12 Units
This course provides the architectural foundations for low-power systems out of which sensors, low power embedded systems, internet of things devices and the like are created. It includes microarchitecture, energy-aware programming, energy harvesting, energy management, and real-time measurement and abstraction of energy usage at runtime. As a part of the course, we will naturally build embedded systems at a level where energy usage can be measured and controlled.

Embedded Real-Time Systems (18-648) – 12 Units
Real-time embedded systems pervade many aspects of modern life ranging from household appliances, transportation and motion control systems, medical systems and devices, robotics, multimedia and mobile communications, video-games, energy generation/distribution/management, to aerospace and defense systems. This course has three complementary goals. One, it will cover the core concepts and principles underlying these systems, including resource management, scheduling, dependability and safety. Implications to multi-core platforms, SoCs, networks and communication buses will also be discussed. Mathematical models and analysis techniques will be presented. Two, the course will offer hands-on experience with implementing real-time embedded systems on realistic platforms. This will be facilitated by detailed discussions of hardware-software interfaces, concurrency and communications. Finally, application-level concepts such as signal processing, image processing, computer vision, sensor fusion and feedback control will complete an overview of the breadth and depth of real-time embedded systems. Knowledge of the C programming language, basic computer architecture and an assembly language will be assumed.

Distributed Embedded Systems (18-649) – 12 Units

Embedded computers seem to be everywhere, and are increasingly used in applications as diverse as transportation, medical equipment, industrial controls, and consumer products. This course covers how to design and analyze distributed embedded systems, which typically consist of multiple processors on a local area network performing real time control tasks. The topics covered will include issues such as communication protocols, synchronization, real-time operation, fault tolerance, distributed I/O, design validation, and industrial implementation concerns. The emphasis will be on areas that are specific to embedded distributed systems as opposed to general-purpose networked workstation applications. This course assumes that students already know fundamental topics such as interrupts, basic I/O, and uniprocessor scheduling that are commonly taught in introduction-level embedded system courses such as 18-348 and 18-349. Any graduate student who has not taken one of the pre-requ isites is responsible for understanding relevant material necessary for this course. Additionally, all students are responsible for knowing or learning on their own intermediate-level programming in Java. Prerequisites: 18348 or 18349 and senior or graduate standing.

Policies of Wireless Systems (18-650) – 12 Units

This course will address public policy issues related to wireless systems. It investigates policies related to a wide variety of emerging wireless systems and technologies, including current and next-generation cellular systems, wifi and white space devices, emerging methods of accessing spectrum, communications systems for emergency responders (firefighters, police, emergency medical services), current and next-generation television, and satellite communications. This can include the government role in facilitating the creation of infrastructure, in advancing competition among broadcasters and communications service providers, in using scarce spectrum efficiently, in promoting public safety and homeland security, and in protecting privacy and security. Because these are inherently interdisciplinary issues, the course will include detailed discussions of technology, economics, and law, with no prerequisites in any of these areas. This course is cross-listed as 18-650, 19-403, 19-713, and 95-824. Senior or graduate standing required.

Networked Cyber-Physical Systems (18-651) – 12 Units

Cyber-physical systems (CPS) represent a new class of systems that bring together sensing, computation, communication, control and actuation to enable continuous interactions with physical processes. This integration of networked devices, people, and physical systems provides huge opportunities and countless applications in biology and healthcare, automotive and transportation, power grids and smart buildings, social and financial markets, etc. Hence, CPS need to provide real-time efficiency, adaptability, optimality, security and robustness to natural disasters or targeted attacks. While the focus on embedded systems relies on building computational models for specific applications, CPS need a multidisciplinary approach and a more general computational paradigm such that more-direct interactions between the system and physical world become possible. This course is primarily an in-depth introduction to networked CPS with an emphasis on methods for modeling, design, and optimization. Focus is on the dominant design paradigms like low-power and communication-centric design. Topics to be covered include: physical processes, models of concurrency, sensing and workload modeling, human behavior modeling, data-driven modeling, networking at micro- and macro-scale, system-

wide resources management, programming, validation and integration. From a practical standpoint, students will directly experiment with hardware prototypes and software tools to explore concrete CPS examples. By structure and contents, this class is primarily targeted to ECE students; it can also provide a valuable basis for interdisciplinary research to students in CS and related disciplines.

Foundations of Software Engineering (18-652) – 12 Units
In this course, you will learn about software engineering paradigms that have shaped the software industry over the past few decades. You will be exposed to fundamental disciplines of software engineering as well as engineering practices that crosscut system, project, and user perspectives. You will learn to iteratively define requirements, and architect, design, implement, integrate, test, and deploy a solution. You will work on self-organizing teams and manage the work collaboratively. You will also learn to solve a real problem subject to multiple constraints while keeping the stakeholders involved throughout the lifecycle and balancing the underlying engineering tradeoffs. The topics are applied in the context of a semester-long group project. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the "Software Engineering and Design" course area requirement. Prerequisites: Basic software development experience with proficiency in at least one modern programming language and modern programming concepts. Prior to admission, students must successful complete a programming assignment to demonstrate familiarity with required software technologies. Students who have successfully completed 18-652, Foundations in Software Engineering, are not eligible to take this course.

Software Architecture and Design (18-653) – 12 Units
Software Architecture and Design is a one-semester course, aiming to train our graduate students from software engineers toward becoming a Software Architect, who is the ¿Technical Lead¿ of a software project team. The primary objective of the course is to help students develop skills in designing, developing, and justifying reasonable software architecture for enterprise-scale software-intensive systems, considering both functional and non-functional requirements as well as contextual system environments. Core topics include: overview of software architecture, micro architectural patterns (so-called design patterns) and macro architectural patterns (i.e., modern patterns), service oriented architecture, architectural modeling, viewpoints and perspectives, architectural analysis techniques, architectural tactics (QoS), agile architecture, and some advanced topics. Literature survey and study of state-of-the-art technologies, as well as both individual and group project work, are essential ingredients of this class. Research and practical projects build upon one another. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the Software Engineering and Design requirement. Anti-requisites: 17-655 from CS Dept. Pre-requisites: 18-652

Software Verification and Testing (18-654) – 12 Units
Verification and testing (V&T) support software engineers and development teams in their endeavor to build dependable systems. These interrelated activities form the backbone of a high-quality software solution that performs its function as intended. V&T is no longer considered an exclusively backend phase undertaken by a separate quality assurance unit, vulnerable to

availability of discretionary resources near project end. Rather, V&T is a cross-functional discipline applied throughout the software lifecycle from beginning to end. As such V&T is an integral and essential part of any sensible software development process. This course introduces the students to concepts, principles, theory, types, tools, and techniques of V&T with exposure to both modern, widely-applicable approaches and traditional, formal techniques. Students will acquire sufficient depth and breadth in V&T through a balanced coverage of topics. The course syllabus spans fundamentals such as V&T principles, systematic testing, input space analysis, and test coverage; practical strategies such as test-driven development, unit testing, and test design; and formal approaches such as abstraction, model checking, static analysis, and symbolic execution. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the ¿Analysis¿ area core course requirement. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the Analysis area core course requirement.

Service Oriented Computing (18-655) – 12 Units

Service Oriented Computing (SOC) is a one-semester course that introduces how to build and leverage software systems as a service to facilitate reusability, scalability, availability, and interoperability, in a networked environment. SOC has been significantly changing the way how software systems and applications are analyzed, architected, designed, implemented, tested, evaluated, delivered, consumed, maintained and evolved. Its comprising techniques have enabled the emergence of the contemporary third-generation software engineering: Service Oriented Software Engineering (SOSE). In this course, key concepts and standards, core enabling technologies and innovative consulting methods, as well as major solution patterns, are captured in the whole lifecycle of SOSE. Research and practical projects build upon one another. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the "Software Engineering and Design" area requirement. Prerequisites: Proficiency with either Java or Python programming language and in modern software development concepts.

Data Intensive Workflow Development for Software Engineers (18-656) – 12 Units

Many software systems nowadays have become increasingly data intensive and data centered applications. Manipulating comprehensive datasets and heterogeneous data sources typically requires composing and executing a series of computational or data manipulation steps, called a workflow. A data-oriented workflow is a formal way of defining, automating, repeating and adapting multi-step computational procedures driven by data events. The primary objective of the course is to help students develop skills in engineering data-oriented workflows, in the context of service-oriented software engineering, big data, cloud computing, Internet of Things, social networking, and mobile computing. Core topics include: data-oriented workflow theory, models, languages, techniques, architectures, systems, tools; workflow discovery, reuse, recommendation, orchestrations and choreographies; workflow properties and data dependencies; data provenance capture, storage, retrieval, and mining; workflow execution, allocation, and optimization on cloud; workflow as a service, as well as collaborative data analytics on the Internet. Literature survey and study of state-of-the-art technologies, as well as both individual and group project work, are essential ingredients of this class. Research and

practical projects build upon one another. Please note that this course is intended for ECE master students with a concentration in Software Engineering and will satisfy the Systems area requirement.

Decision Analysis and Engineering Economics for Software Engineers (18-657) – 12 Units
Engineering software systems entails continuously making resource and technical decisions at multiple levels subject to different sources of uncertainty, cost-benefit tradeoffs, historical data, and flexibility demands. This course will develop quantitative and modeling skills for economics-based and decision-theoretic reasoning in software engineering through a repertoire of techniques from several fields. Special consideration will be given to reasoning under uncertainty and empirical approaches to tackle a variety of software engineering decision-making problems, including technology, architecture, design, product, and process decisions. The analysis techniques covered will be illustrated through domain-specific examples. Analysis techniques that will be covered include Monte Carlo Simulation, Net Present Value, Expected Value of Information, Decision Tree Analysis, Real Options Theory, Utility Theory, and Analytic Hierarchy Process. Basic data analysis concepts, including descriptives, linear regression, correlation, and hypothesis testing will be explained and used. Examples and fully-developed case studies will illustrate how these techniques can be combined to best leverage their strengths. The course has a practical focus, but includes coverage of the necessary background theories. Orientation is distinctly quantitative. Knowledge of basic probability is required. Pre-requisites: 18-652 (can be taken concurrently)

Software Requirements and Interaction Design (18-658) – 12 Units
Good software systems should be engineered with user experience in mind. How can we design software systems that are at once useful, usable, and enjoyable to use?
This course addresses these challenges by integrating two disciplines: requirements engineering and interaction design. Students learn to combine user research, design-based ideation and validation, and requirements definition, within an agile software development process.
Students apply this knowledge during a semester-long project. Their goal is to envision and implement the first version of an innovative software system that could make a unique contribution to society. The system should address a real problem, satisfy real stakeholders' needs, and provide a superior user experience. Students collaborate closely with their stakeholders throughout the project for needs elicitation, design concepts validation, and usability testing.
This course is intended for ECE master students with a concentration in Software Engineering. It is a core course of the MS-SE program satisfying the "Software Engineering and Design" course area requirement.

Software Engineering Methods (18-659) – 12 Units
There has been a rapid evolution of software engineering development methods over the past decades. From Waterfall to Iterative and Incremental, to Agile and Lean, we have witnessed waves of new methods, each adding significant value to the field. However, the plethora of available methods poses a challenge for software practitioners: Which method should be adopted on a specific software project? Software Engineering Methods addresses this challenge

by introducing students to emerging approaches for developing software-intensive systems. Given the vast spectrum of software development endeavors, these approaches aim at defining custom hybrid methods by focusing on software development principles and practices together with their applicability to specific project contexts. Students learn to analyze the context of a software project and recommend a custom hybrid development method that satisfies the project's specific needs. Students apply this knowledge in the context of a semester-long project where the entire class works together as a team of teams. They define the optimal software development method for their project aimed at evolving an existing software system. They build new system increments by adopting their own method. They monitor their progress and reflect on the effectiveness of their approach and the need for continuous improvement. This course is intended for ECE master students with a concentration in Software Engineering and will satisfy the "Systems" course area requirement. Prerequisites: 18652 or instructor permission

Optimization (18-660) – 12 Units

Many design problems in engineering (e.g., machine learning, finance, circuit design, etc.) involve minimizing (or maximizing) a cost (or reward) function. However, solving these problems analytically is often challenging. Optimization is the study of algorithms and theory for numerically solving such problems, and it underpins many of the technologies we use today. This course is an introduction to optimization. Students will: (1) learn about common classes of optimization problems, (2) study (and implement) algorithms for solving them, and (3) gain hands-on experience with standard optimization tools. We will focus on convex optimization problems, but will also discuss the growing role of non-convex optimization, as well as some more general numerical methods. The course will emphasize connections to real-world applications including machine learning, networking, and finance. The course will involve lectures, homework, exams, and a project.

This course is crosslisted with 18460. Although students in 18460 will share lectures with students in 18660, students in 18460 will receive distinct homework assignments, distinct design problems, and distinct exams from the ones given to students in 18660. Specifically, the homework assignments, design problems and exams that are given to the 18660 students will be more challenging than those given to the 18460 students.

Introduction to Machine Learning for Engineers (18-661) – 12 Units

This course provides an introduction to machine learning with a special focus on engineering applications. The course starts with a mathematical background required for machine learning and covers approaches for supervised learning (linear models, kernel methods, decision trees, neural networks) and unsupervised learning (clustering, dimensionality reduction), as well as theoretical foundations of machine learning (learning theory, optimization). Evaluation will consist of mathematical problem sets and programming projects targeting real-world engineering applications.

Hardware Architectures for Machine Learning (18-663) – 12 Units

Machine learning is poised to change the landscape of computing in more ways than its broad societal applications. Indeed, hardware architectures that can efficiently run machine learning

face increasing challenges due to power consumption or run time constraints that technology, platforms, or users impose. This course provides an overview of current advances in hardware architectures that can enable fast and energy efficient machine learning applications from the edge to the cloud. Topics include hardware accelerators, hardware-software co-design, and general or application specific system design and resource management for machine learning applications.

ULSI Technology Status and Roadmap for System on Chips and System in Package (18-664) – 12 Units

This course provides the necessary background for the state-of-the art technologies utilized by the leading edge products covering full spectrum of market drivers from mobile platforms, microprocessors, game chips to the highest performance systems for enterprise solutions computing. We will present all key components of such systems, i.e., logic, analog/RF and embedded memories. Then we present the technology roadmap for the upcoming generations in terms of device architecture options for logic devices (FinFET, Nanowire and Tunnel FET) and memories (Phase Change Memory , Resistive RAM and Magnetic RAM/Spin-Transfer Torque RAM) from the device level all the way to the system level specifications. The last part of the class will be devoted to the system integration issues, namely 3-dimensional integration approaches. This course is designed for MS and PhD students from diverse areas: System/Hardware Design, Circuits and Devices/Nanofabrication and is aimed at bridging the gap among these areas.

Analytical Performance Modeling & Design of Computer Systems (18-687) – 12 Units

In designing computer systems one is usually constrained by certain performance requirements. For example, certain response times or throughput might be required of the system. On the other hand, one often has many choices: One fast disk, or two slow ones? What speed CPU will suffice? Should we invest our money in more buffer space, or a faster processor? Which migration policy will work best? Which task assignment policy will work best? How can we redesign the scheduling policy to improve the system performance? Often answers to these questions are counter-intuitive. Ideally, one would like to have answers to these questions before investing the time and money to build a system. This class will introduce students to analytic stochastic modeling with the aim of answering questions such as those above. Topics covered include Operational Laws, Markov Chain Theory, Queuing Theory, Modeling Empirical Loads, Simulations, and Management of Server Farms.

Introduction to Neuroscience for Engineers (18-690) – 12 Units

The first half of the course will introduce engineers to the neurosciences from the cellular level to the structure and function of the central nervous system (CNS) vis-à-vis the peripheral nervous system (PNS) and include a study of basic neurophysiology; the second half of the course will review neuroengineering methods and technologies that enable study of and therapeutic solutions for diseases or damage to the CNS. A goal of this course is to provide a taxonomy of neuroengineering technologies for research or clinical application in the neurosciences. This course is cross listed with 42-630

Statistical Discovery and Learning (18-697) – 12 Units
This course is designed to give students a thorough grounding in the methods, theory, mathematics and algorithms needed to do research and applications in machine learning. The topics of the course draw from machine learning, classical statistics, data mining, Bayesian statistics and information theory and other areas. This course is project-oriented and is intended to give students abundant hands-on experience with different machine learning algorithms. Students who have already taken CS 10-701/15-781 Machine Learning should not take this course.

Neural Signal Processing (18-698) – 12 Units
The brain is among the most complex systems ever studied. Underlying the brain's ability to process sensory information and drive motor actions is a network of roughly 1011 neurons, each making 103 connections with other neurons. Modern statistical and machine learning tools are needed to interpret the plethora of neural data being collected, both for (1) furthering our understanding of how the brain works, and (2) designing biomedical devices that interface with the brain. This course will cover a range of statistical methods and their application to neural data analysis. The statistical topics include latent variable models, dynamical systems, point processes, dimensionality reduction, Bayesian inference, and spectral analysis. The neuroscience applications include neural decoding, firing rate estimation, neural system characterization, sensorimotor control, spike sorting, and field potential analysis. Prerequisites: 18-290; 36-217, or equivalent introductory probability theory and random variables course; an introductory linear algebra course; senior or graduate standing. No prior knowledge of neuroscience is needed

Technical Writing for Engineers: Linguistic Foundations (18-701) – 6 Units
Mini 1 (Linguistic Foundations) is designed for engineering students who are preparing for taking Qualifying exams. We will review the structure of Quals that have succeeded and Quals that have been less successful. Students will learn the linguistic foundations of successful overview papers (like those required in Qualifying exams). They will learn the linguistic basis of appropriate citation and the competent elaboration of the work of others. They will learn effective linguistic practices of transitioning from the work of others to their own work and elaborating their own work. They will learn principles of concision, character/action, topical coherence, cohesion, and emphasis, principles that work together to provide the written portion of a Qualifying exam with an easy flow and readability. They will learn how this system of principles can help them detect gaps in knowledge they will need to fill in by the time of the oral examination, if not in the written portion of the Qual itself. To the greatest extent possible, students will learn to apply these linguistic principles on the written portion of the Quals they are preparing that semester or have prepared in previous semesters. Prerequisites: ECE PhD standing is required.

Technical Writing for Engineers: Genre Foundations (18-702) – 6 Units
Mini 2 (Genre Foundations) is designed for engineering students ready to focus on archival genres that report new knowledge, genres including but not limited to conference papers and journal publications. Students will learn principles of academic novelty and its history in the Royal Society. We will use customized software that give students a "zoomed-in" look at the impressive variety through which introductions establish significance and how they open a "gap" that the

author's research was designed to fill. We will overview the important genre features and functions of the various sections of the archival paper. Students are expected to bring to the course archival documents they are currently preparing to submit. Students will use the mini to execute a systematic revision of their document based on the genre functions and features discussed. Prerequisites: ECE PhD standing is required.

Managing and Leading Research and Development (18-703) – 12 Units

This course will provide an insider's look at issues in industrial research and development laboratories that future industrial R&D personnel are likely to face.

The instructor, Prof. Mark Kryder spent nine years as Chief Technical Officer and Senior Vice President, Research for Seagate Technology, the largest disk drive manufacturer in the world. In the course, he will try to give students an improved understanding of how research and development are done in a major high-tech firm today.

The course is built around the instructor's personal experiences, but also draws heavily from business management literature and business case studies. It is expected that the course will make the transition from the university to industry easier and faster for students who have taken it and enable them to become more effective in an industrial setting in a shorter period of time.

Examples of issues to be discussed will be the impact of various organizational structures upon R&D; What characteristics are desired in a research staff member vs. a staff development engineer?, What is the importance of diversity in a R&D setting? What are the relative importances of technology, marketing expertise and corporate business models in determining success of a product?; What is meant by "corporate culture" and how does it get defined?; How important are collaboration and teamwork in R&D and are they different?; What is Six Sigma and how important is it in today's business world?; How do you measure performance in R & D?, how do you effectively transfer technology from research to development?; how can you effectively leverage university research and industrial consortia?: How important is intellectual property in various industries? How important is corporate size?: What is the role of technology vision?; What are the effects of globalization on R&D?; What is a technology steering council and how can it be used to facilitate technology transfer and development?

Advanced Cloud Computing (18-709) – 12 Units

Computing in the cloud has emerged as a leading paradigm for cost-effective, scalable, well-managed computing. Users pay for services provided in a broadly shared, power-efficient datacenter, enabling dynamic computing needs to be met without paying for more than needed. Actual machines may be virtualized into machine-like services, abstract programming platforms, or application-specific services, with the cloud infrastructure managing sharing, scheduling, reliability, availability, elasticity, privacy, provisioning and geo-replication.

This course will survey the aspects of cloud computing through about 30 papers and articles, executing cloud computing tasks on a state-of-the-art cloud computing service, and implementing a change or feature in a state-of-the-art cloud computing framework. There will be no final exam, but there will be one or two in-class exams. Grades will be about 50% project work and about 50% examination results.

Elements of Photonics for Communication Systems (18-712) – 12 Units
The aim of this course is to provide students with a basic understanding of the elements of photonics, including the necessary primary devices that form the building blocks of modern optical communication systems. The photon is the fundamental unit particle of light, with frequencies in the range of several hundred Terahertz (~100 x 1012 Hz). It is a fact of the fundamental theorem of communication that information capacity increases directly with frequency. It is no wonder then that photonic communication systems have become the backbone of modern, ultra-fast and high capacity communication networks. The use of light in communication systems involves the generation, transmission, and detection of photons, along with the encoding (modulation) of signals of interest onto the light carrier wave, and the subsequent decoding (de-modulation) at the destination.

This course begins with an introduction to basic electromagnetic theory (in the frequency range that corresponds to light). The introduction includes Maxwell's equations in both free space and dielectric media. The scalar wave equation derived from the vector Maxwell equations is solved in free space as well as in dielectric media, taking into account the boundary conditions that affect the transmission and reflection of light at the dielectric interfaces. This background is then used in the discussion of the dielectric slab and the related fiber-optic waveguide that is used in the transmission of optical signals in short- and long-haul communication systems.

The course continues with a discussion of semiconductor light generators, with a particular focus on edge-emitting and surface-emitting lasers. Photon detectors—of the semiconductor variety—are then discussed. The course ends with a discussion of other important optical components such as modulators, filters, couplers, multiplexers and demultiplexers. Prerequisites: 18-300 and 18-310 and (18-402 or 33-439) and senior or graduate standing.

Physics of Applied Magnetism (18-715) – 12 Units
In this course we address the physics of magnetism of solids with emphasis on magnetic material properties and phenomena which are useful in various applications. Various applications of magnetism are used to motivate the understanding of the physical properties and phenomena. The content of this course includes the origins of magnetism at the atomic level and the origins of magnetic ordering (ferro-, ferri-, and antiferro-magnetism), magnetic anisotropy, magnetic domains, domain walls, spin dynamics and electronic transport at the crystalline level. The principles of magnetic crystal symmetry, tensors, and energy minimization are utilized to explore magnetic properties such as resonance, domain structures, magnetocrystalline anisotropy, magnetostriction and magnetoelasticity, and susceptibility. Phenomenological properties, such as the technical magnetization process, are used to describe mechanisms of coercivity, eddy current effects and losses, while energy minimization and relaxation are used to explain properties such as single domain particle behavior, memory mechanisms, magnetic aftereffects and thermal stability. Prerequisite: 18-300 or equivalent background in electromagnetic fields; Senior level solid state physics and materials, or the equivalent, and a senior or graduate student standing.

Advanced Analog Integrated Circuits Design (18-721) – 12 Units

This course will familiarize students with advanced analog integrated circuit design issues. Analog circuit design issues play an important role in creating modern ICs. First and foremost, analog circuits act as the interface between digital systems and the real world. They act to amplify and filter analog signals, and to convert signals from analog to digital and back again. These analog interfaces appear in all communications devices (e.g., cell phones) both to condition the "transmitted" signal and as sensitive "receivers." In addition, these analog interfaces appear in sensors (e.g., accelerometer). The goal of this course is to familiarize students with some of the advanced analog circuit design ideas that are involved in these tasks. Specific topics will include analog filtering (continuous-time and discrete-time), sample-and-hold amplifiers, analog-to-digital converters, digital-to-analog converters. Prerequisites: 18-623 (was 18-523 before Fall 2005) and senior or graduate standing.

RFIC Design and Implementation (18-723) – 12 Units

This course covers the design and analysis of radio-frequency integrated systems at the transistor level using state of the art CMOS and bipolar technologies. It focuses on system-level trade-offs in transceiver design, practical RF circuit techniques, and physical understanding for device parasitics. Accurate models for active devices, passive components, and interconnect parasitics are critical for predicting high-frequency analog circuit behavior and will be examined in detail. The course will start with fundamental concepts in wireless system design and their impact on design trade-offs in different transceiver architectures. Following that, RF transistor model, passive matching networks will be discussed. Noise analysis and low-noise amplifier design are studied next. The effects of nonlinearity are treated along with mixer design techniques. Practical bias circuit for RF design will be illustrated. Then, the importance of phase noise and VCO design will be considered together. The course will conclude with a brief study of frequency synthesizer and power amplifier design. Senior or graduate standing required.

Advanced Digital Integrated Circuit Design (18-725) – 12 Units

The purpose of this course is to study the design process of VLSI CMOS circuits. This course covers all the major steps of the design process, which include: logic, circuit and layout design. A variety of computer-aided tools are discussed and used in class. The main objective of this course is to provide VLSI design experience that includes design of basic VLSI CMOS functional blocks, verification of the design, testing and debugging. During the course, one complex VLSI project is submitted for fabrication. 4 hrs. lec.

Introduction to Computer Security (18-730) – 12 Units

This course provides a principled introduction to techniques for defending against hostile adversaries in modern computer systems and computer networks. Topics covered in the course include operating system security; network security, including cryptography and cryptographic protocols, firewalls, and network denial-of-service attacks and defenses; user authentication technologies; security for network servers; web security; and security for mobile code technologies, such as Java and Javascript. More advanced topics will additionally be covered as time permits, such as: intrusion detection; techniques to provide privacy in Internet applications; and protecting digital content (music, video, software) from unintended use. Anti-requisites: 18-631 and 18-487

Network Security (18-730) – 12 Units
Some of today's most damaging attacks on computer systems involve exploitation of network infrastructure, either as the target of attack or as a vehicle to advance attacks on end systems. This course provides an in-depth study of network attack techniques and methods to defend against them. Topics include firewalls and virtual private networks; network intrusion detection; denial of service (DoS) and distributed denial-of-service (DDoS) attacks; DoS and DDoS detection and reaction; worm and virus propagation; tracing the source of attacks; traffic analysis; techniques for hiding the source or destination of network traffic; secure routing protocols; protocol scrubbing; and advanced techniques for reacting to network attacks. Prerequisite: 18-630 OR 18-730, and senior or graduate standing.

Secure Software Systems (18-732) – 12 Units
Poor software design and engineering are the root causes of most security vulnerabilities in deployed systems today. Moreover, with code mobility now commonplace--particularly in the context of web technologies and digital rights management--system designers are increasingly faced with protecting hosts from foreign software and protecting software from foreign hosts running it. This class takes a close look at software as a mechanism for attack, as a tool for protecting resources, and as a resource to be defended. Topics covered include the software design process; choices of programming languages, operating systems, databases and distributed object platforms for building secure systems; common software vulnerabilities, such as buffer overflows and race conditions; auditing software; proving properties of software; software and data watermarking; code obfuscation; tamper resistant software; and the benefits of open and closed source development. Senior or graduate standing required.

Applied Cryptography (18-733) – 12 Units
A wide array of communication and data protections employ cryptographic mechanisms. This course explores modern cryptographic (code making) and cryptanalytic (code breaking) techniques in detail. This course emphasizes how cryptographic mechanisms can be effectively used within larger security systems, and the dramatic ways in which cryptographic mechanisms can fall vulnerable to cryptanalysis in deployed systems. Topics covered include cryptographic primitives such as symmetric encryption, public key encryption, digital signatures, and message authentication codes; cryptographic protocols, such as key exchange, remote user authentication, and interactive proofs; cryptanalysis of cryptographic primitives and protocols, such as by side-channel attacks, differential cryptanalysis, or replay attacks; and cryptanalytic techniques on deployed systems, such as memory remanence, timing attacks, and differential power analysis. Senior or graduate standing required.

Foundation of Privacy (18-734) – 12 Units
Privacy is a significant concern in modern society. Individuals share personal information with many different organizations - healthcare, financial and educational institutions, the census bureau, web services providers and online social networks - often in electronic form. Privacy violations occur when such personal information is inappropriately collected, shared or used. We

will study privacy in a few settings where rigorous definitions and enforcement mechanisms are being developed - statistical disclosure limitation (as may be used by the census bureau in releasing statistics), semantics and logical specification of privacy policies that constrain information flow and use (e.g., by privacy regulations such as the HIPAA Privacy Rule and the Gramm-Leach-Bliley Act), principled audit and accountability mechanisms for enforcing privacy policies, anonymous communication protocols - and other settings in which privacy concerns have prompted much research, such as in social networks, location privacy and Web privacy (in particular, online tracking & targeted advertising).

Special Topics in Computer Systems: Engineering Safe Software Systems (18-737) – 12 Units
Modern software systems suffer from poor reliability and security due to overwhelming complexity. Traditional software testing and debugging, which account for more than half the cost of software development, often fail to find critical bugs in software. In recent years there has been an increasing interest in developing automated techniques for improving software reliability. These techniques combine ideas from program analysis, constraint solving, and model checking and have shown great promises in making software more reliable and secure. In this course, we will study these new techniques, with emphasis on automated test-case generation based on symbolic execution and fuzz testing. We will see how these techniques can be used for detecting bugs in software, finding performance bottlenecks, detecting and preventing security vulnerabilities, and analyzing the reliability of software components. We will further study component-based verification and emerging techniques for automated software repair. Finally, we will discuss challenges related to the analysis of systems with deep learning components, which have a simpler structure than more traditional software but tend to be massive in scale. Senior or graduate standing required.

Sports Technology (18-738) – 12 Units
The course's lecture content will cover background material on key aspects of sports technology, including topics such as computer vision, artificial intelligence, data mining, the physics of sports and understanding of real-world systems and guest lectures from experts in the field. The topics covered in depth will include the types of sensors and algorithms used in real-world systems deployments today, as well as new applications of the Internet of Things to different aspects of sports, including training, performance, coaching, etc.
This course also comprises a semester-long project experience and research paper geared towards the development of skills to design realistic and practical embedded/mobile systems and applications that enhance various aspects of the training, coaching, playing and scouting of different sports, including football, hockey, baseball, soccer, etc. Students will work in teams on a project that will involve the hands-on design, configuration, engineering, implementation and testing of an embedded-system prototype of an innovative sports technology of their choice. Students will be expected to leverage proficiency and background gained from other courses, particularly with regard to embedded real-time principles, software systems and embedded programming. The project will utilize a synergistic mixture of skills in system architecture, modular system design, software engineering, subsystem integration, debugging and testing. From inception to demonstration of the prototype, the course will follow industrial project

practices, such as version control, design requirements, design reviews, user studies and quality assurance plans. Advanced undergraduate or graduate standing required.

Computer Architecture – (18-740) – 12 Units

The Internet has transformed our everyday lives, bringing people closer together and powering multi-billion dollar industries. The mobile revolution has brought Internet connectivity to the last-mile, connecting billions of users worldwide. But how does the Internet work? What do oft repeated acronyms like "LTE", "TCP", "WWW" or a "HTTP" actually mean and how do they work? This course introduces fundamental concepts of computer networks that form the building blocks of the Internet. We trace the journey of messages sent over the Internet from bits in a computer or phone to packets and eventually signals over the air or wires. We describe concepts that are common to and differentiate traditional wired computer networks from wireless and mobile networks. Finally, we build up to exciting new trends in computer networks such as the Internet of Things, 5-G and software defined networking. Topics include: physical layer and coding (CDMA, OFDM, etc.); data link protocol; flow control, congestion control, routing; local area networks (Ethernet, Wi-Fi, etc.); transport layer; and introduction to cellular (LTE) and 5-G networks. A final project asks you to a build a HTTP video server of your own. This course is cross-listed with 18-441 - both editions will share Lectures and Recitations. However, students in the two courses will receive different exams and will have a different project. The students in the two versions of the course will be graded on a separate curve.

Computer Architecture and Systems (18-742) – 12 Units

Historically, the performance and efficiency of computers has scaled favorably (according to "Moore's Law") with improvements at the transistor level that followed a steady trend (so-called "Dennard scaling"). Unfortunately, device scaling has hit a limit on performance and power improvements dictated by physical device properties. To continue to make systems capable, fast, energy efficient, programmable, and reliable in this "post-Dennard" era, computer architects must be creative and innovate across the layers of the system stack. This course begins with a recap of conventional, sequential computer architecture concepts. We will then discuss the end of convention, brought about by the end of Dennard Scaling and Moore's Law, and several trends that these changes precipitated. The first trend is the wholesale shift to parallel computer architectures and systems, covering parallel hardware and software execution models, cache coherence, memory consistency, synchronization, transactional memory, and architecture support for programming, debugging, and failure avoidance. The second trend is the shift to incorporating specialized, heterogeneous components into parallel computer architectures. Topics will include reconfigurable architectures, FPGAs in the datacenter, ASIC accelerators, GPGPU architectures, and the changes to the system stack that these components demand. The third trend is the emergence of newly capable hardware and software systems and new models of computation. Topics will include approximate and neuromorphic computing, intermittent computing, emerging non-volatile memory and logic technologies, and analog and asynchronous architectures, and may include future emerging topics.

Energy Aware Computing (18-743) – 12 Units

This course provides a comprehensive coverage of topics related to energy aware and green computing. While it is widely recognized that power consumption has become the limiting factor in keeping up with increasing performance trends, static or point solutions for power reduction are beginning to reach their limits. This course is intended to provide an insight into: (i) power and energy consumption modeling and analysis; (ii) energy aware computing, i.e., how various power reduction techniques can be used and orchestrated such that the best performance can be achieved within a given power budget, or the best power efficiency can be obtained under prescribed performance constraints; and (iii) green computing in the context of large scale computing systems or smart grid-aware computing. Recommended: basic VLSI design, basic computer system organization, basic compiler design and OS knowledge. Prerequisites: Senior or Graduate Standing.

Connected Embedded Systems Architecture (18-744) – 12 Units

Connected Embedded Systems Architecture (CESA) is a one-semester lab-based course that addresses the core concepts of modern embedded systems with a particular emphasis on the emerging field of apps that span small, embedded devices (including wearable electronics, so-called Internet of Things devices, and mobile phones) to the cloud. We will examine the evolution of the nature of IoT from the early days of wireless sensor networks to the future vision of federated, time-synchronized, scalable, virtualized "fog computing" platforms.

The course is designed to take a systems approach and, as such, will include relevant topics from both software (cloud, network, device) and hardware (network and device). The course content is aimed at systems engineers who wish to architect, develop and deploy cloud-connected embedded systems in which the "apps" change, mature and evolve over time. The course stresses the creation of engineering frameworks in which tradeoffs can be rationally made between computing and storage that should be done on coin-cell-powered devices vs. computing and storage that should be done in the network or in the cloud.

Rapid Prototyping of Computer Systems (18-745) – 12 Units

This is a project-oriented course which will deal with all four aspects of project development; the application, the artifact, the computer-aided design environment, and the physical prototyping facilities. The class, in conjunction with the instructors, will develop specifications for a mobile computer to assist in inspection and maintenance. The application will be partitioned between human computer interaction, electronics, industrial design, mechanical, and software components. The class will be divided into groups to specify, design, and implement the various subsystems. The goal is to produce a working hardware/software prototype of the system and to evaluate the user acceptability of the system. We will also monitor our progress in the design process by capturing our design escapes (errors) with the Orthogonal Defect Classification (ODC). Upon completion of this course the student will be able to: generate systems specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of numerous subsystems; use computer-aided design tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application. This course is cross-listed as 18540.

Storage Systems (18-746) – 12 Units
This course covers the design, implementation, and use of storage systems, from the characteristics and operation of individual storage devices through the OS, database, and networking approaches involved in tying them together and making them useful to key applications' demands and technology trends. Topics to be covered include: network-attached storage, disk arrays, storage networking, storage management, advanced file systems, disk performance enhancement, wide-area data sharing, and storage security. 3 hrs. lec. The class will continue to be like previous years, with the same advanced content and high-level expectations.

Wireless Device Architecture (18-747) – 12 Units
Growth of the Internet of Things depends on semiconductor devices ¿ systems-on-chip (SoC) ¿ with significant computational, communications and sensing capabilities. Integration of entire systems on one or a very small number of dies has made it possible to deploy hundreds of billions of end-points that will link the cyber world with the physical world. At this scale, a key design requirement is that such devices can be handled at most once during their lifetime. Batteries should be life-long, and reprogramming should be over-the-air. How then should such devices be architected? We begin by examining modern digital communications including modulation and coding schemes, basic RF subsystems and antennas. We examine the computational structures that allow us to reduce communication to computation. Anticipating that such devices will need to be highly programmable, we consider concepts from traditional computer architecture and their applicability to this energy-constrained domain. We also examine the rapid evolution of transducer technologies and how these are being integrated into SoCs. Then, we consider how an architect can make tradeoffs across these domains to meet design objectives. Students will take advantage of a purpose-built experimental platform called PowerDué that enables deep exploration of these topics in realistic applications. Background in computer architecture, signals and systems, and E&M field theory is recommended. Graduate standing is required to register for this course.

Wireless Sensor Networks (18-748) – 12 Units
The use of distributed wireless sensor networks have surged in popularity in recent years with applications ranging from environmental monitoring, to people- and object-tracking in both cooperative and hostile environments. This course is targeted at understanding and obtaining hands-on experience with the state of the art in such wireless sensor networks which are often composed using relatively inexpensive sensor nodes that have low power consumption, low processing power and bandwidth. The course will span a variety of topics ranging from radio communications, network stack, systems infrastructure including QoS support and energy management, programming paradigms, distributed algorithms and example applications. Some guest lectures may be given. Each discussion-oriented lecture will be preceded by the reading of 1-2 papers, resulting in a rich collection of papers by the end of the semester. Early in the semester, hands-on exercises will be used to teach the programming of FireFly sensor nodes by using the 'nano-RK' power-aware sensor real-time operating system (RTOS) and using 802.15.4 radio communications. Then, project groups of no more than 3 students will define, design, implement and test a sensor network project. Final in-class project presentations will be

supplemented by a written report. A final exam may be conducted to evaluate the students' understanding of the materials covered. Grading criteria will include classroom participation, course project content and report, and a final exam. Class size will be limited to 20 students or less. Hands-on experience with network programming, operating systems and assembly language are essential. Exceptions only with explicit permission of instructor. Prerequisites: 15-213 and ((18-348 or 18-349) or 15-410), and senior or graduate standing.

Building Reliable Distributed Systems (18-749) – 12 Units

The course provides an in-depth and hands-on overview of designing and developing reliable distributed systems, throughout a system?s lifecycle, starting from fault-tolerant design and execution (replication, group communication, databases) to fault-recovery (fault-detection, logging, check-pointing, failure-diagnosis) for various classes of faults (crashes, communication errors, software upgrades). The course will cover real-world practices for reliability, supplemented by case studies of large-scale downtime incidents. The concepts will be taught in the context of contemporary cloud-computing platforms, and the course will include a hands-on project that involves the design, implementation and empirical evaluation of a reliable distributed cloud-based system. Students will be taught to write, review, and present a conference-style research paper by the end of the semester, with the goal of documenting the design, lessons learned and experimental results of their team project. Students can expect to learn about the reliability issues underlying cloud computing, the tools and best practices for implementing and evaluating reliability, and the strengths and weaknesses of current cloud-computing platforms from the perspective of reliability. Prerequisites: Graduate standing or instructor permission

Wireless Networks and Applications (18-750) – 12 Units

This course introduces fundamental concepts of wireless networks. The design of wireless networks is influenced heavily by how signals travel through space, so the course starts with an introduction to the wireless physical layer, presented in a way that is accessible to a broad range of students. The focus of the course is on wireless MAC concepts including CSMA, TDMA/FDMA, and CDMA. It also covers a broad range of wireless networking standards, and reviews important wireless network application areas (e.g., sensor networks, vehicular) and other applications of wireless technologies (e.g., GPS, RFID, sensing, etc.). Finally, we will touch on public policy issues, e.g., as related to spectrum use. The course will specifically cover: Wireless networking challenges Wireless communication overview Wireless MAC concepts Overview of cellular standards and LTE Overview of wireless MAC protocols WiFi, bluetooth and personal area networks, etc. Wireless in today's Internet: TCP over wireless, mobility, security, etc. Advanced topics, e.g., mesh and vehicular networks, sensor networks, DTNs, localization, sensing, etc. Although students in 18-750 will share Lectures and Recitations with students in 18-452, they will receive distinct homework assignments and exams from students in 18-452. The main project will also be different. The students in the two version of the course will also be graded on a separate curve.

Applied Stochastic Processes (18-751) – 12 Units

Basic probability concepts : Probability space, simple and compound events, statistical independence, and Bayes Rule. Total Probability Concept; Bernoulli trials; Poisson Law. De Moivre-Laplace Theorem. Definition of a Random Variable (RV); Probability distribution of an RV: cumulative distribution function (CDF) and probability density function (PDF). Two Random Variables; several Random Variables. Functions of RV?s; conditional distributions; conditional expectations; joint distributions. Moments, generating functions, and characteristic functions of RVs. Chebyshev inequality. Estimation; linear estimation; minimum mean square estimation; and orthogonality principle. Limit theorems; Central Limit Theorem; Law of Large Numbers (both strong LLN and Weak LLN). Definition of a Random Process (RP). Different notions of stationarity. Poisson and Gaussian processes. Autocorrelation and Power Spectral Density (PSD) of an RP. Processing of random (stochastic) processes by linear systems. Ergodicity. Spectral analysis. Matched Filtering. Selected applications from telecommunications, data networking (queuing), Kalman filtering.

Estimation, Detection and Learning (18-752) – 12 Units

This course discusses estimation, detection, identification and machine learning, covering a variety of methods, from classical to modern. In detection, the topics covered include hypothesis testing, Neyman-Pearson detection, Bayesian classification and methods to combine classifiers. In estimation, the topics include maximum-likelihood and Bayesian estimation, regression, prediction and filtering, Monte Carlo methods and compressed sensing. In identification and machine learning, topics include Gaussian and low-dimensional models, learning with kernels, support vector machines, neural networks, deep learning, Markov models and graphical models.

Information Theory (18-753) – 12 Units

The first half of the course comprises of the concepts of entropy, mutual information, the Asymptotic Equipartition property, applications to source coding (data compression), applications to channel capacity (channel coding), differential entropy and its application to waveform channel capacities, and a subset of advanced topics such as network information theory, or rate-distortion theory, as time permits. The second half of the course comprises finite-field algebra, Hamming codes, cyclic codes (CRC and BCH codes), a brief introduction to Reed-Solomon codes, and perhaps universal codes (Lempel-Ziv coding). Prerequisites: 36-217 and senior or graduate standing.

Error Control Coding: Theory and Applications (18-754) – 12 Units

Modern digital communication systems and digital data storage systems owe their success, in part to the use of error control coding. By careful insertion of redundant bits or symbols in the transmitted or stored bit streams, the receiver can detect and correct errors induced by channel impairments such as noise, inter-symbol interference and noise. For example, compact disc (CD) owes its ruggedness to the use of cross-interleaved Reed-Solomon (CIRC) code. High-speed networks employ Cyclic Redundancy Check (CRC) to ensure that the data was transmitted accurately. This course is aimed at introducing the basic theory and select applications of error control coding (ECC). Towards that goal, following topics will be covered. Mathematical background Linear block codes Low density parity check (LDPC) codes Cyclic codes Reed-Solomon

(RS) codes Convolutional codes Turbo codes Example application of ECC in digital communications Example application of ECC in digital data storage.

Networks in the Real World (18-755) – 12 Units
18-755 is a graduate-level course that focuses on networks and their applications to various natural and technological systems. Specifically, this class delves into the new science behind networks and their concrete applications technological, biological, and social systems, as well as various design synergies that exist when looking at these systems from a cyber-physical perspective. By scope and contents, this is not just another class on ?networks?. Want to know how complex networks dominate our world? How communities arise in social networks? How group behavior dominates Twitter? How swarms of bacteria can navigate inside the human body? How patterns of interaction can be identified in hardware and software systems? Want to work on cutting edge projects involving systems and synthetic biology? Or social networks? Or networks-on-chip and internet-of-things? Then this class is for you! Course requirements consist of a few homework assignments, a semester-long project, and in-class presentations of relevant papers. By structure and contents, this class targets primarily the computer engineering and computer science students, but it also provides a valuable foundation for interdisciplinary research to students in related disciplines. Senior or graduate standing standing is required to take this course.

Packet Switching and Computer Networks (18-756) – 12 Units
This course is designed to provide graduate students an understanding of the fundamental concepts in computer networks of the present and the future. In the past, the scarce and expensive resource in communication networks has been the bandwidth of transmission facilities. Accordingly, the techniques used for networking and switching have been chosen to optimize the efficient use of this resource. These techniques have differed according to the type of information carried: circuit switching for voice and packet switching for data. It is expected that elements of circuit and packet switching will be used in the integrated networks. This course focuses on packet switching for computer networks and protocol design. Topics in the course include: computer networks over-view; OSI layers, queuing theory; data link protocol; flow control; congestion control; routing; local area networks; transport layer. The current networks and applications will be introduced through the student seminars in the last weeks of the course. 4 hrs. lec. Prerequisites: 18-345 and senior or graduate standing.

Network Management and Control (18-757) – 12 Units
This course provides an understanding of the principles of broadband networks. The broadband networks differ from currently existing communication networks in many aspects and these issues will be dealt with in the course. Broadband networks are designed to support many different services, ranging from low bandwidth (telemetry) to high bandwidth applications (digitized video). The course will cover the underlying concepts of the broadband networks, and expose the research problems in next generation networks. Many concepts (ATM, SONET, MPLS, high-speed switching architecture, high-speed network control, unified control plane (GMPLS), and optical networks) will be discussed. The course project will explore latest network

technologies, design networking systems, and evaluate via simulation techniques. 4 hrs. lec. Prerequisites: A course in probability; 18-756 and senior or graduate standing.

Wireless Communications (18-758) – 12 Units
In this course, the communication problem will be introduced, and channel impairments such as noise, inter-symbol interference and fading will be described. Solutions to combat these impairments, based on digital communication theory, will be described. These will include signal space analysis, detection, equalization, coding and diversity. Examples drawn from communication standards will illustrate how the theory is implemented in practical communication systems.

Wireless Networks (18-759) – 12 Units
In this course, we will do a quick review of wireless communications and networking principles which will be the basis of more advanced work and research. The emphasis will be on understanding the impact of mobility and connectivity that can be provided or supported by different wireless networks. To this end, wireless communications standards such as GSM (2G), 3G, 4G, and the ongoing work on 5G in addition to key wireless technologies such as Bluetooth, WiFi, Zigbee, RFID, and WiMax will be reviewed. Then, we will study the key papers in the following hot topics in wireless networking: 1) Ad Hoc Wireless Networks and Sensor Networks; 2) Self-organizing networks and adaptive complex networks; 3) Cognitive Networks; 4) Vehicular Ad Hoc Networks; 5) Social Networks; 6) The challenges of 5G wireless networks; 7) Internet of Things (IoT); 8) Role of Artificial Interference (AI) and Machine Learning (ML) in wireless networks.

VLSI CAD: Logic to Layout (18-760) – 12 Units
A large digital integrated circuit (IC) may require 100,000 lines of high-level description in a hardware modeling language, which then turns into 10,000,000 logic gates, which ultimately end up as 1 billion polygons on the masks that define the integrated circuit. This course describes in detail the important CAD tools that perform the many steps of the transformation from Boolean equations to fabrication masks. We focus on mathematical models, algorithms, and data structures. We will write programs for simple versions of these tools. We will look at, and experiment with, a few real tools. The course covers a review of Boolean algebra, followed by (i) synthesis tools for 2-level and multi-level logic, that transform Boolean equations and finite state machine descriptions into optimized logic, and (ii) verification tools that decide whether the logic you built does the same thing as the specification you started with. Finally, the course covers geometric layout synthesis tools for component partitioning, placement, and wire routing and timing verification tools that determine if performance constraints are met. The CAD algorithms covered in the lectures are applicable not only to VLSI systems, but also to non-silicon applications (e.g., social computing, biology, financial).

Circuit Simulation: Theory and Practice (18-762) – 12 Units
This course explores the models, numerical methods and algorithms that are used for simulation and optimization of circuits. The course begins with coverage of the algorithms that are used in the ubiquitous SPICE program and its many variants. This is followed by an overview of the

numerous analog and digital simulation techniques that have followed since the introduction of SPICE. The course further covers some of the most recent modeling and simulation work including, but not limited to, model order reduction, harmonic balance methods, nonlinear macromodeling, compact device modeling, and statistical timing analysis. Finally, the use of circuit simulation algorithms for non-circuit problems will be explored. 4 hrs. lec.

Digital System Testing and Testable Design (18-675) – 12 Units

For this course, time- and topic-indexed videos of lecture, homework, projects, etc. will be available from the online learning portal/website. In addition to these resources, two 1-hour live sessions are scheduled per week for recitation. Each student is strongly urged to attend one of these two sessions each week, either remotely or in the classroom on the Carnegie-Mellon Pittsburgh campus. This course examines in depth the theory and practice of fault analysis, test generation, and design for testability for digital ICs and systems. The topics to be covered include circuit and system modeling; fault sources and types; the single stuck-line (SSL), delay, and functional fault models; fault simulation methods; automatic test pattern generation (ATPG) algorithms for combinational and sequential circuits, including the D-algorithm, PODEM, FAN, and the genetic algorithm; testability measures; design-for-testability; scan design; test compression methods; logic-level diagnosis; built-in self-testing (BIST); VLSI testing issues; and processor and memory testing. Advance research issues, including topics on MEMS and mixed-signal testing are also discussed. 4 hours of lecture per week Prerequisites: 18-240 and 15-211 and (18-340 or 18-341) Senior or graduate standing required.

Linear Systems (18-771) – 12 Units

A modern approach to the analysis and engineering applications of linear systems. Modeling and linearization of multi-input-- multi-output dynamic physical systems. State-variable and transfer function matrices. Emphasis on linear and matrix algebra. Numerical matrix algebra and computational issues in solving systems of linear algebraic equations, singular value decomposition, eigenvalue-eigenvector and least-squares problems. Analytical and numerical solutions of systems of differential and difference equations. Structural properties of linear dynamic physical systems, including controllability, observability and stability. Canonical realizations, linear state-variable feedback controller and asymptotic observer design. Design and computer applications to electronic circuits, control engineering, dynamics and signal processing. 4 hrs. lec. Pre-Reqs: 18-470 or 18-474 and Graduate standing in CIT or MCS.

Non Linear Control (18-776) – 12 Units

This course provides an introduction to the analysis and design of nonlinear systems and nonlinear control systems; stability analysis using Lyapunov, input-output and asymptotic methods; and design of stabilizing controllers using a variety of methods selected from linearization, vibrational control, sliding modes, feedback linearization and geometric control. 4 hrs. lec.

Complex Large-Scale Dynamic Systems (18-777) – 12 Units

This course is motivated by the ever-growing complexity of man-made dynamic systems and the need for flexible monitoring, operations and design techniques for such systems. Of particular interest are systematic model-based methods for relating the key real-life problems for such

systems and the state-of-the-art techniques for large-scale dynamic systems. Examples of such real-life complex systems are critical man-made infrastructure systems (electric power systems, gas networks, transport industries, data networks, and their interdependencies) as well as large-scale systems on chips. In this course we will first review the traditional large-scale methods for model simplification (aggregation), time scale separation of sub-processes and singular perturbation techniques to account for these, stability analysis, and estimation and control. In the second, novel part of this course, we recognize the highly interactive nature of the evolving complex systems, in which much monitoring, data gathering, and decision making is made at the lower, physical levels of the system, and some coordination exists at the higher system level at which physical layers interact. Several conceptual challenges are posed for minimal coordination of such decision makers under high uncertainties, in order to have predictable performance. These concepts will be illustrated using the same man-made network systems of interest introduced at the beginning of the course. Requirements: Some background in dynamic systems is highly desirable. Students interested in large-scale real-life complex systems, their relation to the state-of-the-art methods available and new research challenges will gain from taking this course. 4 hrs lec. Prerequisites: senior or graduate standing.

Speech Recognition and Understanding (18-781) – 12 Units

The technology to allow humans to communicate by speech with machines or by which machines can understand when humans communicate with each other is rapidly maturing. This course provides an introduction to the theoretical tools as well as the experimental practice that has made the field what it is today. We will cover theoretical foundations, essential algorithms, major approaches, experimental strategies and current state-of-the-art systems and will introduce the participants to ongoing work in representation, algorithms and interface design. This course is suitable for graduate students with some background in computer science and electrical engineering, as well as for advanced undergraduates. Prerequisites: Sound mathematical background, knowledge of basic statistics, good computing skills. No prior experience with speech recognition is necessary. This course is primarily for graduate students in LTI, CS, Robotics, ECE, Psychology, or Computational Linguistics. Others by prior permission of instructor.

Machine Learning (18-782) – 12 Units

Machine Learning is a foundational discipline of the Information Sciences. It combines elements from Mathematics, Computer Science, and Statistics with applications in Biology, Physics, Engineering and any other area where automated prediction is necessary. The aim of the course is to present some of the topics which are at the core of modern Machine Learning, from fundamentals to state-of-the-art methods. Emphasis will be put both on the essential theory and on practical examples and lab projects. Each exercise has been carefully chosen to reinforce concepts explained in the lectures or to develop and generalize them in significant ways. This course is directed both at students without previous knowledge in Machine Learning, and at those wishing to broaden their expertise in this area. The course assumes some basic knowledge of probability theory and linear algebra. Nevertheless, the first module of the course will revisit these topics. Students are also expected to have knowledge of basic computer science principles

and skills, at a level sufficient to write a reasonably non-trivial computer program. Students who have already taken CS 10-701/15-781 or ECE 18-697 should not take this course.

Data, Inference, and Applied Machine Learning (18-785) – 12 Units
Please see the ECE website https://www.ece.cmu.edu/ for more information. This course will provide the methods and skills required to utilize data and quantitative models to automate predictive analytics and make improved decisions. From descriptive statistics to data analysis to machine learning the course will demonstrate the process of collecting, cleaning, interpreting, transforming, exploring, analyzing and modeling data with the goal of extracting information, communicating insights and supporting decision-making. The advantages and disadvantages of linear, nonlinear, parametric, nonparametric and ensemble methods will be discussed while exploring the challenges of both supervised and unsupervised learning. The importance of quantifying uncertainty, statistical hypothesis testing and communicating confidence in model results will be emphasized. The advantages of using visualization techniques to explore the data and communicate the outcomes will be highlighted throughout. Applications will include visualization, clustering, ranking, pattern recognition, anomaly detection, data mining, classification, regression, forecasting and risk analysis. Participants will obtain hands-on experience during project assignments that utilize publicly available datasets and address practical challenges.

Wavelets and Multiresolution Techniques (18-790) – 12 Units
The goal of this course is to expose students to multiresolution signal processing methods and their use in real applications as well as to guide them through the steps of the research process. All the necessary mathematical tools are introduced with an emphasis on extending Euclidean geometric insights to abstract signals; the course uses Hilbert space geometry to accomplish that. With this approach, fundamental concepts---such as properties of bases, Fourier representations, sampling, interpolation, approximation, and compression---are often unified across finite dimensions, discrete time, and continuous time, thus making it easier to focus on the few essential differences. The course covers signal representations on sequences, specifically local Fourier and wavelet bases and frames. It covers the two-channel filter bank in detail, and uses this signal-processing device as the implementation vehicle for all sequence representations that follow. The local Fourier and wavelet methods are presented side-by-side, without favoring any one in particular. Through the project, students will learn how to choose an appropriate representation and apply it to the specific problem at hand. There will be 2-3 hours of pre-recorded video per week that can be viewed online at any time. There will also be two 1-hour sessions in person that are not mandatory and can be viewed later online. The instructor will also be available for meetings in person or online as needed. The total amount of work per week is expected to be around 12 hours on average Pre-requisite: 18-491. Students are expected to have a good background in basic engineering mathematics, signal processing and linear algebra. This course is cross listed with 42-732

Methods in Medical Image Analysis (18-791) – 12 Units
Students will gain theoretical and practical skills in medical image analysis, including skills relevant to general image analysis. The fundamentals of computational medical image analysis

will be explored, leading to current research in applying geometry and statistics to segmentation, registration, visualization, and image understanding. Student will develop practical experience through projects using the National Library of Medicine Insight Toolkit (ITK), a popular open-source software library developed by a consortium of institutions including Carnegie Mellon University and the University of Pittsburgh. In addition to image analysis, the course will include interaction with clinicians at UPMC. It is possible that a few class lectures may be videoed for public distribution. Prerequisites: Knowledge of vector calculus, basic probability, and either C++ or python.

Advanced Digital Signal Processing (18-792) – 12 Units
This course will examine a number of advanced topics and applications in one-dimensional digital signal processing, with emphasis on optimal signal processing techniques. Topics will include modern spectral estimation, linear prediction, short-time Fourier analysis, adaptive filtering, plus selected topics in array processing and homomorphic signal processing, with applications in speech and music processing. 4 hrs. lec.

Image and Video Processing (18-793) – 12 Units
This course covers signal processing techniques specialized for handling 2D (images) and 3D (videos) signals. It builds upon 1D signal processing techniques developed in 18-290 and 18-491 and specializes them for the case of images and videos. In this class, you will learn fundamental tools and techniques for processing images and videos, and will learn to apply them to a range of practical applications. This course provides the fundamentals for studying images and videos. We will develop signal models specific to images and videos, develop associated optimization techniques for solving restoration problems like denoising, inpainting, study specialized compression algorithms. Specific focus will be on transform-domain, PDE and sparsity-based models and associated optimization techniques. These formal techniques will be enriched via applications in mobile devices, medical image processing, and compressive sensing.

Pattern Recognition Theory (18-794) – 12 Units
Decision theory, parameter estimation, density estimation, non-parametric techniques, supervised learning, linear discriminant functions, clustering, unsupervised learning, artificial neural networks, feature extraction, support vector machines, and pattern recognition applications (e.g., face recognition, fingerprint recognition, automatic target recognition, etc.). 4 hrs. lec. Prerequisites: 36-217, or equivalent introductory probability theory and random variables course and an introductory linear algebra course and senior or graduate standing.

Bioimage Informatics (18-795) – 12 Units
Bioimage Informatics (formerly Bioimaging) 12 units This course gives an overview of tools and tasks in various biological and biomedical imaging modalities, such as fluorescence microscopy, electron microscopy, magnetic resonance imaging, ultrasound and others. The major focus will be on automating and solving the fundamental tasks required for interpreting these images, including (but not restricted to) deconvolution, registration, segmentation, pattern recognition, and modeling, as well as tools needed to solve those tasks (such as Fourier and wavelet methods). The discussion of these topics will draw on approaches from many fields, including statistics,

signal processing, and machine learning. As part of the course, students will be expected to complete an independent project. Prerequisites: 18-396 Signals and Systems

Machine Learning for Signal Processing (18-797) – 12 Units
Signal Processing is the science that deals with extraction of information from signals of various kinds. This has two distinct aspects -- characterization and categorization. Traditionally, signal characterization has been performed with mathematically-driven transforms, while categorization and classification are achieved using statistical tools. Machine learning aims to design algorithms that learn about the state of the world directly from data. A increasingly popular trend has been to develop and apply machine learning techniques to both aspects of signal processing, often blurring the distinction between the two. This course discusses the use of machine learning techniques to process signals. We cover a variety of topics, from data driven approaches for characterization of signals such as audio including speech, images and video, and machine learning methods for a variety of speech and image processing problems. Prerequisites: Linear Algebra, Basic Probability Theory, Signal Processing and Machine Learning. 18-797 is a cross listing of 11-755 offered by LTI.

Fundamentals of Semiconductors and Nanostructures (18-817) – 12 Units
This course is designed to provide students with a foundation of the physics required to understand nanometer-scale structures and to expose them to different aspects of on-going research in nanoscience and nanotechnology. Illustrative examples will be drawn from the area of semiconductor nanostructures, including their applications in novel and next-generation electronic, photonic, and sensing devices. The course begins with a review of basic concepts in quantum physics (wave-particle duality, Schrödinger's equation, particle-in-a-box, approximation methods in quantum mechanics, etc.) and then continues with a discussion of bulk three-dimensional solids (band structure, density of states, the single-electron effective-mass approximation). Size effects due to nanometer-scale spatial localization are then discussed within a quantum-confinement model in one-, two-, and three- dimensions for electrons. An analogous discussion for photons is also presented. The basic electronic, optical, and mechanical properties of the low-dimensional nanostructures are then discussed. A select number of applications in electronics, photonics, biology, chemistry, and bio-engineering will be discussed to illustrate the range of utility of nanostructures. Upon completion of the course, students will have an appreciation and an understanding of some of the fundamental concepts in nanoscience and nanotechnology. The course is suitable for first-year graduate students in engineering and science (but advanced undergraduates with appropriate backgrounds may also take it with permission from the instructor). Prerequisites: 09-511, 09-701, 09-702, 18-303, 18-310, 18-402, 27-770, 33-225, 33-234 or familiarity with the material or basic concepts covered in these courses and senior or graduate standing.

Mobile and Pervasive Computing (18-843) – 12 Units
This is a course exploring research issues in the newly emerging field of mobile computing. Many traditional areas of computer science and computer engineering are impacted by the constraints

and demands of mobility. Examples include network protocols, power management, user interfaces, file access, ergonomics, and security. This will be an "advanced" course in the truest sense --- most, if not all, the topics discussed will be ones where there is little consensus in the research community on the best approaches. The course will also offer significant "hand-on" experience in this area. Each student will have to present and lead the discussion on a number of papers. Students will work in groups of three under the guidance of a mentor on a hands-on project. Each student will also be required to write one of two documents: (a) a research proposal (similar in spirit to an NSF proposal) on an idea in mobile computing or (b) a short business plan for a commercial opportunity in mobile computing. Grading will be based on the quality of the presentations, the project, and the proposal or business plan. Prerequisites: 15-410 and senior or graduate standing.

Internet Services (18-845) – 12 Units

This course investigates the issues involved in providing scalable and highly available network services over the best-effort Internet. Examples of such services include Web servers, application servers, search engines, proxy caches, online auction systems, and remote visualization. Topics include network programming, server design, clustering, caching, proxies, remote execution, resource naming, discovery, and monitoring, and wide-area metacomputing. The course consists of lectures on existing technology, student presentations of research papers, and a project where students design and implement a significant network service.

Wireless Systems Design Experience (18-846) – 12 Units

This project-oriented course is the culmination of the MS ECE Wireless Systems Concentration. It provides third-semester students with a design experience that brings together concepts from the Wireless Systems core to solve a real-world problem.

The class organizes the students as a design team to build an outdoor system for distributed sensing of physical quantities, wireless connectivity to a data repository, and analysis and presentation of the data. The specific problem domains (e.g., pavement-mounted traffic sensors, sensors for overland water flow, soil moisture, or stream height) are selected to present specific challenges in wireless connectivity, low-power operation, distributed synchronization, federation of dissimilar sensor types, real-time computation, and information presentation. The instructors and project sponsors (customers) will guide the students in developing an understanding of the problem domain (environment and requirements) and selecting suitable technologies for addressing the challenges specific to it, creating and documenting a system architecture with verifiable interfaces, decomposing the architecture into sub-problems that sub-groups of students can address, integrating the results into a single system, and verifying system performance against the documented requirements. Consistent with the Wireless Systems concentration methodologies, student work will be organized around fixed-length sprints followed by an evaluation of progress with the customer and instructors.

Upon completion of this course, the student will be able to: generate systems specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of wirelessly-connected subsystems; use power and RF

modeling tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application.

Engineering and Economics of Electric Energy Systems (18-875) – 12 Units
The course has two parts. The first part introduces basic components and networks used in the electric power industry. This is followed by systematic modeling of these components, as well as of the entire system. Methods for modeling and analyzing both system equilibria and dynamics are presented. Simulations and lab demos are given to simulate and analyze typical system blackouts. This is followed by introducing decision and control methods for preventing these problems, as well as for managing the system more reliably, securely and efficiently over broad ranges of its operating conditions. The emphasis is on IT, software and control (both distributed and coordination) for achieving pre-specified system performance. This part of the course will involve simulation demos and hands on studies in which students create their own power network, simulate it and assess for performance. The second part of the course will review the industry structure, the experience with deregulatio n, and economic issues concerning choice of generating fuel and technology, the costs of blackouts, and environmental discharges. The course will integrate engineering and economic aspects to examine the design, investment, and operations that satisfy public desires for low cost, nonpolluting, reliable, and secure power. Knowledge of basic electric circuits and/or basic economics is assumed. 3 hrs. lec., 1 hr. rec. Prerequisites: Basic electric circuits and/or basic economics and at least graduate standing.

Ph.D. Reading and Research (18-990) – Variable Units
Ph.D. level research.

Introduction to Graduate Studies (18-989) – 1 Unit
The Introduction to Graduate Studies course is designed to increase awareness and understanding of academic integrity issues, Carnegie Mellon community standards and the ethical job search. This is done via various sessions/modules that are already offered via several entities throughout campus (such as the CPDC, ICC, and GCC). Topics covered include: paraphrasing and citation, participating in the US classroom, avoiding plagiarism, unconscious bias, combating sexual violence on campus, finding jobs and internships, negotiation, communication, relationship building and other topics of interest. The course culminates in students writing a reflection paper. For international students, the paper should compare western academic and cultural standards to those of their home country. For domestic students, the paper should be a reflection on CMU's community standards. Active participation in 5 sessions/modules in the above mentioned areas and the submission of the reflection paper will determine a pass/fail grade.

Internship for Electrical and Computer Engineering Ph.D. Students (18-996, 18-997, 18-998) – Variable Units
The Department of Electrical and Computer Engineering considers experiential learning opportunities important educational options for its graduate students. One such option is an internship, normally completed during the summer. The ECE Graduate Office will add the course

to the student's schedule. This process should be used by any Electrical and Computer Engineering graduate student wishing to have their internship experience reflected on their official University transcript. International students should also be authorized by the Office of International Education (OIE). Completion of written assignments and requirements will determine the letter grade for the course. Prerequisites: Graduate standing in ECE

ECE Graduate Teaching Internship (18-992) – 12 Units
Two semesters of Teaching Internship are required for the ECE Ph.D. program. Ph.D. students or M.S. students who intend to pursue a Ph.D. are eligible for the TI. Students should obtain their advisor's permission prior to applying for the TI. Students must complete the online TA application to be considered for a position. TIs are assigned to work 10 hours per week. Registration of 12 units is required for each semester of teaching. See http://www.ece.cmu.edu/student/teaching.html for further information about applying for a teaching internship position.

APPENDIX D: ADDITIONAL INFORMATION ON FEDERAL AND STATE AID / FINANCIAL AID POLICIES

Carnegie Mellon University Consumer Information

Below is a summary of consumer information made available to all Carnegie Mellon University prospective and current students as required by the Higher Education Act of 1965, as amended. Required Disclosure have been categorized into five topics. Each disclosure gives a brief description of information that is required to be disclosed and explains how it can be obtained. This information may be changed from time to time as required.

If you need assistance or would like a paper copy, contact the Student Financial Aid Office, 5000 Forbes Avenue, Warner Hall, Pittsburgh, PA. If you wish to speak with a representative about the information contained here, please contact Associate Director Catherine Demchak at (412) 268-1353.

Information about the Institution:

Accreditation Information

Carnegie Mellon University is accredited by the Middle States Commission on Higher Education (MSCHE), 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104 (www.msche.org). The Commission may be contacted by telephone at 267-284-5000 or via email at info@msche.org or espanolinfo@msche.org (Spanish/Español). The university's current "Statement of Accreditation Status" can be found at, https://www.msche.org/institution/.

State Approvals

Carnegie Mellon University is licensed to operate in the states listed below. Individuals may contact the relevant agency for more information or information about how to file a complaint.

California

Bureau for Private Postsecondary Education
1747 North Market Blvd, Suite 225, Sacramento, CA 95834
Telephone: 888-370-7589
Email: bppe@dca.ca.gov
Website: www.bppe.ca.gov

New York

New York State Education Department
Office of Higher Education
Room 977 Education Building Annex
Albany, NY 12234
Telephone: 518-486-3633
Email: hedepcom@nysed.gov
Website: www.highered.nysed.gov

Pennsylvania

Pennsylvania Department of Education
Office of Postsecondary and Higher Education
333 Market Street, 12th Floor
Harrisburg, PA 17126-0333
Telephone: 717-783-8228
Email: ra-collunivseminfo@pa.gov
Website: www.education.state.pa.us

Washington, D.C.

Office of the State Superintendent of Education
Government of the District of Columbia
810 First Street NE 9th Floor
Washington, DC 20002
Telephone: 202-727-6436
Email: osse@dc.gov
Website: osse.dc.gov

Inquiries regarding the university's accreditation status or authorization to operate in any of the above states may be directed to: Associate Vice President / Director of Enrollment Services, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh PA 15213, telephone: 412-268-5399, email: krieg@andrew.cmu.edu.

Distance Education, State Authorization and Reciprocity Agreement (SARA)

The State Authorization Reciprocity Agreement (SARA) is an agreement among member states, districts, and territories in the United States, which establishes national standards for interstate offering of postsecondary distance education courses and programs. It is intended to standardize the process of offering online courses and programs by postsecondary institutions located in

states other than the state in which the enrolled student(s) are residing. SARA is overseen by a national council (NC-SARA) and administered by four regional education compacts.

Carnegie Mellon University has been approved by the Commonwealth of Pennsylvania to participate in NC-SARA and was accepted as a SARA institution on May 2, 2017; additionally, Carnegie Mellon secured approval through NC-SARA on May 18, 2017. Carnegie Mellon University is listed as an approved, participating institution on the NC-SARA website (http://www.nc-sara.org/). At this time, 49 of the 50 United States are SARA members. California is not a member of SARA; however, Carnegie Mellon is able to offer online education to California residents.

Except where prohibited by applicable law, students who reside outside of the United States generally are not restricted from enrolling in our online programs. Some online programs do require in-person attendance at one of Carnegie Mellon's teaching locations (e.g., Carnegie Mellon's Pittsburgh, Pennsylvania campus) for short portions of the program. Students interested in enrolling in a specific online program are encouraged to contact the person designated by the online program for questions about the program's requirements or enrollment.

Copyright Infringement Policies

Carnegie Mellon University takes copyright violation seriously. Besides raising awareness about copyright law, it takes appropriate action in support of enforcement as required by policy and law. United States copyright law (http://www.copyright.gov/) "protects the original works of authorship fixed in any tangible medium of expression, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device".

The University's Fair Use Policy (http://www.cmu.edu/policies/administrative-and-governance/fair-use.html) states that all members of the University must comply with US copyright law and it explains the fair use standards for using and duplicating copyrighted material. In addition, the policy prohibits the duplication of software for multiple uses, meeting the Digital Millennium Copyright Act (DMCA) (http://www.copyright.gov/legislation/dmca.pdf) requirements. The DMCA criminalizes the development or use of software that enables users to access material that is copyright protected. Furthermore, the Computing Policy (http://www.cmu.edu/policies/information-technology/computing.html) prohibits the distribution of copyright protected material via the University network or computer systems, unless the copyright owner grants permission.

The Higher Education Opportunity Act of 2008 (Public Law 110-315) Section 488, requires institutions of higher education to annually inform students that "unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject the students to civil and criminal liabilities". Carnegie Mellon does this by publication of a news article on Computing Services' website or via mass mail communication each semester. The law goes on to require institutions "to provide a summary of penalties for violation of Federal copyright laws, including disciplinary actions that are taken against students who engage in unauthorized

distribution of copyrighted materials using the institution's information system." Copyright protected materials can include, but are not necessarily limited to:

Music

Movies or other videos

Literary works

Software

Digital images or libraries

Cost of Attending the University

Actual tuition and fee charges can be found on the Student Financial Services' website at https://www.cmu.edu/sfs/tuition/index.html.

For estimated books and supplies, room and board, and personal/miscellaneous expenses view the cost of attendance for the Graduate program at https://www.cmu.edu/sfs/tuition/graduate/index.html.

Descriptions of Academic Programs

Information on the university's graduate academic programs and degree offerings is available from the various schools/colleges and admitting offices. Links to those programs can be found at https://www.cmu.edu/academics/index.html.

Faculty

Information on the university's faculty and instructional personnel is available from individual schools/colleges. This information can be found on the university's academics website at https://www.cmu.edu/academics/index.html**.**

Facilities & Services for Disabled Students

The Office of Disability Resources provides responsive and reasonable accommodations to students who self-identify as having a disability, including physical, sensory, cognitive and emotional disabilities. If you would like to learn more about the services and accommodations provided by the Office of Disability Resources, visit their website at https://www.cmu.edu/disability-resources/students/. To discuss your accommodation needs, please email us at access@andrew.cmu.edu or call us at 412-268-6121 to set up an appointment.

Student Privacy & FERPA

One of the most significant changes a parent or guardian experiences in sending a student to college is the difference in privacy standards for educational records. Carnegie Mellon values the student's right to privacy. The university adheres to a federal law called the Family Educational Rights and Privacy Act (also called FERPA or the Buckley Amendment) that sets privacy standards for student educational records and requires institutions to publish a compliance statement, including a statement of related institutional policies. For more detailed information, view the university's brochure at https://www.cmu.edu/hub/privacy/ferpa-brochure.pdf.

Return to Title IV Funds Policy and Procedural Statement

Policy Reason

The U. S. Department of Education requires that the university determine the amount of Federal Title IV aid earned by a student who withdrawals of fails to complete the period of enrollment. The university must determine the earned and unearned portions of Title IV aid as of the date the student ceased attendance based on the amount of time the student spent in attendance. Up through the 60% point in the period of enrollment, a pro rata schedule is used to determine the amount of Title IV funds the student has earned at the time of withdrawal. After the 60% point in the period of enrollment, a student has earned 100% of the Title IV funds he or she was scheduled to receive. For a student who withdraws after the 60% point-in-time, there are no unearned funds. Federal regulations can be found at:

Federal Student Aid Handbook, Volume 5

Chapter 1 Withdrawals and the Return of Title IV Funds 34 CFR 668.22

Policy and Procedural Statement

At Carnegie Mellon Title IV funds are awarded to a student under the assumption that the student will attend school for the entire period for which the assistance is awarded. When a student withdraws, the student may no longer be eligible for the full amount of Title IV funds that the student was originally scheduled to receive.

If a recipient of Title IV grant or loan funds withdraws from a school after beginning attendance, the amount of Title IV grant or loan assistance earned by the student must be determined. If the amount disbursed to the student is greater than the amount the student earned, the unearned funds must be returned. If the amount disbursed to the student is less than the amount the student earned, and for which the student is otherwise eligible, he or she is eligible to receive a Post-withdrawal disbursement of the earned aid that was not received.

Carnegie Mellon determines the Withdrawal Date and Date of Determination to complete the return calculation. A student's withdrawal date and date of determination varies depending on the type of withdrawal. When a student provides official notification to Carnegie Mellon through the Student Leave of Absence and Withdrawal Process, the withdrawal is defined as official withdrawal. When the student does not complete the Student Leave of Absence and Withdrawal Process and no official notification is provided by the student it is considered an unofficial withdrawal.

Leave of Absence/Withdrawal Process

A student may leave Carnegie Mellon by either taking a leave of absence (leaving the university temporarily with the firm and stated intention of returning) or by withdrawing from the university (leaving the university with no intention of returning). Students choosing to take a leave of absence should first contact their academic advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon. A student deciding to leave the university should take the following steps:

- Complete a Leave of Absence or Withdrawal Form.

- The form must include all necessary signatures or the process will not be completed.
- Return the completed form to the University Registrar's Office, 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213.

Determination of Withdrawal Date

Official Withdrawals (Notification Provided by the Student)

Those withdrawals defined as official are processed in accordance with federal regulations. The Office of the Registrar provides information that identifies which students have processed a Student Leave of Absence and Withdrawal Form for each semester. This information includes the Date of Withdrawal, the Date of Determination, Withdrawal/Leave Status (LA, LS, & W2) and the semester of attendance. This information is maintained in the student's academic file and in the university's Student Information System.

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- Date the student began the withdrawal or leave of absence process;
- Date the student notified his or her home department;
- Date the student notified the associate dean of his or her college; or
- Date the student notified the dean of students.

Unofficial Withdrawal (No Official Notification Provided by the Student)

For a student who withdraws without providing notification to Carnegie Mellon, the institution determines the withdrawal date using defined criteria. This category of withdrawals includes students that drop out and students that do not earn a passing grade.

To identify the unofficial withdrawals the Registrar develops a preliminary list of students that did not complete the semester by reviewing the final student grade reports. The list includes all students with: a) semester units carried, b) 0 semester units passed, c) 0 quality points earned, and d) 0.0 QPA. The Registrar contacts the academic divisions about each student to determine if the student actually completed the semester and earned the grades (0.0) or failed to complete the semester and did not notify the University of their status.

For students who do not notify the University of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- The midpoint of the semester;
- The last date the student attended an academically-related activity such as an exam, Tutorial or study group, or the last day a student turned in a class assignment.

Date of Determination that the Student Withdrew

Carnegie Mellon is not required to take attendance and the Date of Determination that a student withdrew varies depending upon the type of withdrawal: Official or Unofficial.

For withdrawals where the student provided *Official Notification* the Date of Determination is: The student's withdrawal date, or the date of notification, whichever is later.

For withdrawals where the student did not provide *Official Notification* the Date of Determination is: The date the institution becomes aware the student has ceased attendance.

For a student who withdrawals without providing notification to the institution, the institution must determine the withdrawal date no later than 30 days after the end of the enrollment period.

Calculation of Earned Title IV Assistance

The withdrawal date is used to determine the point in time that the student is considered to have withdrawn so the percentage of the period of enrollment completed by the student can be determined. The percentage of Title IV aid earned is equal to the percentage of the period of enrollment completed.

The amount of Title IV federal aid earned by the student is determined on a pro-rata basis up to the end of 60% of the semester. If the student completed 30% of a term, 30% of the aid originally scheduled to be received would have been earned. Once a student has completed more than 60% of a term, all awarded aid (100%) has been earned. The percentage of federal aid earned and the order in which the unearned aid is returned are defined by federal regulatory requirements.

The calculation of earned Title IV funds includes the following grant and loan funds if they were disbursed or could have been disbursed to the student for the period of enrollment for which the Return calculation is being performed:

- Pell Grant
- Iraq and Afghanistan Service Grant
- TEACH Grant (not available at Carnegie Mellon)
- FSEOG Grant
- Federal Direct Loan

Institutional Charges

Institutional charges are used to determine the portion of unearned Title IV aid that the school is responsible for returning. Carnegie Mellon ensures that all charges for tuition, fees, room and board, as well as all other applicable institutional charges are included in the return calculation. Institutional charges do not affect the amount of Title IV aid that a student earns when he or she withdraws.

The institutional charges used in the calculation usually are the charges that were initially assessed the student for the period of enrollment. Initial charges are only adjusted by those changes the institution made prior to the student's withdrawal (for example, for a change in enrollment status unrelated to the withdrawal). If, after a student withdraws, the institution changes the amount of institutional charges it is assessing a student, or decides to eliminate all institutional charges, those changes affect neither the charges nor aid earned in the calculation.

Return of Unearned Funds to Title IV

If the total amount of Title IV grant and/or loan assistance that was earned as of the withdrawal date is less than the amount that was disbursed to the student, the difference between the two amounts will be returned to the Title IV program(s) and no further disbursements will be made.

If a student has received excess funds, the College must return a portion of the excess equal to the lesser of the student's institutional charges multiplied by the unearned percentage of funds, or the entire amount of the excess funds.

The funds will be returned in the order below as prescribed by federal regulations, within 45 days from the date of determination that a student withdrew.

- Unsubsidized Federal Stafford Loans
- Subsidized Federal Stafford Loans
- Federal PLUS loans
- Federal Pell Grants
- Federal Supplemental Educational Opportunity Grants (FSEOG)

Post-Withdrawal Disbursements

If the total amounts of the Title IV grant and/or loan assistance earned as of the withdrawal date is more than the amount that was disbursed to the student, the difference between the two amounts will be treated as a post-withdrawal disbursement. In the event that there are outstanding charges on the student's account, Carnegie Mellon will credit the student's account for all or part of the amount of the post-withdrawal disbursement up to the amount of the allowable charges.

Any amount of a post-withdrawal disbursement that is not credited to a student's account will be offered to the student within 30 days of the date that the institution determined that the student withdrew. Upon receipt of a timely response from the student, the College will disburse the funds within 90 days of the date of determination of the student's withdrawal date.

Return of Title IV Funds – Withdrawals for Programs Offered in Modules

The return of Title IV funds for programs offered in modules is defined in a separate policy statement at Carnegie Mellon. This document is included as an addendum to the Carnegie Mellon University Return to Title IV Funds Policy and Procedural Statement (see below).

Policies and Procedures

Federal Student Aid Handbook, Volume 5, Chapter 2 Withdrawals and the Return of Title IV Funds

CFR 668.22 (a), (f) and (l)

Dear Colleague Letter GEN-11-14 July 2011

For all programs offered in modules, a student is a withdrawal for Title IV purposes if the student ceases attendance at any point prior to completing the payment period or period of enrollment

(unless the institution has written confirmation from the student that that they will attend a module that begins later in the enrollment period).

The regulations require the institution to determine whether Title IV funds must be returned based on the number of days actually completed versus the number of days the student was scheduled to attend in the payment period. The regulations prevent students from enrolling in modules or compressed courses spanning the period, completing a portion of the period, and retaining all aid for the period.

A program is considered to be offered in modules if a course or courses in the program do not span the entire length of the payment period or period of enrollment. The rule impacts all programs offering courses shorter than an entire semester, including semester-based programs with a summer term consisting of two consecutive summer sessions.

The Student Financial Aid Office has established the following procedures associated with handling withdrawals from programs offered in modules. An Associate Director of Student Financial Aid has the primary responsibility for compliance and implementation of these regulatory requirements.

The institution will identify students enrolled for the summer session that are eligible for Title IV Aid.

- Pell eligible students are identified
- Students with summer loans are identified
- The period of enrollment and enrollment status will be identified for each student

All Leave/ Withdrawal Forms processed by the University Registrar's Office will be reviewed for the summer sessions to record the Withdrawal Date and Date of Determination to identify any student receiving federal funding.

The Student Financial Aid Office will identify any students that drop courses in the summer sessions.

- During Summer I this is standard procedure
- During Summer II this is reviewed after 10th day reporting
- Any additional dropped courses will be reviewed through the 60% enrollment period

Students who are identified as official withdrawals or that officially drop all courses in a session will be reviewed to determine the amount of federal financial aid earned. If a Return of Title IV aid is required, existing institutional procedures will be followed.

At the end of the enrollment period the institution will determine if any students are identified as 'unofficial withdrawals.' If a Return of Title IV aid is required, existing institutional procedures will be followed.

If a student does not begin courses in all sessions, a Return of Title IV aid may not be required, but other regulatory provisions concerning recalculation may apply.

If a student completes both courses in module one, but officially drops courses in module two while attending module one the student is not a withdrawal.

Since the enrollment is less than half time, the student is no longer eligible for the loan and the funds must be returned.

The following information obtained from the Federal Student Aid Handbook, Chapter 2, Withdrawals and the Return of Title IV Funds, will be used to determine whether a student enrolled in a series of modules is a withdrawal.

How to determine whether a student in a program offered in modules has withdrawn

Schools can determine whether a student enrolled in a series of modules is a withdrawal by asking the following questions.

1. *After beginning attendance in the payment period or period of enrollment, did the student cease to attend or fail to begin attendance in a course he or she was scheduled to attend?*

If the answer is no, this is not a withdrawal.

If the answer is yes, go to question 2.

2. *When the student ceased to attend or failed to begin attendance in a course he or she was scheduled to attend, was the student still attending any other courses?*

If the answer is yes, this is not a withdrawal; however other regulatory provisions concerning recalculation may apply.

If the answer is no, go to question 3.

3. *Did the student confirm attendance in a course in a module beginning later in the period (for non-term and nonstandard term programs, this must be no later than 45 calendar days after the end of the module the student ceased attending)?*

If the answer is yes, this is not a withdrawal, unless the student does not return.

If the answer is no, this is a withdrawal and the Return of Title IV Funds requirements apply.

Contact

Questions regarding this policy or its intent should be directed to the Student Financial Aid Office at 412-268-1353.

Satisfactory Academic Progress Policy and Procedural Statement

To be eligible for federal, state, and institutional financial aid, all students are required to maintain Satisfactory Academic Progress toward the completion of a degree. Each university determines its own policy in accordance with federal regulations set forth by the U. S. Department of Education regarding satisfactory progress standards to ensure student success. To maintain Satisfactory Academic Progress at Carnegie Mellon University, students must meet the following minimum standards for both of the qualitative (QPA) and quantitative (completion rate) measures:

Student Type	QPA (Qualitative)	Completion Rate (Quantitative)*
First Year Undergraduate	1.75	80%
Undergraduate Upper-class	2.00	80%
Heinz Graduate	3.00	80%
Other Graduate (excluding Tepper)	2.00	80%

**To calculate the completion rate, the cumulative number of completed units is divided by the cumulative number of units attempted. Advance Placement credits are excluded from both figures.*

In addition to the above mentioned Financial Aid Satisfactory Academic Progress standards, federal regulations require a student to complete their degree within a specified amount of time. The maximum timeframe cannot exceed 150 percent of the time published as needed for completion of the program.

Scope:

This policy applies to Federal aid including Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Work-Study, Federal Direct Loans, and Federal Direct PLUS Loan programs; state grant aid; and Carnegie Mellon institutional aid including grants, loans, and scholarships.

Federal regulations can be found at:

Federal Student Aid Handbook, Volume 1

Chapter 1 School Determined Requirements

34 CFR 668.16(e)

34 CFR 668.32(f)

34 CFR 668.34

Evaluation:

Carnegie Mellon evaluates all students for Financial Aid Satisfactory Academic Progress annually, at the end of the spring semester. Students that are included in the review are undergraduates, graduates, both full-time and part-time.

Courses that do not count toward a student's degree cannot be used to determine enrollment status for financial aid purposes. Carnegie Mellon will count transfer credit hours that are accepted toward a student's educational program as both attempted hours and completed hours. Advanced Placement Non-Degree and Non-Credit courses are not counted as units passed or attempted. When a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student's QPA. For financial aid eligibility, only one repeat per course is permitted in the determination of enrollment status for courses previously passed.

If the student withdraws and is not assigned a W grade, then it will not be counted in the number of units attempted or completed. If the W grade is assigned, the units will be counted in the number of units attempted and will be counted as zero in the number of units completed.

If the student has incomplete units, the units will be counted as attempted and will be counted as zero in the number of units completed.

The Financial Aid Satisfactory Academic Progress evaluation is a cumulative review of all semesters, regardless of whether or not the student received financial aid during the academic year.

If the minimum requirements are not achieved, the student is ineligible to receive financial aid. In such a case, the student is notified and given an option to appeal their financial aid status. More information about the appeal process can be found at www.cmu.edu/sfs/docs/federal-title-iv.pdf.

A financial aid package will not be completed unless an appeal is received, approved and processed accordingly. If by chance a financial aid package is processed and released to the student, it is conditional and subjected to financial aid removal until an appeal is received, approved and processed accordingly.

Contact:

Accountable Department: Enrollment Services, Student Financial Aid. Questions regarding this policy or its intent should be directed to the Student Financial Aid Office, phone: 412-268-1353.

Student Body Diversity

For Information about the diversity of the university student body, contact the Institutional Research and Analysis Office, https://www.cmu.edu/ira/index.html.

For information about the University's Diversity, Equity and Inclusion initiative, visit the Center for Student Diversity and Inclusion's website at https://www.cmu.edu/student-diversity/.

Written Arrangement Information

A U.S. Department of Education regulation requires disclosure of specific information to prospective and current students regarding written arrangements between Carnegie Mellon University (CMU) and any institution(s) that provides a portion of an educational program to students enrolled at CMU. CMU enters into such arrangements to enrich the educational experiences offered to its students. In accordance with the regulation, CMU provides this information at http://www.cmu.edu/hub/consumer-information/docs/written-arrangement.pdf.

Student Complaints & Consumer Information by State

As required for compliance with U.S. Federal Program Integrity Regulations, state official/agency contact information for each U.S. state/territory that could handle a student's complaint is provided at https://www.cmu.edu/hub/consumer-information/docs/complaints.pdf.

Gainful Employment Disclosures

As required by U.S. Department of Education regulations Gainful Employment Disclosures (Disclosures about CMU certificate programs that prepare students for specific occupations) can be found at https://www.cmu.edu/hub/consumer-information/.

Information about Student Financial Aid:

Meeting the cost of higher education is a significant investment. We are committed to providing a comprehensive financial aid program that makes it possible for admitted students to attend Carnegie Mellon.

Application Process & Timeline:

Graduate Students: **To apply for financial aid for the 2021-2022 academic year, follow the steps below.**

Free Application for Federal Student Aid (FAFSA)

The FAFSA is required if applying for federal financial aid programs. There are now two ways to complete the *Free Application for Federal Student Aid (FAFSA)* form: a redesigned https://studentaid.ed.gov/sa/fafsa website or a mobile app (available through Google Play, https://play.google.com/store/apps/details?id=com.fsa.mystudentaid or the Apple App Store, https://itunes.apple.com/us/app/mystudentaid/id1414539145.

We recommend using the IRS Data Retrieval Tool (DRT) (https://studentaid.ed.gov/sa/resources/irs-drt-text) to complete the FAFSA. The DRT transfer process has been improved to include stronger security and privacy protections; therefore, tax information transferred will not display on the form or Student Aid Report. Instead, the phrase "Transferred from the IRS" will appear in the fields.

Those selected for federal verification after FAFSA completion or those unable to use the IRS DRT will need to request an IRS Tax Return Transcript (https://www.irs.gov/individuals/get-transcript).

Additional information:

Apply as soon as possible after October 1.

Carnegie Mellon's federal code is 003242.

Use 2018 tax information to complete the FAFSA.

A Department of Education Federal Student Aid (FSA) ID is required. View FSA ID instructions at https://fsaid.ed.gov/npas/index.htm.

Students must complete the FAFSA's electronic signature requirement.

MPN & Entrance Counseling

All first-time Federal Direct Loan borrowers are required to complete entrance counseling. The entrance counseling session provides information about borrower rights and responsibilities. CMU will be notified when a student has completed online entrance counseling. Funds will not be disbursed until the entrance counseling session has been completed. Students

who completed a federal entrance counseling session while at CMU, do not have to complete another session.

Additional information:

View entrance counseling instructions (https://www.cmu.edu/sfs/financial-aid/types/federal-loans/direct/mpn-entrance-counseling.html).

Complete entrance counseling session at https://studentloans.gov.

Grad PLUS Loan

If you plan on borrowing a Federal Direct Graduate PLUS Loan, this is a two-part process and both parts must be completed in order for your loan to be originated. If you borrowed a Grad PLUS Loan last academic year, you are only required to complete the application portion of the process. The application portion of the process cannot be completed before June 1, 2019.

Additional information:

View detailed Grad PLUS Loan instructions at https://www.cmu.edu/sfs/financial-aid/types/federal-loans/plus/instructions.html.

The two-part process may be completed at https://studentloans.gov.

Financial Aid Eligibility Notification

Once a student completes all of the steps above, a financial aid package will be determined. The Student Financial Aid Office will notify the student by email that a financial aid award letter has been posted to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home). The letter contains information and further instructions regarding the student's eligibility and awards. If a student's circumstances change, then financial aid eligibility will be re-evaluated and the student will receive notification that a revised award letter is available in SIO.

Missing Documents

If we are unable to process a student's financial aid package due to missing documents, a Financial Aid Alert email will be sent to the student requesting the required documents by a specified date. Until the entire application process is completed and all required documents are submitted, our office may be unable to complete a student's financial aid package. Students may log in to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home) to view documents that have been received by our office. View instructions for submitting missing documents at https://www.cmu.edu/sfs/financial-aid/missing-documents/index.html.

Teacher Certification

Teacher certification students at the graduate level should be aware that federal regulations classify them as a grade level 5 undergraduate student for Federal Direct Student Loan purposes. Teacher certification students are, however, considered a graduate student by Carnegie Mellon for academic purposes.

Available Financial Aid

Scholarships & Grants

Graduate Students:

Graduate students interested in scholarships and grants may contact their program of interest or department. View more information on the Graduate Education Office website, http://www.cmu.edu/graduate/prospective-students/index.html. In addition, the Fellowships & Scholarships Office (http://www.cmu.edu/fso/) provides support to graduate students interesting in pursing certain external scholarships, like Fulbright and UK Awards.

Federal Work-Study

Federal Work-Study (FWS) is a need-based self-help award. If a student has been awarded FWS, the FWS award is the total that can be earned during the academic year as a work-study student.

Federal Loans

For many students and families, educational loans are a necessary part of the process of paying for college. Student Financial Aid certifies loans for students, as well as Federal Direct Parent PLUS Loans for parents of undergraduates and Federal Direct Grad PLUS Loans for graduate students.

Federal Direct Student Loan

The Federal Direct Student Loan is the most widely-used loan for college students and is available to both undergraduate and graduate students. There are two types of Federal Direct Student Loans, subsidized and unsubsidized, and eligibility for both is determined by completing the FAFSA.

Grad PLUS Loan

Eligible graduate students may borrow a Federal Direct Grad PLUS Loan to assist with educational expenses. Students may borrow any amount up to their calculated cost of attendance minus any other aid received.

Private Loans

Private loan programs offer competitive interest rates and borrower benefits. To increase chances of approval and possibly improve the rate you receive, students are strongly recommended to apply with a creditworthy co-signer.

Student Outcomes

Retention and Graduation Rates

Institutional Research and Analysis Office offers up-to-date data on degrees conferred, enrollment reports, freshmen retention rates and race and ethnicity reports for annual degrees. Retention and Graduation rates can be found at https://www.cmu.edu/ira/retentiongradrates.html.

Intercollegiate Athletic Program Participation Rates and Financial Support Data (Equity in Athletics Disclosure Act)

Please visit the U.S. Department of Education's site, The Equity in Athletics Data Analysis (http://ope.ed.gov/athletics/#/) and select the "Get data for one schools" option. Enter "Carnegie Mellon University" in the "Name" field and select the "Continue" button at the bottom of the page.

A printed copy of the report can be requested by calling the Department of Athletics, Physical Education, and Recreation at 412-268-8054 or by sending an email to Josh Centor, Associate Vice President for Student Affairs and Director of Athletics, Physical Education & Recreation, at jcentor@andrew.cmu.edu.

Health and Safety

Drug and Alcohol Abuse Prevention Program

Under the Drug Free Workplace Act of 1988 and the Drug Free Schools and Campuses Act of 1989, the Carnegie Mellon University is required to have an alcohol and other drug policy outlining prevention, education and intervention efforts and consequences for policy violations. The policy can be found at https://www.cmu.edu/policies/administrative-and-governance/alcohol-and-drug-policy.html.

CMU Annual Security and Fire Safety Report

A printed copy of the report can be requested by contacting University Police at 412-268-6232 or campuspd@andrew.cmu.edu.

The annual security and fire safety report (Carnegie Mellon University Police Department Annual Reports) is also available online at http://www.cmu.edu/police/security-fire-reports/index.html.

Vaccination Policies

CMU Prematriculation Immunization Policy can be found at http://www.cmu.edu/policies/student-and-student-life/immunizations.html.

CMU University Health Services Health Requirements for Incoming Students can be found at https://www.cmu.edu/health-services/new-students/.

Other Information

Voter Registration

Please visit http://www.usa.gov/Citizen/Topics/Voting/Register.shtml.

Carnegie Mellon Ethics Hotline

The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to financial matters, academic and student life, human relations, health and campus safety or research.

Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net (user name: tartans; password: plaid). All submissions will be reported to appropriate university personnel.

The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state, or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the vice president for campus affairs, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Obtain general information about Carnegie Mellon University by calling 412-268-2000.

APPENDIX E: ADDITIONAL INFORMATION ON COVID-19 EXCEPTIONS AND UPDATES

COVID-19 Related Updates

Pass/No Pass Policy – For Spring 2020 the university instituted a Pass/No Pass policy to allow passing grades to be converted to P/NP and still count towards degree requirements. All passing grades from Spring 2020 will be counted towards the ECE MS degree, but will not be factored into the students QPA.

Remote Courses – Due to the COVID-19 pandemic the rule where only one online class is allowed per semester is suspended for the 2020-2021 academic year. Students may register for classes that have both remote and in-person delivery modes.

5000 Forbes Avenue

Pittsburgh, PA 15213

www.ece.cmu.edu

@CMU_ECE

Master of Entertainment Industry Management Program

Carnegie Mellon University

August 30, 2021 – May, 13, 2022 Student Handbook
May 16, 2022 – August 5, 2022 Summer Internship
Revised October 11, 2021

Daniel T. Green, Ph.D., Program Director

College of Fine Arts
Mary Ellen Poole, Ph.D. Dean
Eric Anderson, Senior Associate Dean
Kristen Kovak, Senior Associate Dean

H. John Heinz III College
Ramayya Krishnan, Ph.D. Dean
Andy Wasser, Associate Dean
Jackie Speedy, Associate Dean

MEIM – Pittsburgh (Year One)
Hamburg Hall 1119E, 4800 Forbes Ave. Pittsburgh, PA 15213 412.268.6706
MEIM - Los Angeles (Year Two)
4640 Lankershim Blvd. Suite 125 * North Hollywood, CA 91602 818.980.6346
Program Website: http://heinz.cmu.edu/meim
Handbook Website: http://www.heinz.cmu.edu/academic-resources/student-handbook-forms/index.aspx

TABLE OF CONTENTS

1. INTRODUCTION

This handbook provides specific information on the curriculum and program requirements for the Master of Entertainment Industry Management (MEIM) Program. Heinz College also publishes a separate handbook that details College-wide policies and procedures pertaining to educational planning, program committee, teaching, scheduling and course credit, performance standards, academic standing, ethics and discipline, student privacy rights and major forms and deadlines. Students should familiarize themselves with both, as each contains information that is critical for your success. These handbooks can be obtained through your program director and via the Heinz College website at:

http://www.heinz.cmu.edu/academic-resources/student-handbook-forms/index.aspx

1.1 ABOUT HEINZ COLLEGE

The Heinz College was founded in 1968 by a small group of faculty members from the Graduate School of Industrial Administration (now the Tepper School of Business) to better prepare students for the challenges of public and non-profit sector management careers. Originally named the School of Urban and Public Affairs (SUPA), the College offered training in public policy and management through the Master of Science in Public Policy and Management (MSPPM) program. In 1982, the Master of Public Management (MPM) program was added to the College, and in 1987, the Master of Arts Management (MAM) program was created in collaboration with the College of Fine Arts. In the mid-1990's, the College added programs in information systems management to prepare students for private sector careers that bridge the gap between technology and business (MISM and MSISPM). The focus of these programs is on the intelligent application of IT in corporate environments. During the 2000's the program in Entertainment Industry Management was added, as was the MSPPM-DC track.

Over 10,000 students have graduated from the Heinz College and are employed by government, private industry, consulting firms and non-profit, arts, entertainment, and health organizations around the world. Most students in our full-time master's programs come to the Heinz College with three years or less work experience. Students in the part-time programs typically hold full-time professional positions and have 2 or more years of work experience.

In October 2008, the Heinz School became the H. John Heinz III College with two schools: the School of Information Systems and Management and the School of Public Policy and Management. These two schools serve as the platform for our educational programs listed below.

1.2 CARNEGIE MELLON MISSION STATEMENT

The mission statement of Carnegie Mellon University is to create a transformative educational experience for students focused on deep disciplinary knowledge; problem-solving; leadership, communication and interpersonal skills; and personal health and well-being.

To cultivate a transformative university community committed to (a) attracting and retaining diverse, world-class talent; (b) creating a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish; and (c) ensuring individuals can achieve their full potential.

To impact society in a transformative way - regionally, nationally and globally - by engaging with partners outside the traditional borders of the university campus.

1.3 MEIM MISSION STATEMENT

The mission of the Master of Entertainment Industry Management (MEIM) Program is to prepare the next generation of successful executives and entrepreneurs for leadership in Film, TV, Music, Streaming, and Video Game Production, Research, Management, Marketing and Content Distribution across all entertainment media platforms and screens.

The MEIM program instills critical thinking skills, encourages professionalism, integrity, and business ethics; and promotes career development skills to benefit graduates throughout their career. Based on Heinz College's world-class policy and management curriculum, the MEIM program balances a well-designed, rigorous graduate academic experience with practical professional skills acquired through internships with leading industry companies. The MEIM program seeks to create a diverse, global community that includes students, alumni, faculty and the media/entertainment professional community to collectively address the direction of the industry, and to promote positive and effective change through applied research and business strategies.

The objectives of students in the MEIM Program are to:

- Understand and employ the theoretical foundations of entertainment industry management;
- Apply effective leadership tools, skills and techniques;
- Investigate and expand the field through theoretical and applied research;
- Function effectively in collaborative, team and project-based environments; and
- Operate efficiently in a connected, networked professional setting.

The MEIM Program supports its students through:

- Individual attention to the needs and aspirations of all students;
- A culture that values cooperation, collaboration, professionalism and personal responsibility, and
- An academic community that values diversity, promotes creative thinking, and encourages ethical behavior.

2. CARNEGIE MELLON POLICIES & EXPECTATOINS

It is the responsibility of each member of the Carnegie Mellon community to be familiar with university policies and guidelines. In addition to this departmental graduate student catalog the following resources are available to assist you in understanding community expectations:

- The Word/Student Catalog
- Academic Integrity Website
- University Policies Website
- Graduate Education Website

2.1 CARNEGIE MELLON CODE

Students at Carnegie Mellon, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical and moral conduct possible.

These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

As members of the Carnegie Mellon community, individuals are expected to uphold the standards of the community in addition to holding others accountable for said standards. It is rare that the life of a student in an academic community can be so private that it will not affect the community as a whole or that the above standards do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist.

The commitment of its faculty, staff and students to these standards contributes to the high respect in which the Carnegie Mellon degree is held. Students must not destroy that respect by their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from the university.

The Carnegie Mellon Code can also be found online.

3. SUMMARY OF KEY REQUIREMENTS

1) Read both the Heinz College handbook as well as the MEIM handbook (catalogue).
2) Familiarize yourself with the MEIM handbook to ensure that you comply with all program requirements. **If you do not meet all of the requirements for graduation, you will not be permitted to graduate.** You must submit requests for waivers of requirements or approval of special academic programs in advance.
3) To graduate, you *must* complete 198 units of coursework with at least a 3.0 cumulative Grade Point Average. You must successfully complete all first-year course work in Pittsburgh prior to commencing the second year of the program in Los Angeles.
4) Your MEIM Program Director or your faculty advisor must approve your initial schedule and all schedule changes.
5) For each semester except your last, you must take between 45 and 60 units. In your final semester, all students (international as well as domestic students) must take at least 36 units. This means that you will have to take at least five elective credits during the final semester in order to reach 36 units and be considered full-time.
6) Students can change their schedules -- once they have met with their advisor -- using Carnegie Mellon's Online Registration, up until the official Add/Drop deadline for the semester or mini.
7) You are permitted to take up to 12 units of Independent Study but you must submit a petition to the MEIM Program Director for permission to take additional units.
8) If extenuating circumstances beyond your control prevent you from completing all requirements for a course by the end of a semester, you may ask the instructor for permission to take an incomplete and to make-up the work. If the instructor agrees (and s/he may refuse), you must sign a formal contract. You must sign the contract before the end of the semester, and you must complete the work by the end of the following semester. Instructors will impose grade penalties for incompletes, except when they are due to serious illness or other unavoidable circumstances.
9) It is your obligation to understand and comply with the rules of academic conduct at Heinz College. Penalties for breach of these standards can range from failure of the course to removal from the program. Be sure that you know each instructor's rules regarding permissible collaboration on assignments.
10) You must complete an internship of at least 300 hours in the summer between your first and second years in the program. You will automatically be registered into a 0-unit course #94.900 once you have obtained the internship. You also have a 300-hour internship requirement during the fall and spring semesters of the second year of the program. The MEIM Program Director must approve this internship in advance.
11) As summer, fall, and spring internships are a requirement of the MEIM curriculum, F-1 students are allowed to participate via Curricular Practical Training (CPT). CPT employment (paid or unpaid internships) must be directly related to the entertainment industry and must be approved by the MEIM Program Director.

12) A leave of absence must be requested in advance if you intend to be away from College for an extended period of time. Any student who interrupts his or her program of study without such approval will be deemed to have withdrawn and will be required to seek readmission before returning.

4. MEIM RESOURCES

There are several people who will be a part of your journey as a MEIM student. What follows are the key personnel who you will support you throughout your two years in the program. A * denotes Los Angeles based.

Name	Title	Email
Crawford, Brett	MEIM Program Chair	brett@cmu.edu
Eber, David	Director, Admissions & Financial Aid	deber@andrew.cmu.edu
Green, Daniel*	Director, MEIM Program/ Academic Advisor Year One and Two	dtgreen@cmu.edu
Krishnan, Ramayya	Dean, H. John Heinz III College	rk2x@andrew.cmu.edu
Poole, Mary Ellen	Dean, College of Fine Arts	djmartin@cmu.edu
Reilly, Ross	MEIM Coordinator (Pitts): Year One	rossreilly@cmu.edu
Ryan, Mary*	MEIM Senior Academic Coordinator	maryryan@andrew.cmu.edu
Spangler, Matthew	Assistant Director, Career Services	mspangler@cmu.edu

5. EDUCATIONAL PLANNING

5.1 ADVISORS

During your first year in Pittsburgh, you will have access to two advisors. One advisor will be the MEIM program director. You will also be assigned a first-year advisor (located in Pittsburgh) to help with day-to-day advisement. Your advisors can help you in selecting courses and working through academic problems. A mandatory advising session (with the program director) will be planned during orientation. In addition, you should plan to meet with your advisor(s) each semester, but feel free to call upon your advisor or program director at any time. It is your responsibility to obtain approval and communicate schedule and class changes to the program director as well the assigned advisor. In the second year of the program, the program director will act as your sole academic advisor.

5.2 PRE-REGISTRATION PROCESS

To ensure that students in all programs are completing courses in the best sequence for their degree program, students will be pre-registered by the Office of Academic Services at Heinz College for their first semester of courses. The Office of Academic Services will begin to register students prior to their start date. This schedule is not absolute. You may see a 36-unit course on your schedule for a brief period of time to indicate that you will be a full-time student at Heinz College. This 36-unit course is only a placeholder that the Office of Academic Services will use until your core/required courses have been assigned. However, you may or may not see actual courses added to your online schedule until just before classes begin.

Following the results of the Placement Exams that are held during Heinz Orientation, students may have the flexibility to add additional courses to their first semester schedule. Students will meet with their academic advisor(s) prior to the beginning of classes in order to finalize their first semester schedule.

5.3 STUDENT RESPONSIBILITIES

The College's faculty and staff will try to help you in every way possible to successfully complete your program. However, it is ultimately your responsibility to ensure that you meet all of your program's requirements.

5.4 CHANGES TO REQUIREMENTS

This handbook is intended to summarize the policies of the MEIM curricular requirements. These policies and requirements may change. The College will make a serious effort to see that all students are informed of any relevant changes in policy or operations. In general, when such revisions and additions increase requirements, only the next entering class will be bound by such revisions unless specifically communicated to the student.

6. CURRICULUM

The MEIM Program is to be completed in two academic years of full-time study – one year in Pittsburgh and one year in Los Angeles. You must successfully complete all first-year course work in Pittsburgh prior to commencing the second year of the program in Los Angeles. The MEIM curriculum is structured with a set of Common Core courses and electives. In order to successfully complete the MEIM Program, you must complete the following:

- 198 units of course credit;
- passing grades (C-) in all Core courses (unless you exempt them);
- obtain a total QPA of 3.0
- approved electives;
- successful completion of the Capstone project; and
- all other standards for graduation, including meeting minimum grade point averages and completing the required practicum assignments (internships) in good standing.

6.1 COURSE LOADS

A full semester course carries 12 units of credit and is generally expected to require an average of 12 hours per week of time, including time spent in and out of the classroom. "Mini" courses are those that are half a semester in length; they generally carry 6 units of credit, and also require approximately 12 hours per week of time. At times, there may be a 3-unit or 4-unit elective "mini" course offered. These classes are set up to expose the student to a specific area or distinct subject matter in the entertainment industry.

You will need a minimum number of 54 units during each of the first two semesters in Pittsburgh. You will need approval from the program director for a course load that exceeds 60

units, but students are heavily discouraged from taking more than 60 units per semester. Individual circumstances may dictate a heavier or lighter course load in a given semester.

First Year - Pittsburgh

Fall Semester	Spring Semester
• 48 Units Core • 06 Units - Electives • 54 Units minimum needed • Can take up to 6o units without approval	• 30 units Core • 24 Units – Electives • 54 Units minimum needed • Can take up to 6o units without approval

Second Year - Los Angeles

Fall Semester	Spring Semester
• 46 Units Core • Electives (Can take up to 13 units)	• 31 Units Core • Electives (Can take up to 18 units) • You will need at least 5 elective units to get to 36 units to be full-time status • Entire Year 2 = Typically 90 units minimum

155 Core + 43 Electives = 198 Minimum Units to graduate

6.2 CORE (REQUIRED) COURSES

MEIM-Specific Core Courses:		
93.851	Film Economics, Marketing & Distribution	12 units
93.852	Production Management	6 units
93.853	Digital Innovation & Entrepreneurship	6 units
93.855	Intellectual Property Rights Issues	6 units
93.856	Business Development	6 units
93.858	Market Research in Entertainment	3 units
93.861	Script/Story Analysis	6 units
93.869	Television Economics	6 units
93.871	Television Business & Legal Affairs	9 units
93.876	Television Marketing & Advertising	6 units
93.879	Navigating the Entertainment Industry	3 units
93.887	Practicum I	1 unit
93.888	Practicum II	1 unit
93.889	Capstone Management Project I	3 units
93.890	Capstone Management Project II	9 units
94.900	Practicum (Summer)	0 units
		83 units sub total
Heinz College Courses:		
90.707	Statistical Reasoning/90.711 Stat. Reasoning with R/90.777 Intermediate	12 units
90.710	Applied Economic Analysis	12 units
90.718	Strategic Presentation Skills	6 units
90.723	Financial Statement and Analysis of Companies	6 units
90.725	Mgt. Accounting or 95.716 Principals of Finance	6 units

93.717	Writing for the Creative Industries (93.701) Business Writing	6 units
94.700	Organizational Design and Implementation	6 units
94.708	Applied Strategic Marketing	6 units
94.800	Negotiation	6 units
94.732	Managing Disruption in Media and Entertainment	6 units
		72 units sub total
		155 units of Core Classes

6.3 ELECTIVES

Below are courses MEIM students have taken as electives. Not every course will be available each semester and the semester listed may change from year to year. For a complete list of electives, please consult either the Heinz College Fall and Spring schedules of courses or the individual department catalogue:
http://www.heinz.cmu.edu/academic-resources/course-schedules/index.aspx
The list of courses is here: https://api.heinz.cmu.edu/courses_api/course_list/

Pittsburgh Elective (Sample List)

Course Number	Title	Units	Pre-req Class/ College
IT Electives			
90-728	Introduction to Database Management	6	
90-782	Multimedia	12	
90-801	Media & Communications Design 1	6	
90-812	Introduction to Programming with Python	6	
94-806	Privacy in the Digital Age	6	
94-823	Measuring Social	6	
94-832	Business Intelligence & Data Mining SAS	6	
94-870	Telling Stories with Data	6	
95-723	Managing Disruptive Technologies	6	95-710
95-791	Data Mining	6	(95796 or 90777 or 90707 or 90711 or 91801) and (90819 or 95888)
95-865	Unstructured Data Analytics:	6	95888 or 90819 or 95898
Management Electives			

94-801	Acting for Management	6	
94-808	Management Consulting	6	
94-811	Strategy Development	6	
94-813	Project Management	6	
94-814	Evidence Based Management	6	
94-854	Developing as a Leader	6	
Decision Analysis and Modeling			
90-722	Management Science	6	
90-760	Management Science II	6	
94-744	Business Process Modeling	6	
94-834	Applied Econometrics I & II	6 & 6	90711 or 95796 or 90707 or 90777
Entertainment Electives			
45-895	Acting for Business	6	Tepper
53-312	Guest Experience in Theme Park Design	9	ETC
53-371	Role Playing Games Writing Workshop	12	ETC 15104 or 62150
54-187 *cross list 54700	Introduction to Verse/Hip Hop Theatre Writing	9	Drama
54-195	Writing Experimental Theater	9	Drama
54-702	Graduate Music Reading for Production	3	Drama
54-787	Graduate Screenwriting	15	Drama
54-191	Acting for Non-Majors	9	Drama
57-758	Business of Music	6	Music
57-947	Sound Recording	6	Music
57-948	Sound Editing and Mastering	6	Music 57-947
57-801	Introduction to Music Technology	6	Music

Los Angeles Electives

Entertainment Electives				
93.854	Film Acquisition	3	S	Heinz/CFA
93.857	The Business of Gaming	4	F	Heinz/CFA
93.859	Fandom in Music in Media	3	S	Heinz/CFA
93.864	Music Monetization: Song Royalties	3	F	Heinz/CFA
93.866	Creative Producing	6	S	Heinz/CFA
93.873	Film Exhibition	3	S	Heinz/CFA
93.878	Branded Entertainment	3	S	Heinz/CFA
93-837	Artist Development in the Music Industry	3	F	Heinz/CFA
93-872	Music Supervision	3	F	Heinz/CFA

7. RECOMMENDED SCHEDULE OF COURSES

The following schedule of courses, recommended by the MEIM Program, meets the *minimum* unit requirements for graduation (198 units).

MEIM Course Schedule for the Class of 2022
Year 1 Fall: 48 Core (06 electives) = 54 minimum
Year 1 Spring: 30 Core (24 electives) = 54 minimum
Year 1 = 108 units minimum

Summer between year one & two:
Need to complete Summer Practicum (0 units)
Year 2 Fall: 46 Core (up to 16 electives)
Year 2 Spring: 31 Core (up to 18 electives)
Year 2 = 90 units minimum, unless more in year one
155 Core + 43 Electives =
198 Units Total to graduate

NOTE: Core courses must be taken according to the schedule below, unless you obtain permission from the MEIM Program Director to defer required courses or you exempt the class. If you exempt a first-year required course, contact your advisor about appropriate electives or other core courses you might take. Please note that you must successfully complete all first-year classes (in Pittsburgh) before commencing the second year of the program (in Los Angeles).

7.1 FIRST YEAR (PITTSBURGH)

Fall Semester 2021 **Spring Semester 2022**

Course Number	Course Name	Units	Course Number	Course Name	Units
90.710	Econ Analysis 90.709 Intermediate	12	90.718	Strategic Presentation	6
90.707	Stats 90.777 Interm. /90.711 Stats w/R	12	90.723	Finance Statements Analy. of Comp.	6
93.861	Script & Story Analysis	6	90.725	Mgt. Acct./Princ of Finance 95.716	6
93.717	Writing (94.701) Bus writing	6	94.732	Managing Disruption: Media/Entert ^	6
94.708	Applied Strategic Marketing	6	94.800	Negotiation	6
94.700	Org Design & Implement	6	9x.xxx	Electives	24
		48 Core 6 Electives 54 total			30 Core 24 Electives 54 total

*90.707 Statistical Reasoning/ 90.711 Statistical Reasoning with R/ 90.777 Intermediate Statistical Methods

^ Class counts towards Heinz IT Requirement

7.2 SUMMER INTERNSHIP: BETWEEN YEAR ONE AND TWO

Summer 2022

Course Number	Course Name	Units
94.900	Summer Practicum	0

7.3 SECOND YEAR (LOS ANGELES)

Fall Semester 2022 **Spring Semester 2023**

Course Number	Course Name	Units	Course Number	Course Name	Units
93.851	Film Econ Mktg. & Distribution	12	93.855	Intellectual Property	6
93.852	Production Management	6	93.856	Business Development	6
93.853^	Digital Innovation/Entrepreneur ^	6	93.858	Market Research in Entertainment	3
93.871	TV Bus & Legal Affairs	9	93.869	Television Economics	6
93.876	TV Marketing & Advertising	6	93.888	Practicum II	1
93.879*	Navigating the Ent. Industry	3	93.890	Capstone II	9
93.887	Practicum I	1	------	-------LA Electives--------	---
93.889	Capstone I	3	93.854	Film Acquisitions	3
-------	-------LA Electives----------	---	93.859	Fandom in Music and Media	3
93.857	The Business of Gaming	4	93.866	Creative Producing	6
93.864	Music Monetization/ Song Royalties	3	93.873	Film Exhibition	3
93.837	Artist Dev. in the Music Industry	3	93.878	Branded Entertainment	3
93872	Music Supervision	3			
		46 Core 13 Elective		Need 36 minimum	31 Core 18 Elective
	* 93.879 is pass/fail course ^ Class counts towards Heinz IT Requirement			* Some LA electives may change due to faculty availability	

8. THE CAPSTONE PROJECT: ENTERTAINMENT INDUSTRY PARTNERS

A key feature of the MEIM second-year curriculum is the Capstone Project. This yearlong mandatory course goes further than a traditional thesis by giving students the opportunity to work on a topical applied research project under the direction and guidance of a marquee entertainment business client company. The Capstone project offers students the opportunity to apply and demonstrate their analytical and practical management skills in relation to a specific concept or issue while addressing and deepening their understanding of the challenges and issues the entertainment industry faces on a daily basis.

8.1 COLLABORATION

The Capstone thesis gives students the opportunity to work together in teams, much as they will do in their actual careers within this very project-centric, team-oriented industry. Researching, compiling, drafting and presenting the Capstone Project provides students with a compelling "deliverable" on their resume, further supporting their career prospects. Work experiences gained from student projects provide strong comparative advantages to graduating students in job interviewing and acquiring job offers. There is both a writing component and a presentation component related to the Capstone thesis. Working together on the Capstone, students will:

- Develop project management, teamwork, and communication skills
- Integrate and synthesize the lessons from prior coursework
- Engage in a "real world" organizational experience
- Earn "bragging rights" around a professional project for an industry company performed as part of the degree.

8.2 PAST CAPSTONE SPONSORS HAVE INCLUDED:

• 3Blackdot • Adult Swim/Turner Broadcasting • Amblin Television • Anonymous Content • BBC America • Black List, The • C4 R & D • Concord Music (Stax Records) • CreatorIQ (SocialEdge) • D Squared Entertainment • Enso Collaborative • Faceware Technologies • Flipagram • Fox Television Studios • IM Global • IMAX • IPSOS OTX Research • Jerry Bruckheimer Games • John Wells Productions • Lancit Media • LD Entertainment • Lionsgate Entertainment • MPRM Public Relations • National Research Group (NRG) • NBCU/Wilshire Studios • Neon Studios	• Networked Insights • Nielsen Company • PlayStation • PricewaterhouseCooper • Producers Guild of America, The • Programmers of Colour Collective • PSB Insights • ReFrame (Women in Film) • RelishMIX • Rogers & Cowan PMK • ScreenEngine • Solstice Studios • Sony Music Entertainment • Sony Pictures Television • Sundance Institute • SuperBam • Toronto International Film Festival • Troika Pictures • Twitter • Variety Media • ViacomCBS • Village Roadshow Entertainment Group • Walt Disney/ABC Television Group • Warner Bros. Studios

9. INTERNSHIPS

The required practicum (internship) assignments allow the students to gain first-hand knowledge of how the theories and principles learned in the classroom are implemented in the profession. Not only will this practicum allow students to test and refine classroom experiences in a professional setting but it also allows students to enhance their personal network of contacts and build their resume. The internships also serve as the foundation for many discussions in the rest of the program's curriculum.

The practicum program provides the necessary foundation for an individual to develop a functional business referral network by giving the student almost 1000 hours of internship time

- time spent working closely with an array of different colleagues at different levels of their respective hierarchies. Only by successfully networking their way through these internships, and the attendant networking opportunities they have access to after working hours, can the students build the kind of referrals they will need to land their first job.

There is an internship requirement during the summer (94.900) and both the fall (93.887) and spring (93.888) semesters of the second year of the program. There is no internship requirement in the first year of the program, though some students do partake in opportunities while in Pittsburgh. Students may do an internship after conferring with the Program Director and the Career Services MEIM representative.

At the end of your internships (summer, fall, and spring) your Career Services Advisor will request that your supervisor complete an evaluation form about your internship performance. You are also required to complete an evaluation survey as well as a self-reflection statement describing how your internship fulfilled the educational goals of the program. If you do not successfully complete an eligible internship along with your survey and self-evaluation, you will not fulfill your internship requirement necessary for graduation.

9.1 THE SUMMER INTERNSHIP

The mandatory summer internship is intended to acquaint MEIM students with industry practices and vernacular, to strengthen the students' professional networks, and to expand students' skills, knowledge and resumes. Students enroll in a 0-unit Summer Practicum class (94.900).

During the summer between the first and second year of study, MEIM students complete a 300-hour full-time internship at a film, television, digital production studio, music, gaming production company or a related agency. The internship is a core requirement and a graduation requirement of the MEIM Program. Students cannot progress to the second year of the program without successfully completing the summer internship. Please note the following in regard to the summer internship:

- Minimally, the internship requires the equivalent of eight-to-ten weeks of employment at 30 hours per week (or approximately 300 hours minimally). The internship should have formal supervision, be professional in nature, include work that is of importance to the organization, and should have significant educational value.
- Before beginning the internship, students must complete the online Career Services Internship Reporting form for approval.
- The internship will be verified with the students' supervisors and then approved. Students must notify their Career Advisor of any significant changes in their internships, such as length, location, hours of work, etc.
- Once the internship has been approved, students will be registered for the zero-unit internship course. Students will not receive academic credit for the internship, but it

will be reflected on their transcript as a course with P/F grade. If a student plans to exempt the internship, they will need to complete the Petition for Course Exemption.

- **F1 Visa Students:** You must apply for Curricular Practical Training (CPT) employment authorization for your summer internship. CPT authorization is required regardless of the internship being paid or unpaid. CPT is only available to F-1 students who have not graduated and who have been enrolled on a full-time basis for one full academic year (i.e. fall and spring.) The MEIM program requires students to complete a summer internship, therefore international students can qualify for CPT. Processing CPT may take up to 2 weeks and you cannot begin employment until you receive authorization. Guidelines, forms and instructions can be found at the Office of International Education's website.

9.2 SECOND-YEAR PRACTICUM

The second-year practicum is an immersion in the heart of the entertainment industry, exponentially enlarging the benefits of the previous skills and providing the students with a critical platform for showcasing their knowledge and experience.

Unique to the program is the schedule that allows students to work nearly full time (30+ hours/week – Mondays through Thursdays) in the management divisions of film, interactive, music, gaming, television studios, production companies, agencies or related firms supporting the entertainment industry.

9.3 PRACTICUM CREDIT

The MEIM Program recognizes that federal labor law requires the film/television/music/gaming industry to limit internship opportunities to students who receive formal credit for the practicum. The fact that internships are degree requirements is sufficient for most firms' human resources and legal department, but MEIM students may encounter practicum opportunities where more formal credit is required. Because of this, MEIM students enroll for practicum credit (94.900 – summer, 93.887- fall, 93.888 - spring). These are either 0 or 1-unit core class requirements in the program.

According to the U.S. Department of Labor, an internship should be similar to the training a student would receive in an educational environment. The internship experience should be beneficial to the intern and the intern should work under the supervision of existing staff at the company. For that reason, work related to the MEIM internships is to be on-site and not performed remotely. Though a student may be paid for the internship, an intern is not automatically entitled to wages for the time spent at the internship. Many of our students have subsequently been hired at the company where he or she has interned, but it should be noted that the intern is not entitled to a job at the conclusion of the internship.

10. UNIVERSITY LIBRARIES

The University Libraries provide a range of services including access to the Libraries' collections, expertise, and facilities; use of collections held by other libraries; and services enabling Carnegie Mellon students, faculty, and staff to deposit their work in the University Libraries.

The University Libraries host a web page (www.library.cmu.edu) that provides access to numerous resources useful to faculty and students in public affairs and administration. These include library catalogs, databases, subject web pages, a virtual reference desk and more. Some frequently used journals include: Human Rights Quarterly, Contributions to Economic Analysis & Policy, Economic Policy Review, Business & Politics, and Global Economy Journal.

The web page also has links to sites focusing on associations and societies, gateways, government documents, journals, reference resources, statistical sources, think tanks and academic departments. Students can find physical books, eBooks, music scores, conference proceedings, reports, government documents, music, videos, streaming content, and more.

Access to most library databases is university-wide and searchable from on- or off-campus. Some of the available databases concerned with public affairs and administration include: PAIS International, INFORMS PubsOnline, Homeland Security Digital Library, LexisNexis Academic, LexisNexisCongressional, CQ Library and ProQuest. In order to request material, a student can go directly to the library (when on campus) or can make requests off campus by visiting the main library website: https://www.library.cmu.edu/using/borrow/what

Members of the Carnegie Mellon community can use and borrow directly from The Carnegie Library of Pittsburgh and the University of Pittsburgh libraries except for those that do not participate in the Oakland Library Consortium (OLC): Fine Arts, Law, Nursing, Western Psychiatric Institute, and the Pitt branch libraries in Bradford, Greensburg, Johnstown, and Titusville.

There are three libraries on campus at Carnegie Mellon to which all students, staff and faculty have access.

- Hunt Library, 4909 Frew Street
- Mellon Institute Library, Mellon Institute, 4th floor, 4400 Fifth Avenue
- The Engineering and Science Library, Wean Hall, 4th floor

In addition, MEIM-LA also has a library with many entertainment industry text books and trade publications.

- MEIM Library, 4640 Lankershim Blvd. Ste 125, North Hollywood CA 91602

The library holds over 700 DVD's of films and TV shows for viewing and research including the American Film Institute (AFI) Top 100 films of all time. The library also holds over 300 books on entertainment related topics. In order to borrow one of these items, students make a request to the MEIM Senior Academic Coordinator and items can be held for up to three weeks.

11. WEB RESOURCES

MEIM Web Page	http://www.heinz.cmu.edu/school-of-public-policy-management/entertainment-industry-management-meim/index.aspx
MEIM LinkedIn	https://www.linkedin.com/in/meim-program-1933a890/
MEIM Twitter	https://twitter.com/meimprogram
Univeristy Web Ressources	www.cmu.edu
University Libraries	www.library.cmu.edu
Heinz College Web Resources	www.heinz.cmu.edu
Course Schedules	www.heinz.cmu.edu/academic-resources/course-schedules/index.aspx
Course Descriptions	http://heinz.cmu.edu/academic-resources/course-results/index.aspx
Academic Calendar	https://www.heinz.cmu.edu/heinz-shared/_files/img/current-students/heinz-college-academic-calendar-2020-21.pdf

12. RELATED MEIM PARTICIPATION CONTACTS

Listed below are some of the organizations that MEIM students have been involved with in the past.tiff

Academy of Television Arts and Sciences	www.emmys.com
American Pavilion at Cannes, The	ampav.com
Association of Arts Administration Educators	https://artsadministration.org
Creative Minds Group at Cannes, The	thecreativemindgroup.com
Emma Bowen Foundation	https://www.emmabowenfoundation.com/about_us
EntertainmentCareers.net	Entertainmentcareers.net
Festival de Cannes	festival-cannes.com
Film Independent	filmindependent.org
Future Now Media & Entertainment Conference	www.futurenowconference.com
Hollywood Radio & TV Society	hrts.org
Hubb Conference	www.digitalmusicnews.com/2018/10/23/latest-caa-the-hubb-summit/
IRTS Foundation	https://irtsfoundation.org
Sundance Film Festival	sundance.org
South by Southwest Film and Interactive Festival	sxsw.com
T. Howard Foundation	https://www.t-howard.org/about-us/
Toronto International Film Festival (tiff)	https://tiff.net/films

13. ACADEMIC STANDARDS

To graduate, you *must* complete 198 units of coursework with at least a 3.0 cumulative Grade Point Average. You must successfully complete all first-year course work in Pittsburgh prior to commencing the second year of the program in Los Angeles. For each semester except your last, you must take between 45 and 60 units. In your final semester, all students (international as well as domestic students) must take at least 36 units. This means that you will have to take at least five elective credits during the final semester in order to reach 36 units and be considered full-time.

13.1 GRADES

Below are the policies surrounding grades for students in the MEIM Program. Instructors are responsible for determining their own grading scale to establish how many points a student may need in order to earn a particular grade. However, the Heinz College operates on the grade weighting system shown below:

Grade	Interpretation	Points
A+	Exceptional	4.33
A	Excellent	4
A-	Very Good	3.67
B+	Good	3.33
B	Acceptable	3
B-	Fair	2.67
C+	Poor	2.33
C	Very Poor	2
C-	Minimal Passing	1.67
R	Failing	0

13.2 UNIVERSITY POLICY ON GRADES

The university policy on grading offers details concerning university grading principles for students taking courses and covers the specifics of assigning and changing grades, grading options, drop/withdrawals and course repeats. It also defines the undergraduate and graduate grading standards.

14. ACADEMIC INTEGRITY POLICY

The following is Carnegie Mellon University's policy on academic integrity.
at https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html

Additional information and resources regarding Academic Integrity are also available
at https://www.cmu.edu/student-affairs/ocsi/academic-integrity/index.html.

Students at Carnegie Mellon are engaged in preparation for professional activity of the highest standards. Each profession constrains its members with both ethical responsibilities and disciplinary limits. To assure the validity of the learning experience a university establishes clear standards for student work.

14.1 POLICY STATEMENT

In any manner of presentation, it is the responsibility of each student to produce her/his own original academic work. Collaboration or assistance on academic work to be graded is not permitted unless explicitly authorized by the course instructor(s). Students may utilize the assistance provided by Academic Development, and the Global Communication Center, unless specifically prohibited by the course instructor(s). Any other sources of collaboration or assistance must be specifically authorized by the course instructor(s).

In all academic work to be graded, the citation of all sources is required. When collaboration or assistance is permitted by the course instructor(s) or when a student utilizes the services provided by Academic Development, and the Global Communication Center, and the acknowledgement of any collaboration or assistance is likewise required. This citation and acknowledgement must be incorporated into the work submitted and not separately or at a later point in time. Failure to do so is dishonest and is subject to disciplinary action.

Instructors have a duty to communicate their expectations including those specific to collaboration, assistance, citation and acknowledgement within each course. Students likewise have a duty to ensure that they understand and abide by the standards that apply in any course or academic activity. In the absence of such understanding, it is the student's responsibility to seek additional information and clarification.

Policy Violations

Cheating occurs when a student avails her/himself of an unfair or disallowed advantage which includes but is not limited to:

- Theft of or unauthorized access to an exam, answer key or other graded work from previous course offerings.
- Use of an alternate, stand-in or proxy during an examination.
- Copying from the examination or work of another person or source.
- Submission or use of falsified data.
- Using false statements to obtain additional time or other accommodation.

- Falsification of academic credentials.
- Plagiarism is defined as the use of work or concepts contributed by other individuals without proper attribution or citation. Unique ideas or materials taken from another source for either written or oral use must be fully acknowledged in academic work to be graded. Examples of sources expected to be referenced include but are not limited to:
- Text, either written or spoken, quoted directly or paraphrased.
- Graphic elements.
- Passages of music, existing either as sound or as notation.
- Mathematical proofs.
- Scientific data.
- Concepts or material derived from the work, published or unpublished, of another person.

Unauthorized assistance refers to the use of sources of support that have not been specifically authorized in this policy statement or by the course instructor(s) in the completion of academic work to be graded. Such sources of support may include but are not limited to advice or help provided by another individual, published or unpublished written sources, and electronic sources. Examples of unauthorized assistance include but are not limited to:

- Collaboration on any assignment beyond the standards authorized by this policy statement and the course instructor(s).
- Submission of work completed or edited in whole or in part by another person.
- Supplying or communicating unauthorized information or materials, including graded work and answer keys from previous course offerings, in any way to another student.
- Use of unauthorized information or materials, including graded work and answer keys from previous course offerings.
- Use of unauthorized devices.
- Submission for credit of previously completed graded work in a second course without first obtaining permission from the instructor(s) of the second course. In the case of concurrent courses, permission to submit the same work for credit in two courses must be obtained from the instructors of both courses.

Procedures for dealing with allegations of these policy violations are detailed in the university's Academic Disciplinary Action Procedures for Undergraduate Students and the Academic Disciplinary Action Procedures for Graduate Students, which are published in The WORD student handbook. Periodic review of these procedures will be overseen by the Dean of Student Affairs or her/his designee in consultation with Faculty Senate and the relevant student governing bodies. Any amendments to these procedures are subject to the approval of Faculty Senate. Additional guidelines and procedures for graduate students may exist at the college/department/program level, in which case they are communicated in the college/department/program graduate student handbook.

If a student fails a course because of an academic integrity violation and then retakes the course, both the failing grade and the new grade will be used in evaluations of academic standing and the calculation of the student's QPA.

Any student who violates the academic integrity policy may not be a Student Representative, Teaching Assistant, Research Assistant, Officer of a student club/organization and cannot graduate from the college with highest distinction or distinction or serve as commencement speaker. All academic integrity violations will be reported to the Heinz College Associate Dean and Carnegie Mellon's Dean of Student Affairs or designee, as well as the Heinz College Office of Academic Services.

Cases of academic integrity violations will be reviewed by the Dean or designee, who may impose additional penalties. Students should understand clearly that such offenses are not tolerated at Carnegie Mellon. A first offense could result in being dropped from your program. In the event of a second offense, you will be dropped from your program. Students who want to appeal an academic disciplinary action must state in writing to the College Dean their intention to do so within one week of the penalty date in question, and then must present their appeal to the College Dean no later than two weeks after said penalty date. Appeals must be in writing, with appropriate documentation. In cases where an appeal is filed, disciplinary actions will be held until the 2-week moratorium is complete.

If you dispute that your actions violated the University Policy on Academic Integrity or believe that your department did not follow the proper procedure for investigating or reporting a violation, the university has a formal appeal process in place that provides you with the ability to have your case heard before an Academic Review Board. The initial step of that process is writing a letter to the Provost requesting an appeal and you can find more information in the Student Appeals section of the Graduate Academic Disciplinary Actions Overview. Please note that requests for appeal are not granted automatically and the Provost will determine whether the appeal will move forward to a second-level review.
The University policy on Cheating and Plagiarism is posted on Carnegie Mellon's website at: https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html

14.2 ACADEMIC DISCIPLINARY ACTION OVERVIEW -VIOLATIONS OF POLICIES ON CHEATING AND PLAGIARISM

"Academic Disciplinary Actions" are penalties or sanctions imposed for violation of academic regulations against cheating, plagiarism, or unauthorized assistance as defined by course and/or University Policy.

This procedure should be reviewed in its entirety on-line: https://www.cmu.edu/student-affairs/theword/academic-discipline/index.html

Carnegie Mellon's policy on Academic Disciplinary Actions Overview for Graduate Students is the university procedure that describes procedures for disciplinary actions against graduate students in cases of alleged violations of academic regulations.

Questions regarding the graduate policies and/or procedures pertaining to cheating and plagiarism should be directed to Joanna Dickert in the Office of Community Standards & Integrity at 412-268-2140.

For comprehensive information and resources regarding Academic Integrity please visit: https://www.cmu.edu/student-affairs/ocsi/academic-integrity/index.html

15. EXPECTATIONS

It is important that you communicate effectively and efficiently when dealing with staff, faculty, and fellow students. It is not enough to just show up at classes. To make the most out of the program, you should stay engaged and committed. Keep in mind the following as you progress as a master's student.

15.1 ACTIVE PARTICIPATION IN CLASS

Your contribution in class is vital. Your focused and attentive participation, openness to others' ideas, and positive attitude toward the learning experience are expected throughout the courses offered in the MEIM program. Many faculty members (and almost all faculty in LA) will have a grading component related to class participation.

15.2 SELF-REGULATION

As a master's student, you are expected to regulate your own behavior and to not need to be reminded of deadlines. Ask for feedback, take the initiative to get what you need from classes, and be courageous in the questions you ask. Take risks and take responsibility for your own learning.

15.3 COHERENT, PROFESSIONAL WRITING

You are expected to write in a way that is clear, concise, coherent, and professional. Every written assignment should be at least a second draft. If you have difficulty with your writing, Carnegie Mellon does offer assistance via the Global Communications Center on campus. https://www.cmu.edu/gcc/appointment/index.html. It is to your advantage to take the initiative to pursue assistance in these areas. You also need to keep electronic communication (emails/ LinkedIn) respectful and professional. Communicating effectively is paramount in the entertainment industry.

16. CAREER SERVICES

MEIM is a professional program focused on providing career development skills for our students. Heinz College has a dedicated Career Service Office (based in Pittsburgh) to assist students. https://www.heinz.cmu.edu/current-students/career-services/ In the second year of the program students continue to have access to all of the services available in the first year of the program.

The Career and Professional Development Center (CPDC) offers a variety of services and programs to all student and alumni such as:

- College- and industry-specific career counseling and employment advising
- Career fairs and employer presentations
- Career workshops and professional development programs
- Interview assistance
- On-campus recruiting and campus employment through Handshake
- Resume/cover letter expertise
- Internships and part-time work
- Access to career-related databases and electronic resources

Handshake is Carnegie Mellon's online recruiting system. Through Handshake, employers can request accounts to post jobs, request interviews and information sessions, and review student resumes. Students and alumni can apply to positions, sign up for interviews and find contact information for thousands of recruiters. Handshake can be accessed through the Career and Professional Development Services Center (CPDC) website. https://www.cmu.edu/career/

16.1 CAREER CONSULTANTS

MEIM has assigned a career consultant who provides guidance through one-on-one appointments. Matthew Spangler (based in Pittsburgh) is the Assistant Director of Career Services for the MEIM program and works in tandem with the Program Director (based in Los Angeles). A number of events to help students transition into their careers are planned throughout the two years of the program.

Appointments with Matthew can be made through Handshake. Matthew also holds open office hours and bi-monthly program specific career service meetings/group workshops in the first year of the program. The exact dates and times will be communicated at the beginning of each semester.

16.2 JOB SEARCH GUIDELINES

MEIM strives to play a supportive role in the career pursuits of students, but maintains academics as a priority. It is not acceptable for students to skip classes or assignments in order to attend job interviews. Students should conduct job searched in a manner that does not impede the academic progress through their graduate program.

It is also important for students to understand how to conduct a job search. When applying for jobs, students are expected to exhibit certain ethical behavior, such as arriving on time for interviews, being truthful about their qualifications, and to honor their agreements with recruiters. Further, students should not continue looking and interviewing for a position after they have accepted an offer.

16.3 PLACEMENT SERVICES

Heinz College does not place students into an occupation or position. However, Heinz College does offer a dedicated Career Services office to assist students with internships, resumes, job interviewing techniques, ability to access entertainment careers search websites, and the full-time job search. Students apply and interview for the jobs based on their interest and abilities. In addition, the Program Director and the Assistant Director of Career Services work collectively to coach and advise throughout the second year of the program.

17. OTHER INFORMATION

The entertainment industry is very exciting, but can be quite competitive. The move to Los Angeles can also be intimidating at times. Rest assured that Carnegie Mellon staff, faculty and friends of the program will support you as you progress through the two years of the program. You will also have the support of the growing MEIM alumni population. You should take advantage of opportunities that may be presented to you. The two years will go by fast.

17.1 COLLEGIALITY

At its heart, the MEIM program is an opportunity for you to become a colleague with your classmates and others you meet in the program, including professors. In past years, some teachers have even asked students to work on professional projects outside of class. Respect for one another's ideas, a willingness to engage the hard questions, and openness to new ways of thinking about issues are some of the hallmarks of collegiality. An appropriate balance of challenge and support for one another is expected in the program.

17.2 TRANSPORTATION IN LOS ANGELES

Los Angeles is a large city with many transportation challenges. Los Angeles also has a challenging public transportation system. Accordingly, it is highly suggested that you have access to an automobile and a valid driver's license upon your arrival in Los Angeles. If you have any questions or concerns about this issue, please speak with the Program Director prior to the end of the first year.

17.3 FILM FESTIVALS/EXTRA-CURRICULAR OFFERINGS

All students in the program will attend South by Southwest Film and Interactive Festival (SXSW) in the first year of the program (March), and Sundance Film Festival in the second year of the program (January). The MEIM program will pay for accommodations and festival tickets/badges. Students are responsible for all ground and air transportation, meals, and other incidentals. Some students may have the opportunity to attend Cannes International Festival (Cannes) in France (May, year one). All charges related to Cannes are the responsibility of the student.

In addition, there are several guest speakers and seminars that will be offered throughout the two years you are in the program. It is expected that you will attend as many of these offerings as possible. Attendance at MEIM scheduled events in Pittsburgh should be considered mandatory.

17.4 ATTENDANCE FOR PLANNED EVENTS

Please note that MEIM leadership takes great effort and expense to secure accommodations and tickets for film festivals and other planned events. Students are given plenty of notice regarding which events are mandatory and which events are optional. In addition, students are given time to decline attendance or participation to these events when possible.
As a result, if for some reason a student fails to show up for a film festival or other planned MEIM event that they were originally scheduled to attend, there will be a charge incurred that will be billed to the student's CMU school account. Extenuating circumstances will be taken into consideration, but those circumstances may or may not remove the possibility of a charge. Please be advised as you proceed through the program.

17.5 LINKEDIN MEIM GROUP

The MEIM program maintains a private sub-group on LinkedIn's Heinz College group exclusively for current MEIM students, alumni and faculty/staff. This is a convenient place to share information about business developments, including internship and job opportunities, networking events, cultural events, and other relevant MEIM updates. Students are encouraged to join the group at the beginning of year one.

17.6 EMERGENCY TELEPHONE NUMBERS

Carnegie Mellon University Police Department 300 South Craig Street, Suite, 199 (Filmore Street Entrance) Pittsburgh, PA 15213	Emergency: (412) 268-2323 Non-Emergency: (412) 268-6232 Email: campuspd@andrew.cmu.edu
University of Pittsburgh Medical Center 200 Lothrop St, Pittsburgh, PA 15213	(412) 647-8762
Pittsburgh Fire Bureau Station 18 5858 Northumberland St Pittsburgh, PA	(412) 255-2863
North Hollywood Police Department 11640 Burbank Blvd, North Hollywood, CA 91601	(818) 623-4016
Providence Saint Joseph Medical Center 501 S Buena Vista St, Burbank, CA 91505	(818) 843-5111
Los Angeles Fire Dept. Station 60 (Tujunga Ave.) North Hollywood CA	(818) 756-8660
University Center Information Desk	(412) 268-2107
MEIM - Pittsburgh Hamburg Hall 1119E, 4800 Forbes Ave. Pittsburgh, PA 15213	(412) 268-6706
MEIM - Los Angeles 4640 Lankershim Blvd. Suite 125, North Hollywood, CA 91602	(818) 980-6346

18. STATEMENT OF ASSURANCE

Carnegie Mellon University does not discriminate and Carnegie Mellon University is required not to discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex or handicap in violation of Title VI of the Civil Rights Act of 1964, Title IX of the Educational Amendments of 1972 and Section 504 of the Rehabilitation Act of 1973 or other federal, state, or local laws or executive orders.

In addition, Carnegie Mellon University does not discriminate in admission, employment or administration of its programs on the basis of religion, creed, ancestry, belief, age, veteran status, sexual orientation or in violation of federal, state, or local laws or executive orders.

19. HANDBOOK INFORMATION

This MEIM handbook supersedes and replaces all previous policies and procedures including, but not limited to, all memoranda or written policies which may have been issued on the subjects covered in this handbook prior to the revised date on page one. The policies included in this handbook are guidelines only and are subject to change.

The last update of this document was completed October 11, 2021.

20. ADDENDUM FOR CALIFORNIA PRIVATE POSTSECONDARY EDUCATION ACT OF 2009

Carnegie Mellon University is a private, non-profit institution, approved to operate in California by the California Bureau for Private Postsecondary Education. Approval to operate means compliance with CA state standards set forth in the Ed. Code.

As part of the California Private Postsecondary Education Act of 2009, the Bureau for Private Postsecondary Education (BPPE) requires state-level oversight of private postsecondary schools. As students in the Master of Entertainment Industry Management (MEIM) program reside in the state of California for the second year of the program, the following information is made available to all interested students. https://www.cmu.edu/hub/consumer-information/

Any questions a student may have regarding this catalog that have not been satisfactorily answered by the institution may be directed to the Bureau for Private Postsecondary Education at 1747 North Market Blvd. Suite 225, Sacramento, CA 95834, www.bppe.ca.gov, toll-free telephone number (888) 370-7589 or (916) 574-8900 or by fax (916) 263-1894.

As a prospective student, you are encouraged to review this catalog prior to signing an enrollment agreement. You are also encouraged to review the School Performance Fact Sheet, which must be provided to you prior to signing an enrollment agreement.

A student or any member of the public may file a complaint about this institution with the Bureau for Private Postsecondary Education by calling (888) 370-7589 toll-free or by completing a complaint form, which can be obtained on the bureau's internet website, at www.bppe.ca.gov

Accreditation & State Approvals
Carnegie Mellon University is accredited by the Middle States Commission on Higher Education (MSCHE). Details regarding accreditation & State Approvals can be found here: https://www.cmu.edu/middlestates/about/index.html

20.1 DESCRIPTION OF PROGRAM AND REQUIREMENTS

MEIM students spend the first year of the program taking core courses at Carnegie Mellon University's main campus in Pittsburgh, PA. Second year class sessions are offered at the MEIM: Los Angeles Center, located at 4640 Lankershim Blvd. Suite 125, North Hollywood, CA 91602. Second year students in the MEIM program attend courses at the Los Angeles location while working side-by-side with industry professionals throughout the year as full-time interns in a studio or production company. Approximately 20-30 students are enrolled at the Los Angeles campus per year.

A description of the Master of Entertainment Industry Management Program, the requirements for completion including required course load and internship requirements, can be found on the MEIM website:
http://www.heinz.cmu.edu/school-of-public-policy-management/entertainment-industry-management-meim/index.aspx

First Year - Pittsburgh

Fall Semester	Spring Semester
• 48 Units Core • 06 Units - Electives • 54 Units minimum needed • Can take up to 6o units	• 30 units Core • 24 Units – Electives • 54 Units minimum needed • Can take up to 6o units

Second Year - Los Angeles

Fall Semester	Spring Semester
• 46 Units Core Electives (Can take up to 16 units)	• 31 Units Core • Electives (Can take up to 18 units) • You will need at least 5 elective units to get to 36 units to be full-time status • Entire Year 2 = Need 90 units minimum

155 Core + 43 Electives = 198 Minimum Units to graduate

20.2 DESCRIPTION OF MEIM LOS ANGELES CLASSES

FALL 2021 CLASS DESCRIPTIONS & OBJECTIVES

93.851 Film Econ Mktg. & Distribution (12 units)

Instructors: Jon Baker/Ashleigh Bohr

Course Description: This course will provide an overview of the feature film industry, from the filmmaking process to the distribution machine. Although it covers financing, pre-production, production and post-production, it is not a technical production class for filmmakers. Rather, it is a business class in how to manage feature film product as a studio executive or independent producer.

93.852 Production Management (6 units)

Instructors: Ed Lammi/John Harrison

Course Description: This class examines the nuts and bolts of Film and Television production, specifically from the Studio, Network, and Line Production perspective. The syllabus follows the common practices and protocols of the Industry from Pre-Production, through Production and Post-Production, including discussion of the tangential marketing and distribution business sectors as they relate to Production Management. In addition to lecture and discussion format, the class will include participation by guest speakers to cover specific areas of domain expertise. Finally, the course will cover some of the best practices and personal development guidelines that relate to the unique business culture of entertainment, including some historical perspective.

93.853 Digital Innovation and Entrepreneurship (6 units – Core counts as IT Elective)

Instructor: Bob Moczydlowsky

Course Description: This is not a technical course. We won't learn to write code, nor will we produce any creative work. Instead, we'll examine business models, distribution philosophies and the physics of media as they apply to for-profit entertainment companies. We'll start with an overview of Internet history and vocabulary, designed to make students fluent in the business language of the Web. From there, we'll examine Internet business models of the past, present and future, and examine specific case studies of both successes and failures. Once we've established a core understanding of the media landscape, we'll spend a class on the subject of Media Physics and the way quality content both creates and destroys business opportunity, regardless of – and sometimes in spite of – the marketing campaigns it's associated with. We'll discuss how this disruption creates significant business opportunity – especially for artists and artists' business partners. Why license copyrights when there are emerging tools that provide many of the functions previously controlled by studios and labels? But this opportunity isn't limited to just artists – Independent Entrepreneurs will also shape a large portion of the future of entertainment. We'll conclude the class by talking about the process of securing angel and venture funding, and we'll also cover how to organize a business for success.

93.871 TV Bus & Legal Affairs (9 units)
Instructor: Adam Hime
Course Description: The goal of this class is to provide students with a practical understanding of how a typical major studio Television Business & Legal Affairs department fits into today's Production and vertically integrated Studio/Network environment. In addition, students will become acquainted with basic deal terms, contractual provisions utilized in the television industry, as well as practical advice on negotiation tactics & skills and reading and understanding budgets.

93.876 TV Marketing & Advertising (6 units)
Instructor: Erin Franzman
Course Description: This course is designed to provide a comprehensive look at one of the most powerful mediums in existence today: Advertising & Marketing on broadcast and cable television. Focus will be given to the marketing of television shows and networks. How digital technology is changing the television landscape for businesses, viewers and marketers. The history of advertising on television and what the future of the industry might be will also be addressed. The class will encompass both the marketing of television to the viewer and how advertisers are finding new ways to use television to reach viewers.

93.879 Navigating the Industry (3 units)
Instructor: Paula Wagner
Course Description:
The course will be an in-depth analysis of the entertainment industry, specifically, the movie and theater businesses and transformations in the digital era. The class will highlight talent representation (agents, managers, lawyers, etc.), film packaging, the studio system, and the transitions between screen to stage with some attention to Broadway theatre. The class will indoctrinate participants into the language and dynamics of the industry through the eyes of an insider to help prepare students for the practical realities of entering, building, and sustaining a career in the entertainment field. In other words, this class focuses on examining the basic 'nuts and bolts' of the industry and the changing landscape due to the rapidly evolving distribution models.

93.889 Capstone I (3 units)
Instructor: Dan Green
Advisors: Anna Andree, Krysta Brown, Keith Eich, Alison Emilio, Dan Green, Tom Meredith, Kevin Stein,
Course Description: The Capstone Project is a two-semester applied research project that represents the final requirement of the Master of Entertainment Industry Management (MEIM) Program. The Capstone provides the opportunity for students to apply the sum knowledge and skills gained from the MEIM program to real world issues facing the entertainment industry. Working in teams, and in consultation with industry professionals, students will define, outline and deliver an in-depth examination of a specific research topic, fulfilling a series of deliverables over the course of the project, and adhering to established research project formats and guidelines.

93.857 The Business of Gaming (4 units) – Elective
Instructor: Holly Newman
Course Description:
This class will focus on the business aspects that relate to the gaming industry. This industry has grown quickly in the last 10 years to overtake theatrical motion pictures as a leading source of commercial entertainment – in content development, distribution and the licensing of its IP.
The course will focus on the ways in which its creative and business practices are both unique, and also share common characteristics with other forms of screen-based entertainment.
The course will focus on the following key areas:
- The publishing business model, and how Games evolved from and relate to software distribution. Covered material will include: licensing agreements, the development and ownership of Intellectual Property, and the impact of software piracy on business models.
- The game publishers, and an overview of the key companies and competing business strategies, including game genres, key titles/franchises, management of developer relationships, and the publishers' relationships with licensors and licensees (primarily vis-à-vis the motion picture business).
- The lexicon and how to effectively communicate with buyers and sellers of Intellectual Property.
- The production process, and how to reconcile with film and television production timelines and milestones. Covered material will include: the game development process from inception through release – including visual and character development, level design, play testing, level testing, coding, game engines, animation & motion capture.
- The future of the game business and an overview of current trends including social games, cloud distribution, iOS/Android and how they impact rights allocations and revenue streams.

93.837 Artist Development in the Music Industry (3 units) – Elective
Instructor: Benjy Grinberg
Course Description: The music industry has changed drastically over the last 15 years. How music is produced, distributed and consumed has gone through seismic changes. Therefore, the way that artists develop and reach their fans has also evolved.
This course will give insight and knowledge as to how the music industry works today. It will examine the various dimensions of artist development including talent discovery, social media, putting together an artist's team, making independent and major label albums, streaming, expanding artist fan bases, touring, and merchandising. The class will also touch upon the changing expectations and career trajectory of the musical artist. This class will be of great help to those interested in being an artist, managing an artist, working for or starting a label, or simply understanding the music business better.

93.864 Music Monetization & Song Royalties (3 units) – Elective
Instructor: Olivia Barton
Course Description: A multitude of contradictions and complications exist within the music industry. According to the Recording Industry Association of America, music revenues in 2016 were the highest they've been in over eight years with the largest year-over-year percentage increase in over 18 years. However, these numbers do not reflect the tumultuous waters in

which those connected to the music industry find themselves today. While streaming services have increased accessibility, the issues of piracy and artist control are of grave concern.
This course will examine how the record labels and publishers are responding to the changing economy of the music industry. Discussions will address the big players in the music industry (Sony Music, Universal Music, Warner Music Group, Sony/ATV, & UMPG) as well as indie record labels' business strategy, how legal aspects of the music industry effect artists, publishers, and consumers (digital rights management, etc.), as well as the ever-increasing reliance on streaming and the technical companies providing music services. Topics to be examined include copyright law, label and publishing agreements with artists, and backend monetization of assets.

93.872 Music Supervision (3 units) – Elective
Instructor: Bonnie Greenberg
Course Description: The course defines the role of the music supervisor, who draws on combined resources of the film and music communities to marry music and moving images. The course is intended to lead students to a better understanding and appreciation of the use of music in the filmmaking process. Lectures, assignments, presentations and discussions with guest speakers present the principles and procedures of music supervision.

SPRING 2022 CLASS DESCRIPTIONS & OBJECTIVES

93.855 Intellectual Property (6 units)
Instructor: Adam Hime
Course Description: The goal of this class is to provide students with the solid underlying principles of intellectual property laws affecting and regulating the protection and distribution of entertainment content. The class covers all of the basic legal concepts required for a complete picture of intellectual property law but is aimed at non-lawyers and non-law students.

93.856 Business Development (6 units)
Instructor: Michele Smith
Course Description: Business development uses the lenses of strategy and commercialization to identify opportunities for expansion and growth. It relies heavily on its functional cousins - Sales, Marketing, Finance and Corporate Strategy. Each functional area will be explored within the various sectors of the entertainment industry through class discussions, assignments and a final project. In this class, we will focus on business development in media and entertainment.
The class will examine how entertainment executives leverage product development, sales and marketing opportunities to facilitate growth. We will discuss how to effectively be an entrepreneur while navigating relationships inside and outside the corporation. Students will explore the development of business models, alternative monetization strategies, and develop a POV on investment/funding as well as mergers and acquisitions (M&A).

93.858 Market Research in Entertainment (3 units)
Instructor: Kevin Yoder
Course Description: This course provides a comprehensive introduction to marketing research as used across several entertainment industries (film, television, and videogaming). The course will discuss key concepts, processes, and techniques, as well as their applications. The goal is to overview with students the fundamentals of good research practices used by business enterprises, regardless of size (start-up or established) and regardless of vertical.

The course is aimed at a user of research, rather than the one responsible for determining the scope and direction of research activities. The goal is that by the end of this class students will be well-informed and effective user-consumers of research at any company or occupation they go on to after graduation. Students will learn that the techniques of research design, data collection, and data analysis play an important role in the work of a marketing department, especially in regard to establishing strategy and monitoring feedback from the marketplace and consumers. This course focuses on providing students with the tools they need to understand and evaluate research findings they will likely encounter as entertainment industry executives. The aim is to develop an appreciation for the potential contributions and limitations of marketing research.

93.869 Television Economics (6 units)
Instructor: Pat Quinn
Course Description: The goal of this class is to provide students with the solid economic and structural fundamentals of the U.S. television industry, from real life development and production and financing paradigms to business and marketplace fundamentals (with a bit of practical theory thrown in for good measure).

93.890 Capstone II (9 units)
Instructor: Dan Green
Advisors: Anna Andree, Krysta Brown, Keith Eich, Alison Emilio, Dan Green, Tom Meredith, Kevin Stein
Course Description: The Capstone Project is a two-semester applied research project that represents the final requirement of the Master of Entertainment Industry Management (MEIM) Program. The Capstone provides the opportunity for students to apply the sum knowledge and skills gained from the MEIM program to real world issues facing the entertainment industry. Working in teams, and in consultation with industry professionals, students will define, outline and deliver an in-depth examination of a specific research topic, fulfilling a series of deliverables over the course of the project, and adhering to established research project formats and guidelines.

93.854 Film Acquisitions (3 units) – Elective
Instructor: Lakshmi Iyengar
Course Description: Independent film is a term loosely used to mean many things. While the term is often times used to label a genre, it is also a financing method. An independent film can cost $300 and be constructed on a home computer or it could cost $200 million with a studio paying a surplus on top of the budget to distribute it. We will dive in to both the genre and its financing methods, and discover how this is part of a business model that consumers

may never know about. But it is one of the most important sectors that initially discovers almost every piece of acting and filmmaking talent; and promotes it to the next level.
The glamorous and not so glamorous world of film festivals are where studios and distributors scour for up-and-coming talent, where actors go to gain credibility and where has-beens turn to resurrect careers. Building on the world of festivals, we will look at how an independent movie gets financed, packaged, produced and sold to domestic and foreign distributors. This class will explore the various sources of the film product and follow it through distribution, on both a studio and independent level

93.859 Fandom in Music and the Media (3 units) – Elective
Instructor: Jose Cuello
Course Description: Fandom and all forms of entertainment are inextricably tied. From the earliest development of human expression to the technologically diverse present: visuals, performances, games, music, fiction, and play of all kinds, have catered to and been funded/supported/disseminated/worshipped/appropriated by FANS (casual or rabid). Music, Sports, Politics (increasingly), Movies, TV/Streaming, Video Games, Social Media Platforms themselves, are all arguably the most influential methods in history for exposing audiences to new artists/celebrities/micro-celebrities/ideas/heroes/villains. Fandom has become more than content consumption. The role of FANS can, and often does, serve as the key driver of entertainment business and creative decisions.

The goal of this class is to provide students with the broadest understanding of the landscape of FANDOM today and historically, as well as the role it plays from the POV of decision makers and those that finance and produce content on the corporate level. We will also focus on the resources and processes for discovering artists/influencers/leaders/celebrities, mobilizing FANS as business strategies, navigating the process of FAN engagement effectively, satisfying business and legal affairs protocol in doing so, and pushing the role of FANDOM (and artists themselves) in broad strategic thinking beyond the final produced project.

93.866 Creative Producing (6 units) – Elective
Instructor: Mark Christopher
Course Description: Creative Producing: Visuals and Vision. This course focuses on the main interpreters of the script (producers, directors and their teams) from the POV of an instructor who has worked primarily as a director and writer with a strong producorial hand. Topics will include choice of material, and early creative discussions with an emphasis on visual language, story, character and the various components used to bring an idea from page to screen. Also examined will be the producer and director's function as it relates to other key positions within the entertainment industry. Classroom participation is mandatory in this course (presenting projects, defending them and critiquing others).

93.873 Film Exhibition (3 units) – Elective
Instructors: Miguel Mier/Alberto Alcaraz
Course Description: I. Rationale: Understanding the Film Exhibition Industry is key to conceptualize, create and launch content. The economic rationale is the driver behind the films, which maintain the industry profitability and hence-forth guarantee the sustainability of the sector over time.
II. Course Aims and Objectives: At the end of the course, students will be able to understand and identify the critical factors in the success of film exhibition management in order to make the best decisions based on the economic rationale.
The course will allow students to contribute value to any of the three perspectives of the film industry´s value chain: production, distribution or exhibition.

93.878 Branded Entertainment (3 units) – Elective
Instructor: Shelley Ong Teshima
Course Description: Price is not the only measure of value for consumers. Perceived value is derived from a combination of characteristics including quality, reliability, positive or negative associations, and memorability, to name a few. These are not only factors that impact a consumer's purchase decision, but also qualities that make up a brand. Strong brands, then, build equity and real financial value for companies. Building and maintaining a brand is a philosophical and tactical undertaking.
In this course, students will build a foundational understanding of branding through class discussions, articles and case studies. Students will examine the difference between brand and marketing/communications as well as the importance of brand as business and its application to global branding. They will also examine how a company finds and communicates value proposition relative to their competitors, users and communities at large. Students will consider the impacts of brand valuation as well as the spectrum of branded content. Class participants will look at how branded content is evolving with new technology and communications methods. Students will then be able to apply this groundwork to various marketing and communications tactics globally and across all media platforms, both traditional and modern.

20.3 INFORMATION REGARDING THE FACULTY AND THEIR QUALIFICATIONS

Heinz Faculty members are experts in their field of study. You may find information about those who teach in the first year of the program at the following website:
http://www.heinz.cmu.edu/faculty-and-research/faculty-profiles/index.aspx?search_type=a&from_letter=A&to_letter=A

For information and bios about those who teach in Los Angeles or who teach MEIM specific classes, please refer to the following website page.
https://www.heinz.cmu.edu/programs/entertainment-industry-management-master/meim-faculty

Listed below is the list of current faculty members, their non-teaching job titles, their academic qualifications, and a link to their full bios that can be found on the MEIM website.

Andree, Anna (Capstone Advisor)
Research Manager, Universal Studio Group/NBCUniversal
Bachelor in Theatre Arts, Marymount Manhattan College
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/andree-anna/

Aguilar, Alberto (Film Exhibition)
Process and Continuous Improvement Deputy Director, Cinépolis
BA Industrial Engineering, Morelia Tech Institute
MS Quality and Productivity Systems, Monterrey Tech
MBA IPADE Business School
https://www.heinz.cmu.edu/faculty-research/profiles/alcarazaguilar-alberto

Baker, Jonathan (Film Economics, Marketing & Distribution)
Producer, JB Productions (Producer: Sylvie's Love, Basmati Blues, Crown Heights, The Banker)
BA, University of Michigan in music, philosophy and religious studies
https://www.heinz.cmu.edu/faculty-research/profiles/baker-jonathan

Barton, Olivia (Music Monetization and Song Royalties)
Associate Director, Sync Licensing at Sony Music Entertainment
BA, Marketing, the University of Oklahoma
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/barton-olivia

Berlin, Liz (Live Music: Touring and Revenue Streams)
Founder, Partner and touring musician with Rusted Root/ Owner, Mr. Smalls Theatre
University of Pittsburgh
https://www.heinz.cmu.edu/faculty-research/profiles/berlin-liz

Brown, Krysta (Capstone Advisor)
Marketing Manager, Omelet
BS, Psychology and Film, Cornell University
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/brown-krysta/

Christopher, Mark (Creative Producing)
Writer, Director of Film, TV, Stage (54: Directors Cut, Real Life: the Musical)
BA, University of Iowa
MFA, Columbia University
https://www.heinz.cmu.edu/faculty-research/profiles/christopher-mark

Cuello, Joe (Music in the Media)
Head of Strategy and Operations, and People, 1iota, The Fan Agency
BA, University of North Texas
ME, Azusa Pacific University
https://www.heinz.cmu.edu/faculty-research/profiles/cuello-joe

Denick, JiYoung (Capstone Advisor)
Founder and Managing Partner, MineMR
BA, Korea National University of Arts, major in Film Editing
Master of Entertainment Industry Management, Carnegie Mellon University
Master of Arts Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/denick-jiyoung

Eich, Keith (Capstone Advisor)
Past Director, Digital Distribution Operations, NBCUniversal/VP Product Dev. LegalZoom
BS, Electrical Computing Engineering, Carnegie Mellon University
MS, Electrical Computing Engineering, Carnegie Mellon University
Master Information System Management, Carnegie Mellon University
MBA, University of Southern California
https://www.heinz.cmu.edu/faculty-research/profiles/eich-keith/

Emilio, Alison (Capstone Advisor)
Past -Director, ReFrame (Sundance Institute & Women in Film)
BA, Ryerson University (Toronto) – Film & Photo Arts
MS, UCLA – Landscape Architecture
https://www.heinz.cmu.edu/faculty-research/profiles/emilio-alison

Franzman, Erin (TV Marketing)
Vice President, Content Social Strategy, CBS
Bachelor of Science, Cornell University
https://www.heinz.cmu.edu/faculty-research/profiles/franzman-erin

Green, Daniel T. (Script and Story Analysis; Entertainment Ethics; Capstone Thesis Advisor)
Program Director, CMU, Entertainment Industry Management
BA, Southern IL University-Carbondale, Acting and Directing, Minor in Cinematography
MFA, Carnegie Mellon Univeristy, Directing, Drama
Ph.D. Azusa Pacific University, Higher Education and Organizational Leadership
https://www.heinz.cmu.edu/faculty-research/profiles/green-daniel

Greenberg, Bonnie (Music Film Supervision)
Owner, Ocean Cities Entertainment
JD, Southwestern University School of Law
https://www.heinz.cmu.edu/faculty-research/profiles/greenberg-bonnie

Grinberg, Benjy (Artist Development in the Music Industry)
Founder and President, Rostrum Records
BA, magna cum laude, International Relations, University of Pennsylvania
https://www.heinz.cmu.edu/faculty-research/profiles/grinberg-benjy

Harrison, John (Production Management)
Filmmaker, Bean Boy, Inc. (Writer: Residue, Netflix miniseries, and Creepshow anthology series)
BS, Emerson College
MFA, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/harrison-john

Hime, Adam (TV Legal & Business Affairs; Intellectual Property)
Senior VP, Business & Legal Affairs and Associate General Counsel, Endeavor Content
B.A. Political Science, University of CA, Los Angeles
J.D. University of Southern California
https://www.heinz.cmu.edu/faculty-research/profiles/hime-adam

Hollin, Lee (TV Marketing)
SVP and Head of Current Programming, Lionsgate
Bachelor of Theatre Arts, University of Pittsburgh
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/hollin-lee

Iyengar, Lakshmi (Film Acquisitions)
Vice President, Sony Pictures Worldwide Acquisitions
BA in Theater and Minor in Italian, UCLA
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/iyengar-lakshmi

Lammi, Ed (Production Management)
Executive Vice President, Sony Pictures Television
BA English, Penn State University
https://www.heinz.cmu.edu/faculty-research/profiles/lammi-ed

Marzynski, Ashleigh (Film Economics, Marketing & Distribution)
Vice President, Content & Strategy, NRG
B.A. Communication and Arts Management, University of Wisconsin
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/marzynskibohr-ashleigh

Meredith, Tom (Capstone Advisor)
Past General Manager, Television Research, ScreenEngine, LLC/ Area Manager, LA Census 2020
BA Chemistry, California State University, Northridge
MBA Marketing/International Business, Loyola Marymount University
https://www.heinz.cmu.edu/faculty-research/profiles/meredith-tom

Mier, Miguel (Film Exhibition)
Chief Operating Officer, Cinépolis
BS in Economics, ITESM
MS in Management, Stanford GSB, 2007
Double Degree MS in Information Technology, Heinz College at Carnegie Mellon University/ITESM 2011.
https://www.heinz.cmu.edu/faculty-research/profiles/mier-miguel

Moczydlowsky, Bob (Digital Innovation & Entrepreneurship)
Managing Director, TechStars Music
BA, University of Kansas
Master of Entertainment Industry Management, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/moczydlowsky-bob

Newman, Holly (Business of Gaming)
CEO, Liquid Entertainment
Past EVP of Publishing at Crave Entertainment
https://www.heinz.cmu.edu/faculty-research/profiles/newman-holly

Ong Teshima, Shelley (Branding)
Director, Brand Marketing at Lyft
Bachelor of Commerce, University of British Columbia Double Specialization in Marketing and International Business
https://www.heinz.cmu.edu/faculty-research/profiles/teshima-shelleyong

Quinn, Pat (TV Economics)
Partner/Manager: Quinn Media Management
B.A., Bennington College
M.F.A., Yale Drama School
https://www.heinz.cmu.edu/faculty-research/profiles/quinn-pat

Skopov, Emily (Introduction to Television Writing)
Writer/Producer: (Xena: Warrior Princess, Andromeda, Pacific Blue, Novel Romance)
BA, Columbia University
MFA, UCLA

Smith, Michele (Business Development)
Vice President of Legacy and Estate Brand Management, Concord
BA in Liberal Arts, Simon Fraser University, British Columbia
https://www.heinz.cmu.edu/faculty-research/profiles/smith-michele/

Stein, Kevin (Capstone Advisor)
Principal, Kevin Stein Consulting
BA, Boston University
Swathmore College
Harvard University
https://www.heinz.cmu.edu/faculty-research/profiles/stein-kevin

Wagner, Paula (Navigating the Practical Realities of the Entertainment Industry)
Producer/Owner, Chestnut Ridge Productions (Mission Impossible, War of the Worlds, Marshall, Pretty Woman: The Musical)
BFA, Drama, Carnegie Mellon University
https://www.heinz.cmu.edu/faculty-research/profiles/wagner-paula

Kevin Yoder (Market Research)
Executive Vice President, Theatrical Strategy, National Research Group
BA, University of Notre Dame, Liberal Arts
MFA, University of Southern California, Peter Stark Producing Program
J.D. University of Southern California, Gould School of Law
https://www.heinz.cmu.edu/faculty-research/profiles/yoder-kevin/

20.4 UNIVERSITY POLICIES & EXPECTATIONS

It is the responsibility of each member of the Carnegie Mellon community to be familiar with university policies and guidelines. In addition to this departmental graduate student handbook, the following resources are available to assist you in understanding community expectations:

- The Word/Student Handbook: http://www.cmu.edu/student-affairs/theword/index.html
- Academic Integrity Website: http://www.cmu.edu/academic-integrity
- University Policies Website: http://www.cmu.edu/policies/
- Graduate Education Website: http://www.cmu.edu/graduate/policies/index.html
- The WORD is Carnegie Mellon University's student on-line handbook and supplement to the department (and sometimes college) handbook. The Carnegie Mellon Code can also be found on-line at: https://www.cmu.edu/student-affairs/theword/code/index.html

20.5 HEINZ COLLEGE APPLICATION PROCESS

Before applying, please carefully review the application process and admission requirements for the Master of Entertainment Industry Management Program.

20.6 MEIM ADMISSIONS REQUIREMENTS -OVERVIEW

The MEIM program is looking for dynamic, motivated critical thinkers who are drawn to the ever-changing entertainment field. The MEIM program seeks leaders who want to hone their strategic and entrepreneurial skills, and build a strong business foundation to help realize their career goals in the entertainment industry.

MEIM applicants should be interested in how screen-based entertainment is produced, developed, packaged, financed, marketed and distributed. However, MEIM students come from a wide variety of undergraduate backgrounds. While the program welcomes graduates of film, TV and communications programs, students have come to the MEIM program with liberal arts degrees in literature, sociology or history. Business, social science, marketing degrees, fine arts, theater, or even music programs are great preparations for a MEIM degree. In short, because the entertainment industry draws on so many different disciplines, the MEIM program believes in assembling a student body with diverse and synergistic backgrounds.
The MEIM program also welcomes individuals who have completed their Bachelor's degree and spent the past few years pursuing their careers – either in entertainment, or in other fields. Having some professional experience under one's belt can provide an added level of focus, and such students also do well in the program.

For more information on the MEIM student body, including demographics and test scores, view the **class profile**.

Because of the quantitative nature of Heinz College graduate programs, the faculty requires that all incoming students have a solid quantitative foundation prior to enrollment at Heinz. Since successful applicants come from diverse academic backgrounds, the College offers the Quantitative Skills Summer Program (QSSP) to prepare incoming students who did not previously complete college-level courses like advanced algebra, pre-calculus and/or statistics.

The Admissions department invites all interested candidates to contact the college directly with any questions about qualifications, eligibility or any other topic or concern. Admissions' representatives will work closely to help MEIM candidates successfully complete an application to the Program. **Admission Process and Required Application Materials-MEIM Program.**

20.7 VERIFICATION REQUIREMENT FOR ALL ENROLLING STUDENTS

We are committed to ensuring the integrity of our admissions process and the reputation of our educational programs. We also want to protect and enhance the value of the degrees that we confer. The purpose of the background check is to protect all stakeholders of our programs (students, faculty, staff and alumni) from those who would falsify their backgrounds to gain an unfair advantage in the admissions process. We have made the decision to implement an independent verification process of all application materials for any master's student enrolling in the Heinz College. We believe the verification will support our efforts to ensure integrity throughout the program. Upon admission, you will receive more details about this process.

20.8 TRANSFER AND ARTICULATION AGREEMENTS

The MEIM program has not entered into an articulation or transfer agreement with any other college or university.

20.9 CREDIT FOR PRIOR COURSES

In general, the Heinz College does not give credit toward graduation for courses taken prior to entering the Heinz College program. The MEIM program does not award credit for prior work at a job or internship, however, the admissions committee does look upon previous work in a favorable light. Even if you do receive prior credit, however, you must still pay tuition for the number of full-time semesters required by your program in order to receive a degree.

20.10 STUDENTS ON F-1 VISAS AND COURSE LOADS

Regulations governing F-1 students limit how many online/distance courses an F-1 student may take and still be considered to be enrolled full-time and maintaining status. F-1 students are required to be enrolled full-time each semester (36 units or the minimum required for making normal progress towards the completion of the degree). Students in F-1 status cannot not take more than a single online/ distance course (either a mini or a full-semester) in any given semester. Immigration does not consider courses that require physical presence on campus to be distance education/online even if the delivery mode is via distance.

CMU does not provide Visa Services. Our Office of International Education (OIE) issues the I-20 document to enrolling students and counsels' students on immigration-related issues before, during and after enrollment at the university.

20.11 ENGLISH LANGUAGE PROFICIENCY EXAM

All classes are taught in English. No instruction will occur in any language other than English.

The English language proficiency of domestic students is measured during the admission process through the review of the verbal and writing scores on the GRE or GMAT and their admission essay/ statement of purpose (required of all applicants to the MEIM program). In addition, MEIM applicants are provided the options to complete a video interview or a video essay as part of their admission packet. Additionally, many MEIM applicants are required to complete a face-to-face interview or complete a virtual interview with a member of the admissions committee (via Skype, FaceTime or other similar technology). This combination of various methods of communication gauge the students' verbal and written language skills.

If your native language (mother tongue) is *not* English, you are required to submit an official score report from the TOEFL or IELTS. **The only exceptions are for students who have worked or studied for five or more years in Australia, Botswana, Canada, Ghana, Ireland, Kenya, Lesotho, Malawi, Namibia, New Zealand, Nigeria, South Africa, Swaziland, Tanzania, Uganda, United Kingdom, United States, and/or Zambia.** Earning a bachelor's degree in these countries does not automatically qualify you for this waiver due to the five-year minimum requirement. **Your scores must be submitted directly to us by Educational Testing Service (ETS)**. The **recommended TOEFL score is 25 on each section** of the Internet-based test. We strongly recommend that you take the TOEFL or IELTS at least one month prior to the application deadline.

You may submit scores from up to four valid TOEFL or IELTS exam dates. If you have taken the exam more than once, **Heinz College will use the highest score verified in each section in reviewing your application for admission.** For every score you wish to include with your application, you must report the exam date(s) and submit the official score report(s). We will not accept exam scores for test dates that are not listed on the application.

TOEFL (IBT preferred)

The **recommended TOEFL score is 25 on each section** of the Internet-based test (or 620 on the paper-based test and 260 on computer-based test).
The **minimum TOEFL scores required to apply** for admission to any of Heinz College's graduate degree programs are:
Reading: 22 Listening: 22 Speaking: 18 Writing: 22
For more information on the TOEFL or to register, please visit the ETS TOEFL website.

IELTS

If you choose to take the International English Language Testing System (IELTS) in place of the TOEFL, we require that you take the "Academic" format of IELTS. **The recommended IELTS score is 7 overall and 7 in each band.** The **minimum IELTS scores required to apply** for admission to any of Heinz College's graduate degree programs are:
Listening: 6.5 Reading: 6.5 Writing: 6.5 Speaking: 6.0 Overall Band: 6.5.
For more information on the IELTS or to register, please visit the IELTS website.
In addition to TOEFL and IELTS, Heinz will now accept the online Duolingo English Test for applicants for whom English was not their first language. These tests include a proficiency composite score, section subscores, video interview, and writing sample which are shared with Heinz College when you send your results. Certified results are available within 48 hours of the test session.

We will accept results from the current version of the Duolingo English Test on the 160 point scale with subsection scoring (new as of July 2020). **Your scores must be submitted directly to "Carnegie Mellon University – Heinz College of Information Systems & Public Policy" by Duolingo. We receive all Duolingo English Test scores electronically.The recommended Duolingo English Test score is 120 overall (see below for recommended scores in each subsection).**

The **minimum Duolingo English Test scores required to apply** for admission to any of Heinz College's graduate degree programs are:

Literacy: 105 (recommended = 115) Comprehension: 115 (recommended = 125)
Production: 70 (recommended = 100) Conversation: 95 (recommended = 105)
Overall: 105 (recommended = 120)

20.12 LOCATION PROFILE

Carnegie Mellon University's H. John Heinz III College and The College of Fine Arts operates a satellite location in Los Angeles, California, as a part of the Master of Entertainment Industry

Management program (MEIM). The Los Angeles portion of the MEIM program is located in the city of North Hollywood in Los Angeles County. The location consists of a 6,034 square foot suite of offices in a six-story professional office building shared by other tenants, located at 4640 Lankershim Blvd., Suite 125, North Hollywood, CA 91602. The cross street is Hortense.

The suite of offices includes a 20-seat classroom with a TV and overhead projection capability, a 30-seat classroom with two 70-inch televisions and a 45-inch confidence monitor, and a 50-seat classroom with four 70-inch televisions. All classrooms have multiple white boards and moveable chairs/tables. Additionally, most teachers project power point slides on the screens and the use of the white boards is common. There are two conference rooms for student use with moveable chairs/tables. One of the conference rooms has dedicated video conference capabilities. There is a large screening room with a 75-inch television and multiple couches/sitting areas. There is a student computer office, a kitchen, a library with over 1000 DVD's and books and a reading area.

There is a courtyard directly outside of the MEIM entrance between the building and the parking garage. The courtyard has a seating area and planted shrubbery.

20.13 HOUSING

Carnegie Mellon University does not provide housing to students in the Los Angeles portion of the MEIM program. There are several housing options available near the MEIM-LA office and throughout greater Los Angeles. The approximate cost of housing varies depending on the area of the city (anywhere from $1,000 – 2,000 for a one-bedroom apartment). There are several websites to help students find costs:
https://www.rentjungle.com/average-rent-in-los-angeles-rent-trends/

https://la.curbed.com/2018/6/21/17477888/los-angeles-apartments-renters-guide

In March of the first year of the program, MEIM leadership offers a workshop on housing which includes advice from past students and information on the popular neighborhoods that students often live. Listed below is some helpful information regarding housing.

MEIM Recommended areas (just a few)

- Around MEIM, Disney, Warner Bros., Universal:
  - Burbank/ Glendale/ Toluca Lake/ Studio City / North Hollywood (South of Burbank Blvd).
- Around Paramount/ Raleigh Studios/ Dolby Theatre/ Hollywood agencies/ Post Production houses:
  - Hollywood/ Los Feliz/ Silver Lake/ Atwater Village/ Hancock Park/ West Hollywood/Koreatown
- Around a majority of Agencies & Mgt. Firms:
  - West Hollywood/ Beverly Hills/ Beverly Hills Adjacent/ Beverlywood
- Around Sony/ Fox Studios:
  - Culver City (*far* from MEIM)/ West Los Angeles/ Palms/
- Other Areas:
  - East of MEIM: Eagle Rock/ Pasadena
  - West of MEIM: Sherman Oaks/ Van Nuys

- North of MEIM: Montrose/ La Canada

When to find a place:

You can find an apartment within a few days if you do some internet homework first. LA is a transient town so folks move a lot. Be patient and drive around the neighborhoods first. Note the parking situation. Parking is going to become a major conversation for you. Make sure you (and friends) have access to safe, well-lit parking.

Here is a link to find out more information including full statistics about the various LA areas: http://projects.latimes.com/mapping-la/neighborhoods/

Cost of Living & Apartment Prices

If you want to live in the City of Angels, you have to pay a premium. The overall cost of living here is 33% above the national average, with housing costs tending to be among the most expensive in the nation. In the city of Los Angeles, the median cost for apartment rentals is over $1500 per month per person and can be quite a bit more depending on where you live. If you share, students can get a better place that tends to be cheaper. Expect to pay even more for apartments in places like Santa Monica, Malibu and other upscale communities. Last year students' rent ranged from $1000 to $1,500

20.14 ATTENDANCE POLICIES

Students in the Master of Entertainment Industry Management program are expected to attend all classes outlined in a course syllabus as part of their degree. All absences must be approved and arranged with the course professor on an individual basis. Please note that the leadership of the MEIM program do not support excessive course absences for job interviewing, networking events, screenings, or internship conflicts. Excessive course absences may influence a student's ability to pass a course and/or complete their degree.

20.15 STUDENT RECORDS

Heinz College's MEIM program maintains records of the name, address, e-mail address, and telephone number of each student who is enrolled in the program in its student information system and a secure folder for use by Academic Services.

Student Record Retention Policy

The policy of Carnegie Mellon University is to ensure the safety, accessibility, confidentiality, and good condition of the permanent record of every Carnegie Mellon student, past and present.

Carnegie Mellon University (CMU), established in 1900, holds all permanent records of our students (current and former) in the University Registrar's Office. We maintain original paper records in an offsite secure climate-controlled underground storage facility along with a microfilmed copy of each record. In addition, a copy of microfilmed records also resides in the University Registrar's Office in Pittsburgh, PA. This includes all students globally, include those

students studying at our California teaching location and instructional sites. CMU has established the University Registrar's Office as the official data steward of all student records.

Historical Records 1906-1989

For every student enrolled at Carnegie Mellon University as a new or continuing student prior to the fall semester, 1989, and dating back to 1906, the University Registrar's Office of Carnegie Mellon University maintains a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not within the student's official transcript. The official transcript provides brief personal information to identify the student as unique. It contains courses, units and grades; semester and cumulative grade point averages; all degrees earned; transfer credit or advanced placement and dean's list indications.

The University Registrar's Office has established and maintains within a microfiche copy of good, readable, and reproducible quality of the student's permanent record in a secured records unit. A secondary permanent microfilm copy of all records will be maintained in good condition in the climate-controlled, fire-proof, limited-access security at an offsite facility.

Modern Records 1989-Current

For every student enrolling at Carnegie Mellon University as a new or continuing student beginning in fall semester, 1989, the University Registrar's Office of Carnegie Mellon University will establish and maintain within an electronic data file in the University Student Services Suite (S3, our student information system) a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not. The University Registrar's Office staff will, under the direction of the University Registrar, add to the electronic record such new information as pertains to the student's demographic and academic record as it becomes available, semester-by-semester, and as the student progresses in his/her career at Carnegie Mellon University.

Daily, the Carnegie Mellon University Computing Services Division will perform a backup of all databases that have been altered during that day. Weekly, the Computing Services Division will perform a complete backup of all records within the student data file. The Computing Services Division staff will store the daily backups in the climate-controlled, fire-proof, limited-access security facility in the Computer Operations center in Cyert Hall on the Carnegie Mellon University campus. Upon successful completion of the monthly backup, the Computing Services Division staff will securely transfer the weekly and monthly backups from the preceding month to climate-controlled, fire-proof, secured vault at an offsite facility.

Cessation of Operations

In the unlikely event that CMU (which has existed for more than 100 years) ceases to exist, it will make appropriate arrangements to comply with clauses (1) and (2) for all its students consistent with the Commonwealth of Pennsylvania statutes and law. There is an informal plan and agreement with the University of Pittsburgh's University Registrar's Office, that should either school cease, we would exchange student records.

20.16 TUITION AND FEES

The tuition rate for students entering the MEIM program is set in the spring for the class entering in the following fall semester. Tuition and required university fees (generally the student activities fee, technology fee and transportation fee) are subject to change. Students are required to pay the then-current rates for program tuition and required university fees each semester. Tuition typically increases 3% to 5% each academic year. Other fees may apply. For example, requests by students for official university documents (e.g., requests for transcripts, enrollment verifications and academic records) may require payment of the relevant fee(s), and students electing to enroll and participate in tuition payment plans must pay the relevant fees to the payment plan processor. Information about the above required university fees and other fees can be found on Carnegie Mellon University's website, at **http://www.cmu.edu/sfs/.** In addition to the above, Health Insurance is also required. Students are required to show proof of appropriate insurance coverage or purchase student health insurance coverage through Carnegie Mellon University's third-party student health insurance program.

Program Tuition (Year 2 in CA)	$ 52,400
Required University Fees* per Semester (Year 2 in CA)	$ 662
Books and Supplies (estimated Year 2 in CA)	$ 1,250
Estimated Fees/Charges for Entire Program (Year 2 in CA)	$ 54,312

Estimated Cost of Attendance (Beginning in Fall 2020)	**Pittsburgh**		**Los Angeles**	
	Fall 2021	**Spring 2022**	**Fall 2022**	**Spring 2023**
Charged to the Student Account				
Estimated Full-time Tuition	$25,500	$25,500	$26,200	$26,200
Student Activities Fee	111	111	111	111
Transportation Fee	122	122	0	0
Technology Fee	220	220	220	220
Credential Verification Fee	105			
Health Insurance (actual costs may vary)	3,021		3,021	
Optional Costs				
Room (actual costs may vary)	4,129	4,129	4,542	4,542
Board (actual costs may vary)	1,687	1,687	1,855	1,855
Laptop (actual costs may vary)	1,500			
Indirect Costs				
Books/Supplies (actual costs may vary)	625	625	625	625
Travel (actual costs may vary)	1,185	1,185	1,303	1,303
Miscellaneous (actual costs may vary)	3,769	3,769	4,147	4,147
Total Estimated Cost of Attendance (per semester)	**$41,974**	**$37,348**	**$42,024**	**$39,003**

20.17 SCHOLARSHIPS/AWARDS

The fees and charges do not consider any scholarships or similar awards that have been or may be awarded to the student. A student must refer to the student's official financial award or admission letter(s) from Carnegie Mellon University to determine whether the student has been awarded any scholarships or similar awards, and the terms and conditions of those scholarships and awards.

20.18 OTHER FUNDING AVAILABLE FROM THE MEIM PROGRAM

MEIM students are awarded a one-time **$1,200 re-location stipend** to assist all students with their expenses related to moving from Pittsburgh to Los Angeles prior to their second year.

In order to offset a portion of the additional expenses incurred during the second year of the MEIM program, all MEIM students who receive a scholarship for the first two semesters in the program receive **an additional $2,500/semester in scholarship** support in each of their final two semesters in the program.

20.19 FEDERAL AND STATE FINANCIAL AID PROGRAMS

Meeting the cost of a graduate education is a significant investment. Carnegie Mellon University is committed to making it financially possible for graduate students to enhance educational development and reach their career goals. There are many financial aid resources available to students pursuing graduate studies at Carnegie Mellon University. Carnegie Mellon University participates in a number of Federal and state financial aid programs. Information about these financial aid programs can be found on Carnegie Mellon University's website, at http://www.cmu.edu/finaid/index.html

Carnegie Mellon University Consumer Information

Below is a summary of consumer information made available to all Carnegie Mellon University prospective and current students as required by the Higher Education Act of 1965, as amended. Required Disclosure have been categorized into five topics. Each disclosure gives a brief description of information that is required to be disclosed and explains how it can be obtained. This information may be changed from time to time as required.

If you need assistance or would like a paper copy, contact the Student Financial Aid Office, 5000 Forbes Avenue, Warner Hall, Pittsburgh, PA. If you wish to speak with a representative about the information contained here, please contact Associate Director Catherine Demchak at (412) 268-1353.

Information about the Institution:

Accreditation Information

Carnegie Mellon University is accredited by the Middle States Commission on Higher Education (MSCHE), 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104 (www.msche.org). The Commission may be contacted by telephone at 267-284-5000 or via email at info@msche.org or espanolinfo@msche.org (Spanish/Español). The university's current "Statement of Accreditation Status" can be found at, https://www.msche.org/institution/.

State Approvals

Carnegie Mellon University is licensed to operate in the states listed below. Individuals may contact the relevant agency for more information or information about how to file a complaint.

California
Bureau for Private Postsecondary Education
P.O. Box 980818
West Sacramento, CA 95798-0818
Telephone: 888-370-7589
Email: bppe@dca.ca.gov
Website: www.bppe.ca.gov

New York
New York State Education Department
Office of Higher Education
Room 977 Education Building Annex
Albany, NY 12234
Telephone: 518-486-3633
Email: hedepcom@nysed.gov
Website: www.highered.nysed.gov

Pennsylvania
Pennsylvania Department of Education
Office of Postsecondary and Higher Education
333 Market Street, 12th Floor
Harrisburg, PA 17126-0333
Telephone: 717-783-8228
Email: ra-collunivseminfo@pa.gov
Website: www.education.state.pa.us

Washington, D.C.
Office of the State Superintendent of Education
Government of the District of Columbia
810 First Street NE 9th Floor
Washington, DC 20002
Telephone: 202-727-6436
Email: osse@dc.gov
Website: osse.dc.gov

Inquiries regarding the university's accreditation status or authorization to operate in any of the above states may be directed to: Associate Vice President / Director of Enrollment Services, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh PA 15213, telephone: 412-268-5399, email: krieg@andrew.cmu.edu.

Distance Education, State Authorization and Reciprocity Agreement (SARA)

The State Authorization Reciprocity Agreement (SARA) is an agreement among member states, districts, and territories in the United States, which establishes national standards for interstate offering of postsecondary distance education courses and programs. It is intended to standardize the process of offering online courses and programs by postsecondary institutions located in states other than the state in which the enrolled student(s) are residing. SARA is overseen by a national council (NC-SARA) and administered by four regional education compacts.

Carnegie Mellon University has been approved by the Commonwealth of Pennsylvania to participate in NC-SARA and was accepted as a SARA institution on May 2, 2017; additionally, Carnegie Mellon secured approval through NC-SARA on May 18, 2017. Carnegie Mellon University is listed as an approved, participating institution on the NC-SARA website (http://www.nc-sara.org/). At this time, 49 of the 50 United States are SARA members. California is not a member of SARA; however, Carnegie Mellon is able to offer online education to California residents.

Except where prohibited by applicable law, students who reside outside of the United States generally are not restricted from enrolling in our online programs. Some online programs do require in-person attendance at one of Carnegie Mellon's teaching locations (e.g., Carnegie Mellon's Pittsburgh, Pennsylvania campus) for short portions of the program. Students interested in enrolling in a specific online program are encouraged to contact the person designated by the online program for questions about the program's requirements or enrollment.

Copyright Infringement Policies

Carnegie Mellon University takes copyright violation seriously. Besides raising awareness about copyright law, it takes appropriate action in support of enforcement as required by policy and law. United States copyright law (http://www.copyright.gov/) "protects the original works of authorship fixed in any tangible medium of expression, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device".

The University's Fair Use Policy (http://www.cmu.edu/policies/administrative-and-governance/fair-use.html) states that all members of the University must comply with US copyright law and it explains the fair use standards for using and duplicating copyrighted material. In addition, the policy prohibits the duplication of software for multiple uses, meeting the Digital Millennium Copyright Act (DMCA) (http://www.copyright.gov/legislation/dmca.pdf) requirements. The DMCA criminalizes the development or use of software that enables users to access material that is copyright protected. Furthermore, the Computing Policy (http://www.cmu.edu/policies/information-technology/computing.html) prohibits the

distribution of copyright protected material via the University network or computer systems, unless the copyright owner grants permission.

The Higher Education Opportunity Act of 2008 (Public Law 110-315) Section 488, requires institutions of higher education to annually inform students that "unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject the students to civil and criminal liabilities". Carnegie Mellon does this by publication of a news article on Computing Services' website or via mass mail communication each semester. The law goes on to require institutions "to provide a summary of penalties for violation of Federal copyright laws, including disciplinary actions that are taken against students who engage in unauthorized distribution of copyrighted materials using the institution's information system." Copyright protected materials can include, but are not necessarily limited to

- Music
- Movies or other videos
- Literary works
- Software
- Digital images or libraries

Cost of Attending the University
Actual tuition and fee charges can be found on the Student Financial Services' website at https://www.cmu.edu/sfs/tuition/index.html.
For estimated books and supplies, room and board, and personal/miscellaneous expenses view the cost of attendance for,
Graduate program at https://www.cmu.edu/sfs/tuition/graduate/index.html.

Descriptions of Academic Programs
Information on the university's graduate academic programs and degree offerings is available from the various schools/colleges and admitting offices. Links to those programs can be found at https://www.cmu.edu/academics/index.html.

Faculty
Information on the university's faculty and instructional personnel is **available from individual schools/colleges. This information can be found on the university's academics website at** https://www.cmu.edu/academics/index.html**.**

Facilities & Services for Disabled Students
The Office of Disability Resources provides responsive and reasonable accommodations to students who self-identify as having a disability, including physical, sensory, cognitive and emotional disabilities. If you would like to learn more about the services and accommodations provided by the Office of Disability Resources, visit their website at https://www.cmu.edu/disability-resources/students/. To discuss your accommodation needs, please email us at access@andrew.cmu.edu or call us at 412-268-6121 to set up an appointment.

Student Privacy & FERPA

One of the most significant changes a parent or guardian experiences in sending a student to college is the difference in privacy standards for educational records. Carnegie Mellon values the student's right to privacy. The university adheres to a federal law called the Family Educational Rights and Privacy Act (also called FERPA or the Buckley Amendment) that sets privacy standards for student educational records and requires institutions to publish a compliance statement, including a statement of related institutional policies. For more detailed information, view the university's brochure at https://www.cmu.edu/hub/privacy/ferpa-brochure.pdf.

Return to Title IV Funds Policy and Procedural Statement

Policy Reason

The U. S. Department of Education requires that the university determine the amount of Federal Title IV aid earned by a student who withdrawals of fails to complete the period of enrollment. The university must determine the earned and unearned portions of Title IV aid as of the date the student ceased attendance based on the amount of time the student spent in attendance. Up through the 60% point in the period of enrollment, a pro rata schedule is used to determine the amount of Title IV funds the student has earned at the time of withdrawal. After the 60% point in the period of enrollment, a student has earned 100% of the Title IV funds he or she was scheduled to receive. For a student who withdraws after the 60% point-in-time, there are no unearned funds. Federal regulations can be found at:

Federal Student Aid Handbook, Volume 5
Chapter 1 Withdrawals and the Return of Title IV Funds 34 CFR 668.22

Policy and Procedural Statement

At Carnegie Mellon Title IV funds are awarded to a student under the assumption that the student will attend school for the entire period for which the assistance is awarded. When a student withdraws, the student may no longer be eligible for the full amount of Title IV funds that the student was originally scheduled to receive.

If a recipient of Title IV grant or loan funds withdraws from a school after beginning attendance, the amount of Title IV grant or loan assistance earned by the student must be determined. If the amount disbursed to the student is greater than the amount the student earned, the unearned funds must be returned. If the amount disbursed to the student is less than the amount the student earned, and for which the student is otherwise eligible, he or she is eligible to receive a Post-withdrawal disbursement of the earned aid that was not received.

Carnegie Mellon determines the Withdrawal Date and Date of Determination to complete the return calculation. A student's withdrawal date and date of determination varies depending on the type of withdrawal. When a student provides official notification to Carnegie Mellon through the Student Leave of Absence and Withdrawal Process, the withdrawal is defined as official withdrawal. When the student does not complete the Student Leave of Absence and Withdrawal Process and no official notification is provided by the student it is considered an unofficial withdrawal.

Leave of Absence/Withdrawal Process

A student may leave Carnegie Mellon by either taking a leave of absence (leaving the university temporarily with the firm and stated intention of returning) or by withdrawing from the

university (leaving the university with no intention of returning). Students choosing to take a leave of absence should first contact their academic advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon. A student deciding to leave the university should take the following steps:

- Complete a Leave of Absence or Withdrawal Form.
- The form must include **all** necessary signatures or the process will not be completed.
- Return the completed form to the University Registrar's Office, 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213.

Determination of Withdrawal Date

Official Withdrawals (Notification Provided by the Student)

Those withdrawals defined as official are processed in accordance with federal regulations. The Office of the Registrar provides information that identifies which students have processed a Student Leave of Absence and Withdrawal Form for each semester. This information includes the Date of Withdrawal, the Date of Determination, Withdrawal/Leave Status (LA, LS, & W2) and the semester of attendance. This information is maintained in the student's academic file and in the university's Student Information System.

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- Date the student began the withdrawal or leave of absence process;
- Date the student notified his or her home department;
- Date the student notified the associate dean of his or her college; or
- Date the student notified the dean of students.

Unofficial Withdrawal (No Official Notification Provided by the Student)

For a student who withdraws without providing notification to Carnegie Mellon, the institution determines the withdrawal date using defined criteria. This category of withdrawals includes students that drop out and students that do not earn a passing grade.

To identify the unofficial withdrawals the Registrar develops a preliminary list of students that did not complete the semester by reviewing the final student grade reports. The list includes all students with: a) semester units carried, b) 0 semester units passed, c) 0 quality points earned, and d) 0.0 QPA. The Registrar contacts the academic divisions about each student to determine if the student actually completed the semester and earned the grades (0.0) or failed to complete the semester and did not notify the university of their status.

For students who do not notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- The midpoint of the semester;
- The last date the student attended an academically-related activity such as an exam, Tutorial or study group, or the last day a student turned in a class assignment.

Date of Determination that the Student Withdrew

Carnegie Mellon is not required to take attendance and the Date of Determination that a student withdrew varies depending upon the type of withdrawal: Official or Unofficial.

1. For withdrawals where the student **provided *Official Notification*** the Date of Determination is: The student's withdrawal date, or the date of notification, whichever

is later.

2. For withdrawals where the student **did not provide *Official Notification*** the Date of Determination is: The date the institution becomes aware the student has ceased attendance.

For a student who withdrawals without providing notification to the institution, the institution must determine the withdrawal date no later than 30 days after the end of the enrollment period.

Calculation of Earned Title IV Assistance

The withdrawal date is used to determine the point in time that the student is considered to have withdrawn so the percentage of the period of enrollment completed by the student can be determined. The percentage of Title IV aid earned is equal to the percentage of the period of enrollment completed.

The amount of Title IV federal aid earned by the student is determined on a pro-rata basis up to the end of 60% of the semester. If the student completed 30% of a term, 30% of the aid originally scheduled to be received would have been earned. Once a student has completed more than 60% of a term, all awarded aid (100%) has been earned. The percentage of federal aid earned and the order in which the unearned aid is returned are defined by federal regulatory requirements.

The calculation of earned Title IV funds includes the following grant and loan funds if they were disbursed or could have been disbursed to the student for the period of enrollment for which the Return calculation is being performed:

- Pell Grant
- Iraq and Afghanistan Service Grant
- TEACH Grant (not available at Carnegie Mellon)
- FSEOG Grant
- Federal Direct Loan

Institutional Charges

Institutional charges are used to determine the portion of unearned Title IV aid that the school is responsible for returning. Carnegie Mellon ensures that all charges for tuition, fees, room and board, as well as all other applicable institutional charges are included in the return calculation. Institutional charges do not affect the amount of Title IV aid that a student earns when he or she withdraws.

The institutional charges used in the calculation usually are the charges that were initially assessed the student for the period of enrollment. Initial charges are only adjusted by those changes the institution made prior to the student's withdrawal (for example, for a change in enrollment status unrelated to the withdrawal). If, after a student withdraws, the institution changes the amount of institutional charges it is assessing a student, or decides to eliminate all institutional charges, those changes affect neither the charges nor aid earned in the calculation.

Return of Unearned Funds to Title IV

If the total amount of Title IV grant and/or loan assistance that was earned as of the withdrawal date is less than the amount that was disbursed to the student, the difference between the two amounts will be returned to the Title IV program(s) and no further disbursements will be made.

If a student has received excess funds, the College must return a portion of the excess equal to the lesser of the student's institutional charges multiplied by the unearned percentage of funds, or the entire amount of the excess funds.
The funds will be returned in the order below as prescribed by federal regulations, within 45 days from the date of determination that a student withdrew.

- Unsubsidized Federal Stafford Loans
- Subsidized Federal Stafford Loans
- Federal PLUS loans
- Federal Pell Grants
- Federal Supplemental Educational Opportunity Grants (FSEOG)

Post-Withdrawal Disbursements

If the total amounts of the Title IV grant and/or loan assistance earned as of the withdrawal date is more than the amount that was disbursed to the student, the difference between the two amounts will be treated as a post-withdrawal disbursement. In the event that there are outstanding charges on the student's account, Carnegie Mellon will credit the student's account for all or part of the amount of the post-withdrawal disbursement up to the amount of the allowable charges.

Any amount of a post-withdrawal disbursement that is not credited to a student's account will be offered to the student within 30 days of the date that the institution determined that the student withdrew. Upon receipt of a timely response from the student, the College will disburse the funds within 90 days of the date of determination of the student's withdrawal date.

Return of Title IV Funds – Withdrawals for Programs Offered in Modules

The return of Title IV funds for programs offered in modules is defined in a separate policy statement at Carnegie Mellon. This document is included as an addendum to the Carnegie Mellon University Return to Title IV Funds Policy and Procedural Statement (see below).

Policies and Procedures

Federal Student Aid Handbook, Volume 5, Chapter 2 Withdrawals and the Return of Title IV Funds
CFR 668.22 (a), (f) and (l)
Dear Colleague Letter GEN-11-14 July 2011

For all programs offered in modules, a student is a withdrawal for Title IV purposes if the student ceases attendance at any point prior to completing the payment period or period of enrollment (unless the institution has written confirmation from the student that that they will attend a module that begins later in the enrollment period).

The regulations require the institution to determine whether Title IV funds must be returned based on the number of days actually completed versus the number of days the student was scheduled to attend in the payment period. The regulations prevent students from enrolling in modules or compressed courses spanning the period, completing a portion of the period, and retaining all aid for the period.

A program is considered to be offered in modules if a course or courses in the program do not span the entire length of the payment period or period of enrollment. The rule impacts all programs offering courses shorter than an entire semester, including semester-based programs with a summer term consisting of two consecutive summer sessions.
The Student Financial Aid Office has established the following procedures associated with handling withdrawals from programs offered in modules. An Associate Director of Student Financial Aid has the primary responsibility for compliance and implementation of these regulatory requirements.

1. The institution will identify students enrolled for the summer session that are eligible for Title IV Aid.
   - Pell eligible students are identified
   - Students with summer loans are identified
   - The period of enrollment and enrollment status will be identified for each student
2. All Leave/ Withdrawal Forms processed by the University Registrar's Office will be reviewed for the summer sessions to record the Withdrawal Date and Date of Determination to identify any student receiving federal funding.
3. The Student Financial Aid Office will identify any students that drop courses in the summer sessions.
   - During Summer I this is standard procedure
   - During Summer II this is reviewed after 10th day reporting
   - Any additional dropped courses will be reviewed through the 60% enrollment period
4. Students who are identified as official withdrawals or that officially drop all courses in a session will be reviewed to determine the amount of federal financial aid earned. If a Return of Title IV aid is required, existing institutional procedures will be followed.
5. At the end of the enrollment period the institution will determine if any students are identified as 'unofficial withdrawals.' If a Return of Title IV aid is required, existing institutional procedures will be followed.
6. If a student does not begin courses in all sessions, a Return of Title IV aid may not be required, but other regulatory provisions concerning recalculation may apply.
   - If a student completes both courses in module one, but officially drops courses in module two while attending module one the student is not a withdrawal.
   - Since the enrollment is less than half time, the student is no longer eligible for the loan and the funds must be returned.

The following information obtained from the Federal Student Aid Handbook, Chapter 2, Withdrawals and the Return of Title IV Funds, will be used to determine whether a student enrolled in a series of modules is a withdrawal.

How to determine whether a student in a program offered in modules has withdrawn
Schools can determine whether a student enrolled in a series of modules is a withdrawal by asking the following questions.

1. ***After beginning attendance in the payment period or period of enrollment, did the student cease to attend or fail to begin attendance in a course he or she was scheduled to attend?***
   - If the answer is no, this is not a withdrawal.
   - If the answer is yes, go to question 2.

2. ***When the student ceased to attend or failed to begin attendance in a course he or she was scheduled to attend, was the student still attending any other courses?***
   - If the answer is yes, this is not a withdrawal; however other regulatory provisions concerning recalculation may apply.
   - If the answer is no, go to question 3.

3. ***Did the student confirm attendance in a course in a module beginning later in the period (for non-term and nonstandard term programs, this must be no later than 45 calendar days after the end of the module the student ceased attending)?***
   - If the answer is yes, this is not a withdrawal, unless the student does not return.
   - If the answer is no, this is a withdrawal and the Return of Title IV Funds requirements apply.

Contact
Questions regarding this policy or its intent should be directed to the Student Financial Aid Office at 412-268-1353.

<u>Satisfactory Academic Progress Policy and Procedural Statement</u>
To be eligible for federal, state, and institutional financial aid, all students are required to maintain Satisfactory Academic Progress toward the completion of a degree. Each university determines its own policy in accordance with federal regulations set forth by the U. S. Department of Education regarding satisfactory progress standards to ensure student success. To maintain Satisfactory Academic Progress at Carnegie Mellon University, students must meet the following minimum standards for both of the qualitative (QPA) and quantitative (completion rate) measures:

Student Type	QPA (Qualitative)	Completion Rate (Quantitative)*
First Year Undergraduate	1.75	80%
Undergraduate Upper-class	2.00	80%
Heinz Graduate	3.00	80%
Other Graduate (excluding Tepper)	2.00	80%

**To calculate the completion rate, the cumulative number of completed units is divided by the cumulative number of units attempted. Advance Placement credits are excluded from both figures.*

In addition to the above-mentioned Financial Aid Satisfactory Academic Progress standards, federal regulations require a student to complete their degree within a specified amount of time. The maximum timeframe cannot exceed 150 percent of the time published as needed for completion of the program.

Scope:
This policy applies to Federal aid including Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Work-Study, Federal Direct Loans, and Federal Direct PLUS Loan programs; state grant aid; and Carnegie Mellon institutional aid including grants, loans, and scholarships.

Federal regulations can be found at,

Federal Student Aid Handbook, Volume 1
Chapter 1 School Determined Requirements
34 CFR 668.16(e)
34 CFR 668.32(f)
34 CFR 668.34

Evaluation:
Carnegie Mellon evaluates all students for Financial Aid Satisfactory Academic Progress annually, at the end of the spring semester. Students that are included in the review are undergraduates, graduates, both full-time and part-time.

Courses that do not count toward a student's degree cannot be used to determine enrollment status for financial aid purposes. Carnegie Mellon will count transfer credit hours that are accepted toward a student's educational program as both attempted hours and completed hours. Advanced Placement Non-Degree and Non-Credit courses are not counted as units passed or attempted. When a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student's QPA. For financial aid eligibility, only one repeat per course is permitted in the determination of enrollment status for courses previously passed. If the student withdraws and is not assigned a W grade, then it will not be counted in the number of units attempted or completed. If the W grade is assigned, the units will be counted in the number of units attempted and will be counted as zero in the number of units completed. If the student has incomplete units, the units will be counted as attempted and will be counted as zero in the number of units completed.

The Financial Aid Satisfactory Academic Progress evaluation is a cumulative review of all semesters, regardless of whether or not the student received financial aid during the academic year.

If the minimum requirements are not achieved, the student is ineligible to receive financial aid. In such a case, the student is notified and given an option to appeal their financial aid status. More information about the appeal process can be found at https://www.cmu.edu/student-affairs/theword/academic-discipline/appeals-academic-review-board-decisions.html

A financial aid package will not be completed unless an appeal is received, approved and processed accordingly. If by chance a financial aid package is processed and released to the student, it is conditional and subjected to financial aid removal until an appeal is received, approved and processed accordingly.

Contact:
Accountable Department: Enrollment Services, Student Financial Aid. Questions regarding this policy or its intent should be directed to the Student Financial Aid Office, phone: 412-268-1353.

Student Body Diversity
For Information about the diversity of the university student body, contact the Institutional Research and Analysis Office, https://www.cmu.edu/ira/index.html.
For information about the University's Diversity, Equity and Inclusion initiative, visit the Center for Student Diversity and Inclusion's website at https://www.cmu.edu/student-diversity/.

Written Arrangement Information
A U.S. Department of Education regulation requires disclosure of specific information to prospective and current students regarding written arrangements between Carnegie Mellon University (CMU) and any institution(s) that provides a portion of an educational program to students enrolled at CMU. CMU enters into such arrangements to enrich the educational experiences offered to its students. In accordance with the regulation, CMU provides this information at http://www.cmu.edu/hub/consumer-information/docs/written-arrangement.pdf.

Student Complaints & Consumer Information by State
As required for compliance with U.S. Federal Program Integrity Regulations, state official/agency contact information for each U.S. state/territory that could handle a student's complaint is provided at https://www.cmu.edu/hub/consumer-information/docs/complaints.pdf.

Gainful Employment Disclosures
As required by U.S. Department of Education regulations Gainful Employment Disclosures (Disclosures about CMU certificate programs that prepare students for specific occupations) can be found at https://www.cmu.edu/hub/consumer-information/.

Information about Student Financial Aid:
Meeting the cost of higher education is a significant investment. We are committed to providing a comprehensive financial aid program that makes it possible for admitted students to attend Carnegie Mellon.

Application Process & Timeline:
Graduate Students: **To apply for financial aid for the 2020-2021 academic year, follow the steps below.**

1. Free Application for Federal Student Aid (FAFSA)

The FAFSA is required if applying for federal financial aid programs. There are now two ways to complete the *Free Application for Federal Student Aid (FAFSA)* form: a redesigned https://studentaid.ed.gov/sa/fafsa website or a mobile app (available through Google Play, https://play.google.com/store/apps/details?id=com.fsa.mystudentaid or the Apple App Store: https://apps.apple.com/us/app/mystudentaid/id1414539145

We recommend using the IRS Data Retrieval Tool (DRT) (https://studentaid.gov/resources/irs-drt-text to complete the FAFSA. The DRT transfer process has been improved to include stronger security and privacy protections; therefore, tax information transferred will not display on the form or Student Aid Report. Instead, the phrase "Transferred from the IRS" will appear in the fields.

Those selected for federal verification after FAFSA completion or those unable to use the IRS DRT will need to request an IRS Tax Return Transcript (https://www.irs.gov/individuals/get-transcript).

Additional information:

- Apply as soon as possible after October 1.
- Carnegie Mellon's federal code is 003242.
- Use 2017 tax information to complete the FAFSA.
- A Department of Education Federal Student Aid (FSA) ID is required. View FSA ID instructions at https://fsaid.ed.gov/npas/index.htm.
- Students must complete the FAFSA's electronic signature requirement.

2. MPN & Entrance Counseling

All first-time Federal Direct Loan borrowers are required to complete entrance counseling. The entrance counseling session provides information about borrower rights and responsibilities. CMU will be notified when a student has completed online entrance counseling. Funds will not be disbursed until the entrance counseling session has been completed. Students who completed a federal entrance counseling session while at CMU, do not have to complete another session.

Additional information:

- View entrance counseling instructions (https://www.cmu.edu/sfs/financial-aid/types/federal-loans/direct/mpn-entrance-counseling.html).
- Complete entrance counseling session at https://studentloans.gov.

3. Grad PLUS Loan

If you plan on borrowing a Federal Direct Graduate PLUS Loan, this is a two-part process and both parts must be completed in order for your loan to be originated. If you borrowed a Grad PLUS Loan last academic year, you are only required to complete the application portion of the process. The application portion of the process cannot be completed before June 1, 2018.

Additional information:

- View detailed Grad PLUS Loan instructions at https://www.cmu.edu/sfs/financial-aid/types/federal-loans/plus/instructions.html.

- The two-part process may be completed at https://studentloans.gov.

Financial Aid Eligibility Notification
Once a student completes all of the steps above, a financial aid package will be determined. The Student Financial Aid Office will notify the student by email that a financial aid award letter has been posted to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home). The letter contains information and further instructions regarding the student's eligibility and awards. If a student's circumstances change, then financial aid eligibility will be re-evaluated and the student will receive notification that a revised award letter is available in SIO.

Missing Documents
If we are unable to process a student's financial aid package due to missing documents, a Financial Aid Alert email will be sent to the student requesting the required documents by a specified date. Until the entire application process is completed and all required documents are submitted, our office may be unable to complete a student's financial aid package. Students may log in to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home) to view documents that have been received by our office. View instructions for submitting missing documents at https://www.cmu.edu/sfs/financial-aid/missing-documents/index.html.

Teacher Certification
Teacher certification students at the graduate level should be aware that federal regulations classify them as a grade level 5 undergraduate student for Federal Direct Student Loan purposes. Teacher certification students are, however, considered a graduate student by Carnegie Mellon for academic purposes.

Available Financial Aid
Scholarships & Grants
Graduate Students:
Graduate students interested in scholarships and grants may contact their program of interest or department. View more information on the Graduate Education Office website, http://www.cmu.edu/graduate/prospective-students/index.html. In addition, the Fellowships & Scholarships Office (http://www.cmu.edu/fso/) provides support to graduate students interesting in pursing certain external scholarships, like Fullbright and UK Awards.

Federal Work-Study
Federal Work-Study (FWS) is a need-based self-help award. If a student has been awarded FWS, the FWS award is the total that can be earned during the academic year as a work-study student.

Federal Loans
For many students and families, educational loans are a necessary part of the process of paying for college. Student Financial Aid certifies loans for students, as well as Federal Direct Parent PLUS Loans for parents of undergraduates and Federal Direct Grad PLUS Loans for graduate students.

Federal Direct Student Loan
The Federal Direct Student Loan is the most widely-used loan for college students and is available to both undergraduate and graduate students. There are two types of Federal Direct Student Loans, subsidized and unsubsidized, and eligibility for both is determined by completing the FAFSA.

Grad PLUS Loan
Eligible graduate students may borrow a Federal Direct Grad PLUS Loan to assist with educational expenses. Students may borrow any amount up to their calculated cost of attendance minus any other aid received.

Private Loans
Private loan programs offer competitive interest rates and borrower benefits. To increase chances of approval and possibly improve the rate you receive, students are strongly recommended to apply with a creditworthy co-signer.

Student Outcomes
Retention and Graduation Rates
Institutional Research and Analysis Office offers up-to-date data on degrees conferred, enrollment reports, freshmen retention rates and race and ethnicity reports for annual degrees. Retention and Graduation rates can be found at https://www.cmu.edu/ira/retentiongradrates.html.

Intercollegiate Athletic Program Participation Rates and Financial Support Data (Equity in Athletics Disclosure Act)

Please visit the U.S. Department of Education's site, The Equity in Athletics Data Analysis (http://ope.ed.gov/athletics/#/) and select the "Get data for one schools" option. Enter "Carnegie Mellon University" in the "Name" field and select the "Continue" button at the bottom of the page.

A printed copy of the report can be requested by calling the Department of Athletics, Physical Education, and Recreation at 412-268-8054 or by sending an email to Josh Centor, Associate Vice President for Student Affairs and Director of Athletics, Physical Education & Recreation, at jcentor@andrew.cmu.edu.

Health and Safety

Drug and Alcohol Abuse Prevention Program
Under the Drug Free Workplace Act of 1988 and the Drug Free Schools and Campuses Act of 1989, the Carnegie Mellon University is required to have an alcohol and other drug policy outlining prevention, education and intervention efforts and consequences for policy violations. The policy can be found at https://www.cmu.edu/student-affairs/pdfs/2019-2020_alcohol_drug_guide.pdf

CMU Annual Security and Fire Safety Report

- A printed copy of the report can be requested by contacting University Police at 412-268-6232 or campuspd@andrew.cmu.edu.
- The annual security and fire safety report (Carnegie Mellon University Police Department Annual Reports) is also available online at http://www.cmu.edu/police/security-fire-reports/index.html.

Vaccination Policies

- CMU Prematriculation Immunization Policy can be found at http://www.cmu.edu/policies/student-and-student-life/immunizations.html.
- CMU University Health Services Health Requirements for Incoming Students can be found at https://www.cmu.edu/health-services/new-students/.

Other Information

Voter Registration
Please visit https://www.usa.gov/voter-registration

Carnegie Mellon Ethics Hotline
The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to financial matters, academic and student life, human relations, health and campus safety or research.
Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net (user name: tartans; password: plaid). All submissions will be reported to appropriate university personnel.
The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

Statement of Assurance
Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state, or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the vice president for campus affairs, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.
Obtain general information about Carnegie Mellon University by calling 412-268-2000.

20.20 RESPONSIBILITY TO REPAY EDUCATIONAL LOANS

If you obtain a loan to pay for the Master of Entertainment Industry Management program, you will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If you have received federal student financial aid funds, you are entitled to a refund of moneys not paid from federal student financial aid program funds.

20.21 STATEMENT OF NO PETITION IN BANKRUPTCY

Carnegie Mellon University does not have a pending petition in bankruptcy,
is not operating as a debtor in possession, and has not filed a petition in bankruptcy within the preceding 5 years, nor has Carnegie Mellon had a petition in bankruptcy filed against it within the preceding 5 years that resulted in re-organization under Chapter 11 of the United States Bankruptcy Code.

20.22 TUITION RECOVERY FUND

The State of California established the Student Tuition Recovery Fund (STRF) to relieve or mitigate economic loss suffered by a student in an educational program at a qualifying institution, who is or was a California resident while enrolled, or was enrolled in a residency program, if the student enrolled in the institution, prepaid tuition, and suffered an economic loss. Unless relieved of the obligation to do so, you must pay the state-imposed assessment for the STRF, or it must be paid on your behalf, if you are a student in an educational program, who is a California resident, or are enrolled in a residency program, and prepay all or part of your tuition. The STRF Assessment Fee is refundable during the cancellation refund period.

You are not eligible for protection from the STRF and you are not required to pay the STRF assessment, if you are not a California resident, or are not enrolled in a residency program.

It is important that you keep copies of your enrollment agreement, financial aid documents, receipts, or any other information that documents the amount paid to the school. Questions regarding the STRF may be directed to the Bureau for Private Postsecondary Education, 2535 Capitol Oaks Drive, Suite 400, Sacramento, CA 95833, (916) 431-6959 or (888) 370-7589.

To be eligible for STRF, you must be a California resident or are enrolled in a residency program, prepaid tuition, paid or deemed to have paid the STRF assessment, and suffered an economic loss as a result of any of the following:

1. The institution, a location of the institution, or an educational program offered by the institution was closed or discontinued, and you did not choose to participate in a teach-out plan approved by the Bureau or did not complete a chosen teach-out plan approved by the Bureau.

2. You were enrolled at an institution or a location of the institution within the 120 day period before the closure of the institution or location of the institution, or were enrolled in an educational program within the 120 day period before the program was discontinued.

3. You were enrolled at an institution or a location of the institution more than 120 days before the closure of the institution or location of the institution, in an educational program offered by the institution as to which the Bureau determined there was a significant decline in the quality or value of the program more than 120 days before closure.

4. The institution has been ordered to pay a refund by the Bureau but has failed to do so.

5. The institution has failed to pay or reimburse loan proceeds under a federal student loan program as required by law, or has failed to pay or reimburse proceeds received by the institution in excess of tuition and other costs.

6. You have been awarded restitution, a refund, or other monetary award by an arbitrator or court, based on a violation of this chapter by an institution or representative of an institution, but have been unable to collect the award from the institution.

7. You sought legal counsel that resulted in the cancellation of one or more of your student loans and have an invoice for services rendered and evidence of the cancellation of the student loan or loans.

To qualify for STRF reimbursement, the application must be received within four (4) years from the date of the action or event that made the student eligible for recovery from STRF.

A student whose loan is revived by a loan holder or debt collector after a period of non-collection may, at any time, file a written application for recovery from STRF for the debt that would have otherwise been eligible for recovery. If it has been more than four (4) years since the action or event that made the student eligible, the student must have filed a written application for recovery within the original four (4) year period, unless the period has been extended by another act of law.

However, no claim can be paid to any student without a social security number or a taxpayer identification number.

20.23 STUDENT'S RIGHT TO CANCEL (WITHDRAWAL/LEAVES OF ABSENCE)

A student has the right to cancel the student's Enrollment Agreement by either taking a leave of absence from the Program (leaving Carnegie Mellon University temporarily with the firm and stated intention of returning) or by withdrawing from the Program (leaving Carnegie Mellon University with no intention of returning). If the student withdraws or take a leave of absence from Carnegie Mellon University, the student may be eligible for a tuition adjustment or a refund of certain fees (excluding any Application Fee, Registration Fee and Enrollment Deposit, and any applicable Student Tuition Recovery Fund assessment).

To cancel the student's Enrollment Agreement and take a leave of absence or withdraw, the student must complete Carnegie Mellon University's Leave of Absence or Withdrawal form, as applicable, and return it to Carnegie Mellon University's Registrar's Office, at 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213. The Leave of Absence and Withdrawal forms, and additional information of leaves of absence and withdrawal, can be found on Carnegie Mellon

University's website, at https://www.cmu.edu/policies/student-and-student-life/student-leave.html

If the student notifies Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is the earliest of:

- The date the student began the student's withdrawal or leave of absence process at Carnegie Mellon University;
- The date the student notified the student's home department at Carnegie Mellon University;
- The date the student notified the associate dean of the student's College at Carnegie Mellon University; or
- The date the student notified the Carnegie Mellon University Dean of Student Affairs.

If the student does not notify Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is:

- The midpoint of the relevant semester in which the student withdraws or takes a leave of absence;
- The last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day the student turned in a class assignment.

20.24 REFUND POLICY

A. **Refunds in General.** Students who withdraw from the Program or take a leave of absence after having paid the current semester's tuition and fees or receiving financial aid are subject to the following refund and repayment policies. No other charges are refundable. Student Tuition Recovery Fund assessment, if any, is non-refundable.

B. **Exit Counseling.** All borrowers of Federal student loans must complete a Federally-mandated exit counseling session when graduating or dropping to less than half-time enrollment status, including by withdrawing or taking a leave of absence. Exit counseling prepares students for repayment. Students must complete an exit counseling session in its entirety, with complete and correct information; otherwise, the student's degree, diploma and official transcripts may be withheld. Information about exit counseling sessions can be found on Carnegie Mellon University's website, at https://www.cmu.edu/sfs/financial-aid/exit-counseling.html

C. **Withdrawals/Leaves On or Before 10th Class Day.** Students who withdraw or take a leave of absence on or before the 10th class day of the relevant semester may receive a refund of 100% of tuition and fees (excluding any Application Fee or Registration Fee and Enrollment Deposit). STRF assessment, in any, is non-refundable.

D. **Withdrawals/Leaves after 10th Class Day.** Students who withdraw or take a leave of absence after the 10th class day of the relevant semester but before completing 60% of the semester will be assessed tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. There is no tuition adjustment after 60% of the semester is completed. There is no refund of fees after the 10th class day of the relevant semester.

E. **Tuition Adjustment Appeals**. Students may appeal to have tuition adjustments for their leave of absence or withdrawal if they feel that they have extenuating circumstances. These appeals will be reviewed in the context of Carnegie Mellon University's tuition adjustment policy, as stated above. These appeals must be made in writing to Carnegie Mellon University's Registrar using Carnegie Mellon University's Tuition Appeal Adjustment form. Information about Carnegie Mellon University's tuition adjustment policy, and tuition adjustment appeals, can be found on Carnegie Mellon University's website, at https://www.cmu.edu/sfs/tuition/adjustment/

F. **Repayment to Lenders/Third Parties.** If any portion of refundable tuition and/or fees was paid from the proceeds of a loan or third party, the refund may be sent to the lender, third party or, if appropriate, to the Federal or state agency that guaranteed or reinsured the loan, as required by law and/or Carnegie Mellon University policy. Any amount of the refund in excess of the unpaid balance of the loan shall be first used to repay any student financial aid programs from which the student received benefits, in proportion to the amount of the benefits received, and any remaining amount shall be paid to the student.

G. **Responsibility for Loan.** If the student obtains a loan to pay for an educational program, the student will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If the student has received Federal student financial aid funds, the student is entitled to a refund of moneys not paid from Federal student financial aid program funds. If the student is eligible for a loan guaranteed by the Federal or state government and the student defaults on the loan, both of the following may occur: 1) The Federal or state government or a loan guarantee agency may take action against the student, including applying any income tax refund to which the person is entitled to reduce the balance owed on the loan. 2) The student may not be eligible for any other Federal student financial aid at another institution or other government assistance until the loan is repaid.

20.25 WARNING & PROBATION POLICIES

If you receive a warning, it is because the faculty is concerned about your progress at the College and your ability to successfully complete the program. You can expect to receive a warning if your cumulative GPA falls below 3.1 or if your semester GPA falls below 3.0.

If you are placed on probation, it is an indication that the faculty feels you are performing below the level needed to successfully complete the program. If you are on probation, it has implications for future academic action, and your eligibility for financial aid may be affected. The Program Committee considers recommending probation to the faculty if your cumulative GPA falls below 3.0.

If you are placed on probation, you must achieve at least a 3.0 GPA in the semester you are on probation; otherwise, the Program Committee will generally recommend to the faculty that you be suspended or dropped from the program. In addition, you must demonstrate the ability to raise your cumulative GPA to 3.0 within the normal timeframe of graduation. Again, if this seems impossible, the Program Committee will generally recommend to the faculty that you be suspended or dismissed from the program.

20.26 SUSPENSION OR DROP POLICIES

In general, you will be dropped from your program only if you have been on probation during the previous semester. However, under extraordinary circumstances as determined by the faculty, you may be suspended or dropped without previously having been placed on probation. The Program Committee will recommend that you be dropped if, at the end of the semester of probation, your semester GPA falls below 3.0, or if your cumulative GPA is such that it is unlikely that you will be able to complete the program in the normal period of time. The Program Committee may recommend that you be suspended from the program for up to one year if your performance in the program is unsatisfactory, even if you have not previously been placed on probation. Suspension is, in effect, a temporary drop. If you are suspended, you cannot register for or take classes at the College for a specified period of time, usually a year. The faculty views a suspension as a time to make up deficiencies, to develop a mature approach to the program, or to give more thought to future career goals. If you are suspended, you may enroll in your Program again after the specified period and the faculty will indicate the conditions of your re-enrollment in your original suspension letter.

The decision of the faculty to suspend or drop a student is final. If you wish to appeal expulsion from the College, you can speak to the Dean; however, the Dean will only determine whether the Program Committee and the faculty followed due process and considered all relevant information over a sufficient time period.

20.27 LEAVE OF ABSENCE POLICY

Occasionally, a student will have pressing personal circumstances that require him or her to take a leave of absence from the program. In such cases, the student should complete a Leave of Absence form to be approved by the Program Director and Associate Dean. Typically, a leave of absence is for an academic year.

20.28 FILING A GRIEVANCE

The university's policies and procedures for filing a grievance are outlines at http://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

20.29 TRANSFERABILITY OF CREDITS AND CREDENTIALS EARNED

The transferability of credits you earn at Carnegie Mellon University is at the complete discretion of an institution to which you may seek to transfer. Acceptance of the Master degree you earn in Entertainment Industry Management is also at the complete discretion of the institution to which you may seek to transfer. If the Master degree that you earn at this institution are not accepted at the institution to which you seek to transfer, you may be required to repeat some or all of your coursework at that institution. For this reason, you should make certain that your attendance at this institution will meet your educational goals. This may include contacting an institution to which you may seek to transfer after attending Carnegie

Mellon University to determine if your Master of Entertainment Industry Management coursework will be accepted.

This includes but is not limited to conference and research funding; work study jobs in LA, lunch check-ins with administration and leadership including the college deans, and remote participation with student decision making when appropriate. In addition, two students are selected each year to be student representatives who assist in communication between MEIM leadership and the student body. Various networking and social events are planned at the MEIM-LA Center throughout the academic year. These events include Welcome Week LA, Industry Nights, networking events, and end of the semester events.

20.30 STUDENT SERVICES

Though students reside in CA for the second year of the program, they still have access to student services that occur on the main campus. https://www.cmu.edu/student-affairs/ Annie Julian is the Heinz College Associate Director of Student Affairs. Her office is HBH A101G and her email is ajulian@cmu.edu. Listed below are key offices of graduate student support.

20.31 OFFICE OF THE ASSISTANT VICE PROVOST FOR GRADUATE EDUCATION

The Office of the Assistant Vice Provost for Graduate Education, AVPGE, directed by Suzie Laurich-McIntyre, Ph.D., Assistant Vice Provost for Graduate Education, provides central support for graduate students in a number of roles. These include: being an ombudsperson and resource person for graduate students as an informal advisor; resolving formal and informal graduate student appeals; informing and assisting in forming policy and procedures relevant to graduate students; and working with departments on issues related to graduate students and implementation of programs in support of graduate student development.

The Office of the AVPGE often partners with the division of Student Affairs to assist graduate students with their Carnegie Mellon experience. Senior members of the student affairs staff are assigned to each college (college liaisons) and are often consulted by the Assistant Vice Provost for Graduate Education and departments on an individual basis to respond to graduate student needs.

The Office of the Assistant Vice Provost for Graduate Education (AVPGE) offers a robust schedule of professional development opportunities. Some are geared towards a specific population (master's students, PhD students at the beginning of their program, graduate students seeking tenure track positions, etc.) and others are open to all graduate students (time management, balancing, staying healthy). A full schedule of programs can be found at: www.cmu.edu/graduate

The Office of the AVPGE also coordinates several funding programs, and academically focused seminars and workshops that advise, empower and help retain all graduate students, particularly graduate students of color and women in the science and technical fields. The fundamental goals of our programs have been constant: first, to support, advise and guide

individual graduate students as they work to complete their degrees; second, to contribute to the greatest degree possible to the diversification of the academy. Visit the Graduate Education website for information about:

- Conference Funding Grants
- Graduate Small Project Help (GuSH) Research Funding
- Graduate Student Professional Development: seminars, workshops and resources
- Graduate Women Gatherings (GWG)
- Inter-university Graduate Students of Color Series (SOC)

20.32 OFFICE OF THE DEAN OF STUDENT AFFAIRS
www.cmu.edu/student-affairs/index.html

The Office of the Dean provides central leadership of the metacurricular experience at Carnegie Mellon. The offices that fall under the division of Student Affairs led by Dean of Student Affairs Gina Casalegno, include:

Career and Professional Development Center

- Counseling & Psychological Services (CAPS)
- Housing & Dining Services
- Orientation & First Year Programs (note: for undergraduate students)
- Office of International Education (OIE)
- Student Activities
- Student Life

Graduate students will find the enrollment information for Domestic Partner Registration and Maternity Accommodations in the Office of the Dean of Student Affairs and on the website. The Office of the Dean of Student Affairs also manages the Emergency Student Loan (ESLs) process. The Emergency Student Loan service is made available through the generous gifts of alumni and friends of the university. The Emergency Student Loan is an interest-free, emergency-based loan repayable within 30 days. Loans are available to enrolled students for academic supplies, medication, food or other expenses not able to be met due to unforeseeable circumstances. The Office of the Dean of Student Affairs also provides consultation, support, resources and follow-up on questions and issues of Academic Integrity: https://www.cmu.edu/student-affairs/ocsi/

20.33 CLINICAL SERVICES FOR OUT OF STATE STUDENTS OR STUDENTS LIVING INTERNATIONALLY

Counseling & Psychological Services (CaPS) is committed to work with any CMU student regardless of where they currently reside, whether that is guiding the student to find a provider in their area or helping them find the best possible solution given their individual situation. CaPS works on a case by case basis, considering the student's specific needs and current constraints. Due to licensure laws and limitations across different states, clinicians at CaPS can provide ongoing distance counseling only to students who are located within Pennsylvania. CaPS

is aware that some states are beginning to change laws to allow out-of-state providers to provide teletherapy within their states. The leadership of the American Psychological Association (APA) and the American College Health Association (ACHA), as well as other relevant organizations, are advocating for reform across the country on this matter. CaPS is monitoring this situation closely to adapt services to these changes when they come.

If you reside outside of PA, CaPS provides Zoom video consultations with the purpose of assessing student's current needs, learning the student's location, identifying resources around the student, and providing guidance as the stuent secures these resources.
If the student resides internationally, CaPS may also provide Zoom video consultation with the purpose of assessing current needs and providing guidance about next steps.
Mailing List: CaPS also has an events mailing list that students can sign-up for:
https://lists.andrew.cmu.edu/mailman/listinfo/caps-events
Call to get started: 412-268-2922.
https://www.cmu.edu/counseling/virtual-offerings/index.html#students
For information for students on Skills Workshops, Drop-in Groups and Clinics click here.
For information on Outreach programming click here.
For more Community Health & Well-Being and Student Affairs virtual events and opportunities, visit the CMU Student Affairs calendar.

20.34 LOS ANGELES STUDENT SERVICES

The Los Angeles location does its best to stay connected with the main campus. Throughout the academic year there are video conferences with first-year students, the deans and senior administration on the main campus, and participate in decision-making about policies that affect the students.

Aside from the student services support and resources on the main campus, students also have support at the LA campus. Students enrolled in the MEIM program who reside in the Los Angeles office in year two can meet with program director, Daniel T. Green, Ph.D. for on-site connection to various student services resources. These resources include questions regarding housing, transportation, health, personal concerns, entertainment industry organizations, clubs and student organizations, activities and general information. Dan Green's office is located in the MEIM-LA Center, 4840 Lankershim Blvd. Ste. 125, North Hollywood, CA 91602 and can be reached at 818-980-6346.

The MEIM-LA location hosts various networking and social events throughout the second year of the program. These events include a week-long orientation to Los Angeles and the entertainment industry called Welcome Week LA. MEIM leadership also plans Industry Nights where students travel to entertainment companies to meet and network with executives. Networking events, and end of the semester events are also planned throughout the year.

20.35 GRADUATE STUDENT ASSEMBLY
www.cmu.edu/stugov/gsa/index.html

The Carnegie Mellon Student Government consists of an Executive Branch and a Legislative Branch. This is the core of traditional student government, as governed by the Student Body Constitution. The Executive Branch serves the entire student body, graduate and undergraduate, and consists of one president and four vice-presidents. The Legislative Branch for graduate students, The Graduate Student Assembly (GSA) passes legislation, allocates student activities funding, advocates for legislative action in locally and in Washington D.C. on behalf of graduate student issues and needs, and otherwise acts on behalf of all graduate student interests. GSA also contributes a significant amount of funding for conferences and research, available to graduate students through application processes. GSA also plans various social opportunities for graduate students and maintains a website of graduate student resources on and off-campus, https://www.cmu.edu/stugov/gsa/Resources-for-Graduate-Students/index.html Each department has representation on GSA and receives funding directly from GSA's use of the student activities fee for departmental activities for graduate students. The department rep(s) is the main avenue of graduate student representation of and information back to the graduate students in the department.

20.36 INTERCULTURAL COMMUNICATION CENTER (CCC)
www.cmu.edu/icc/

The Intercultural Communication Center (ICC) is a support service offering both credit and non-credit classes, workshops, and individual appointments designed to equip nonnative English speakers (international students as well as international students who attended high school in the U.S.) with the skills needed to succeed in academic programs at Carnegie Mellon. In addition to developing academic literacy skills such as speaking, reading and writing, students can learn more about the culture and customs of the U.S. classroom. The ICC also helps international teaching assistants (ITAs) who are non-native English speakers develop fluency and cultural understanding to teach successfully at Carnegie Mellon and provides ITA testing, required testing indicating a nonnative speaking student has a language proficiency required before being allowed to work with undergraduates in classes, labs or individual meetings.

20.37 OFFICE OF INTERNATIONAL EDUCATION (OIE)
www.studentaffairs.cmu.edu/oie/

Carnegie Mellon hosts international graduate and undergraduate students who come from more than 90 countries. Office of International Education (OIE) is the liaison to the University for all non-immigrant students and scholars. OIE provides many services including: advising on personal, immigration, academic, social and acculturation issues; presenting programs of interest such as international career workshops, tax workshops, and cross-cultural and immigration workshops; supporting international and cultural student groups such as the International Student Union and the International Spouses and Partners Organization; maintaining a resource library that includes information on cultural adjustment, international education and statistics on international students in the United States; posting pertinent

information to students through email and the OIE website, and conducting orientation programs.

20.38 JOB CLASSIFICATION

A MEIM degree can lead to a diverse set of occupations in the entertainment field. Itemized below, is a representative list of the employment positions determined to be within the field of study for a person obtaining a MEIM degree using the United States Department of Labor's Standard Occupational Classification codes (CEC 94910(f)(2)).

Employer Type	**Function**
Agency	Acquisitions
Digital	Advertising
Film	Business/Strategic Development
Gaming (Video)	Development
Music	Distribution and/or Licensing
Sports	Event Management
Streaming	Exhibition
Technology	Finance/Operations
Television	Legal/Business Affairs
	Licensing
	Live Events (Concert/Tour/Festival)
	Marketing/PR
	Producing
	Production Management
	Programming/Scheduling (B'cast/Cable/OTT)
	Research/Analysis
	Talent Representation/Management
	Technology Management (IT/CG/Cloud/Platform)
	Writing
	Virtual Reality/Augmented Reality

Integrated Innovation Institute Pittsburgh/Silicon Valley School Catalog 2021-22 Academic Year

August 30, 2021 – June 30, 2022

Carnegie Mellon University
Integrated Innovation Institute
4612 Forbes Avenue
Pittsburgh, PA 15213
1-844-629-0200
https://www.cmu.edu/iii/degrees/

Branch Campus: Carnegie Mellon University - Silicon Valley
NASA Research Park
Carnegie Mellon University Silicon Valley
P.O. Box 98
Moffett Field, CA 94035
Phone: (650) 335-2886; Fax (650) 603-7032
www.cmu.edu/silicon-valley/

Carnegie Mellon University is a private, non-profit institution, approved to operate in California by the California Bureau for Private Postsecondary Education. Approval to operate means compliance with state standards as set forth in the California Private Postsecondary Education Act of 2009**.** Carnegie Mellon University is accredited through a voluntary, peer-review process coordinated by the Middle States Commission on Higher Education (MSCHE or Middle States). MSCHE is one of six regional accrediting agencies in the United States, each accrediting institutions of higher education within a specific geographic region. Middle States is recognized by the U.S. Department of Education. This recognition

enables MSCHE's member institutions to establish eligibility to participate in federal financial aid programs (e.g., federal loans, grants, and work-study) administered by the U.S. Department of Education. Carnegie Mellon University has been accredited by Middle States since 1921. More information regarding accreditation standards and processes and to view the University's re-accreditation reports on the Middle States Accreditation website at: http://www.cmu.edu/middlestates/.

Approval to operate means compliance with state standards as set forth in the California Private Postsecondary Education Act of 2009**.**

Any questions a student may have regarding this catalog that have not been satisfactorily answered by the institution may be directed to the Bureau for Private Postsecondary Education at 1747 North Market Blvd, Suite 224, Sacramento, CA 95834, www.bppe.ca.gov, toll-free telephone number (888) 370-7589 or by fax (916) 263-1894.

As a prospective student, you are encouraged to review this catalog prior to signing an enrollment agreement. You are also encouraged to review the School Performance Fact Sheet, which must be provided to you prior to signing an enrollment agreement.

A student or any member of the public may file a complaint about this institution with the Bureau for Private Postsecondary Education by calling (888) 370-7589 toll-free or by completing a complaint form, which can be obtained on the bureau's internet website, at www.bppe.ca.gov

Carnegie Mellon University – Mission Statement
To create a transformative educational experience for students focused on deep disciplinary knowledge; problem-solving; leadership, communication and interpersonal skills; and personal health and well-being.

To cultivate a transformative university community committed to (a) attracting and retaining diverse, world-class talent; (b) creating a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish; and (c) ensuring individuals can achieve their full potential.

To impact society in a transformative way - regionally, nationally and globally - by engaging with partners outside the traditional borders of the university campus.

Integrated Innovation Institute – Educational Program Objectives

Master of Science in Software Management

- Identify and develop opportunities for software product innovation in support of the needs of individuals, organizations, and society.
- Formulate and execute a software project management strategy to deliver high-quality products and services.
- Collaborate in a multidisciplinary team environment in the context of a software-intensive project.
- Communicate effectively with a variety of stakeholders through written, spoken and visual communication methods.

Master of Science in Technology Ventures

- Envision, plan, develop and implement a new technology-based venture in both a startup and established enterprise environment.
- Execute processes with applied coursework to deliver technical venture opportunities.
- Understand innovation within emerging set of new ventures that are focused on grand challenge problems.
- Practical experience within an entrepreneurial venture.

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The Integrated Innovation Institute will no longer be admitting and enrolling new students to the Master of Science in Technology Ventures (MSTV) program in Silicon Valley after Spring semester 2022. Students already admitted and enrolled in the MSTV program during or before Spring semester 2022 will remain eligible to complete their degree requirements at the Silicon Valley campus through Spring semester 2023.

CLASS LOCATION

Classes offered for the Master of Science in Software Management (MS-SM) program and Master of Science in Technology Venture (MS-TV) in California are held at:

Branch Campus:
Carnegie Mellon University - Silicon Valley
NASA Research Park, Building 23
Moffett Field, CA 94035
Phone: (650) 335-2886; Fax (650) 603-7032
www.cmu.edu/silicon-valley/

CMU-SILICON VALLEY FACITILIES

The Silicon Valley campus is located in the historic Shenandoah Plaza on the NASA Ames Research Park. We occupy Building 23: a 20,111 sq. ft. two-story historic building and is our administrative and teaching building. It houses our academic space: 5 classrooms, 31 faculty and staff offices, 6 conference rooms, 2 kitchen/break rooms, 1 cafe lounge, and 1 multi-function lounge & event space.

Student Lounges: There are several spaces for students in Silicon Valley to use. The main student lounges can be found in B23, downstairs Room 129 and upstairs Room 227.

Printers: Printers are for use in Building 23 (B23) Room 123 and the hallway in B23 outside of 109/110. Instructions for adding printers and policies are posted next to each printer.

Library Resources

Library and Resources CMU-SV does not operate a library on campus, but we do have specialized library resources available for students, faculty, and staff. Resources include:

1. Interlibrary Loan
2. e-book developments
3. University Libraries Quick Links

Through the Interlibrary loan, students can request books, articles from journals and conferences, technical reports, or other materials to be sent to you. The materials may be from Carnegie Mellon libraries in the U.S. or other institutions worldwide. Electronic delivery for many articles is available. ILLiad is the system that our students use to request these items. What ILLiad can be used for:

- To request to borrow a book, a tech report, a thesis, copy of an article, etc.
- Check status of requests
- Edit requests
- Cancel requests
- Update your contact information or delivery preferences
- Request to renew an interlibrary loan

The ILLiad link can be found at https://illiad.library.cmu.edu/illiad/illiad.dll.

The first time you use the link you need to provide information about yourself. You only need to do this once. When completing the form, choose these options:

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- For **Mailing Address**, state: **Silicon Valley campus**
- For **Delivery Location**, state: **E&S Library**

Ebook developments can be found on our website at http://guides.library.cmu.edu/svc.

See below for an example of ebook developments:
We're building quite a collection of digital resources of interest to the Silicon Valley Campus. An eye-opening list is below:

- AccessEngineering

  This is a "reference tool for professionals, academics, and students that provides seamless access to the world's best-known, most-used collection of authoritative, regularly updated engineering reference information. *AccessEngineering* also comprises dynamic online features, such as instructional, faculty made videos, calculators, interactive tables and charts, as well as personalization tools allowing users to organize crucial project information as they work." *AccessEngineering* includes the well-known Schaum's Outline series of books.

- Knovel

  A digital collection of science and engineering reference books. Carnegie Mellon Users Only (including Silicon Valley Campus). Our access to their new collection on Computer Hardware Engineering is now available! You'll also find the books listed in CAMEO - our online catalog.

- Synthesis Digital Library of Engineering and Computer Science

  "The basic component of the library is a 50- to 100-page 'Lecture'; a self-contained electronic book that synthesizes an important research or development topic, authored by an expert contributor to the field." You'll also find the books listed in CAMEO - our online catalog.

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- Springer e-Books Collection for Computer Science
Thousands of computer science e-books from the publisher

- Springer e-Book Collection for Engineering
Thousands of engineering e-books from the publisher

- Springer e-Book Collection for Mathematics & Statistics
Thousands of mathematics e-books from the publisher

- Plus - General e-Book Collecting from Many Different Publishers
Since we have students, staff, and faculty in Pittsburgh, Qatar, Africa, and Silicon Valley, we're making a concerted effort to collect whatever e-Books we can so that all of our community can use them. You'll find them in CAMEO - our online catalog!

University Quick Links can also be found on the website at http://guides.library.cmu.edu/svc.

Here are examples of some quick links below:

- Articles & Databases
Alphabetical and subject listings of our available databases.

- Cybersecurity

- e-Journals A to Z List
Our automated (partially) method of finding e-Journals that we have access to - even if buried in a full-text database.

- ECE Library Guide
Library research guide for Electrical & Computer Engineering.

- Off-Campus / Wireless Access
EZ Proxy single sign on added as an option

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- University Libraries Home Page

  Our home page has links to the simple and advanced search functions for CAMEO - our online catalog.

For additional questions regarding library resources, please contact Matt Marsteller, Associate Dean for Faculty/Principal Librarian at matthewm@andrew.cmu.edu or by phone: 412-268-7212

OFFICIAL ACADEMIC CALENDAR

The official academic calendar for Carnegie Mellon University can be viewed here: https://www.cmu.edu/hub/calendar/index.html

PROGRAMS OFFERED

The Integrated Innovation Institute offers two degrees in connection with the Carnegie Mellon University - Silicon Valley campus.

Master of Science in Software Management: teaches students how to create innovative software products and services, manage the resources to create them, and gain the business expertise that is required for a successful software enterprise. The curriculum is currently offered through two full-time tracks (12 months or 16 months) and a part-time option. This degree is offered completely from the Carnegie Mellon University - Silicon Valley campus.

Master of Science in Technology Ventures: focuses on entrepreneurial students looking to leverage deep knowledge of emerging technologies into successful business ventures. This 16-month degree connects skills in emerging technology and innovation, with business acumen needed to take an idea into a successful venture. This degree is offered between the Carnegie Mellon University Pittsburgh and Silicon Valley campuses.

The Integrated Innovation Institute will no longer be admitting and enrolling new students to the Master of Science in Technology Ventures (MSTV) program in Silicon Valley after Spring semester 2022. Students already admitted and enrolled in the MSTV program during or before Spring semester 2022 will remain eligible to complete their degree requirements at the Silicon Valley campus through Spring semester 2023.

For detailed outline of the requirements for completion for each program offered at the Integrated Innovation Institute, including a description of the instruction provided in each of the courses, the requirements for completion of each program, including required courses, any final tests or examinations, any required internships or externships, and the total number of credit hours, clock hours, or other increments required for completion can be found online at:

Master of Science in Software Management

- Overview – Full & Part Time Programs: https://www.cmu.edu/iii/degrees/mssm/index.html
- Curriculum: https://www.cmu.edu/iii/degrees/mssm/curriculum.html
- Example Job Classifications for Graduates: https://www.cmu.edu/iii/degrees/admissions/bppe/mssm_jobclassification.pdf

MSSM 16 Months, MSSM 12 Months, & MSSM Part-Time

Full-Time Status

Full-time degree requirements for the MSSM 16- and 12-month curriculum are outlined below. Full-time students must attend courses and complete the degree on campus. Some courses may be offered during evening hours. Degree unit requirements are outlined below. All students are required to maintain full-time status at 48 units per

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semester as set by the degree requirements. If a student is permitted to overload courses one semester for individual academic progress, the 48-unit requirement still applies in subsequent semesters.

Part-Time Status

Students registered below 36 units are considered part-time. Students can complete the program part-time in two years (six academic semesters, including summer terms). Part-time students take one 12-unit course at a time, in the evenings. If schedule permits, day-time courses could be considered by academic advisor recommendation.

Curriculum of Study for MSSM Full-Time 12-Month Degree

Fall Term

Required Course Units: 48 units
49-752 - Product Definition & Validation – 12 units
49-760 - Foundations of Software Management – 12 units
49-786 - Software Engineering Management – 12 units
Restricted Elective (placement at New Student Orientation) – 12 units

Recommended/Optional Professional Development Course(s):
These courses may be taken in addition to the maximum 48 units.
49-794 – Strategies for your Software Industry Career – 3 units

Spring Term

Required Course Units: 48 units
Maximum Course Units: 60 units

49-762 - Software Product Strategy – 12 units
49-763 - The Business of Software – 12 units

49-771 - Process and Project Management – 12 units
Elective Requirement – 12 units of approved electives

Summer Term

Required Course Units: 48 units
Maximum Course Units: 60 units

Electives Courses:
48 units of approved electives

Curriculum of Study for MSSM Full-Time 16-Month Degree

Fall Term #1

Required Course Units: 48 units
49-752 - Product Definition & Validation – 12 units
49-760 - Foundations of Software Management – 12 units
49-786 - Software Engineering Management – 12 units
Restricted Elective (placement at New Student Orientation) – 12 units

Recommended/Optional Professional Development Course(s):
These courses may be taken in addition to the maximum 48 units.
49-794 – Strategies for your Software Industry Career – 3 units

Spring Term

Required Course Units: 48 units
Maximum Course Units: 60 units

49-762 - Software Product Strategy – 12 units
49-763 - The Business of Software – 12 units
49-771 - Process and Project Management – 12 units

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Elective Requirement – 12 units of approved electives

Summer Term

Required Course Units: 3 units
49-793 - Practical Training in Software Management – 3 units

Students completing an internship may also take 12 units of coursework during summer term. Students are responsible for the additional tuition costs during summer term. Additionally, students must maintain full-time student status during subsequent semesters.

Fall Term #2

Required Course Units: 48 units
Maximum Course Units: 60 units

Required Courses - One of the Following:
49-792 - Software Management Practicum – 12 units
49-807 - Integrated Innovation for Large Scale Problems – 12 units

Elective Courses:
36 units of approved electives

Curriculum of Study for MSSM Part-Time Degree

Fall Term #1

Required Course Units: 24 units
49-761 - Elements of Software Management – 12 units
49-770 - Metrics for Software Managers – 12 units

Spring Term #1

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Required Course Units: 24 units
49-771 - Process and Project Management – 12 units
Elective Requirement – 12 units of approved electives

Summer Term #1

Required Course Units: 24 units
24 units of approved electives

Fall Term #2

Required Course Units: 24 units
49-750 - Software Product Definition – 12 units
49-751 - Requirements Analysis – 12 units

Spring Term #2

Required Course Units: 24 units
49-762 - Software Product Strategy – 12 units
49-763 - The Business of Software – 12 units

Summer Term #2

Required Course Units: 24 units
24 units of approved electives

Required Degree Units

Students must complete a minimum of 144 units and successfully complete all required courses to be eligible for graduation. The average grade of 144 units applied to the degree shall be at least a B (3.0 QPA).

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Individual course grades below a C (2.0 QPA) are considered unsatisfactory for the degree requirement.

Master of Science in Technology Ventures

- Overview: https://www.cmu.edu/iii/degrees/mstv/index.html
- Curriculum: https://www.cmu.edu/iii/degrees/mstv/curriculum.html
- Example Job Classifications for Graduates: https://www.cmu.edu/iii/degrees/admissions/bppe/mstv_jobclassification.pdf

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MSTV & MSTV Dual Degree

Full-Time Status

Full-time degree requirements for the MSTV and MSTV Dual Degree curriculums are outlined below. Full-time students must attend courses and complete the degree as defined per campus location. All students are required to maintain full-time student status as defined by the University (36 units) throughout their enrollment. Total unit minimums/maximums per semester are outlined below.

Part-time Status

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At this time, all students connected to the MSTV degree(s) must be registered at full-time student status.

Curriculum of Study for MSTV Degree

Spring Term #1 – Pittsburgh

Required Course Units: 48 units
49-850 - Grand Challenge Innovation – 12 units
Applied Technology/Engineering courses – 36 units

Summer Term – Silicon Valley

Required Course Units: 3 units
49-859 - Master of Science in Technology Ventures - Internship/Practicum – 3 units

Fall Term – Silicon Valley

Required Course Units: 36 units
Minimum Term Units: 48 units
Maximum Term Units: 48 units

Required Courses:
49-802 - Innovation & Entrepreneurship –12 units
49-853 - Product Management – 6 units
49-854 - Business Models and Strategy – 6 units
49-855 - Venture Governance – 6 units
49-856 - Legal Issues in New Venture Creation – 6 units
Elective Course - 12 units of approved electives

Spring Term # 2 – Silicon Valley

Required Course Units: 36 units
Minimum Term Units: 48 units
Maximum Term Units: 60 units (with approval)

Required Courses:
49-804 – The Leadership Challenge – 6 units
49-851 – Financial Fundamentals for New Ventures – 6 units
49-852 – Agile Marketing for New Ventures – 6 units
49-857 – Dynamic Global Teams – 6 units
Elective Course – 24 units of approved electives

Curriculum of Study for MSTV Dual Degree

The MSTV degree can be completed in connection with master's degrees offered in six departments in the College of Engineering. These departments include: Biomedical Engineering (BME), Chemical Engineering (ChemE), Civil & Environmental Engineering (CEE), Electrical & Computer Engineering (ECE), Mechanical Engineering (MechE), and Materials Science & Engineering (MSE). Students admitted to the dual degree program with MSTV will follow the semester sequence outlined below.

Fall Term #1 – Pittsburgh, Home Engineering Department

Degree requirements for MS in Engineering degrees are outlined per department. Please consult home department handbook(s).

Spring Term #1 – Pittsburgh, Home Engineering Department

Required Courses Units: 48 units
49-850 - Grand Challenge Innovation – 12 units
Applied Technology/Engineering courses – 36 units

These 48 course units will double-count toward the MS in Engineering and MSTV degree requirements. There is also a 48-unit maximum that cannot be exceeded for double-counting course units. Additionally, no undergraduate courses are permitted as elective or double-counting units for degree requirements.

At the end of the spring term, students should complete all MS degree requirements within their home engineering department.

Summer Term – Silicon Valley

Required Course Units: 3 units
49-859 - Master of Science in Technology Ventures - Internship/Practicum – 3 units

Fall Term #2 – Silicon Valley

Required Course Units: 36 units
Minimum Term Units: 48 units
Maximum Term Units: 48 units

Required Courses:
49-802 - Innovation & Entrepreneurship –12 units
49-853 - Product Management – 6 units
49-854 - Business Models and Strategy – 6 units
49-855 - Venture Governance – 6 units
49-856 - Legal Issues in New Venture Creation – 6 units
Elective Course - 12 units of approved electives

Spring Term #2 – Silicon Valley

Required Course Units: 36 units
Minimum Term Units: 48 units
Maximum Term Units: 60 units (with approval)

Required Courses:
49-804 – The Leadership Challenge – 6 units
49-851 – Financial Fundamentals for New Ventures – 6 units
49-852 – Agile Marketing for New Ventures – 6 units
49-857 – Dynamic Global Teams – 6 units
Elective Course – 24 units of approved electives

Dual Degree Curriculum of Study for MSTV & University of Strathclyde

The MSTV degree can be completed in connection with master's degrees offered in three different departments at University of Strathclyde. These departments include: Design Engineering, Digital Manufacturing, & Systems Engineering Management. Students admitted to the dual degree program with MSTV will follow the semester sequence outlined below.

Fall Term #1 – Silicon Valley

Required Course Units: 36 units
Minimum Term Units: 48 units
Maximum Term Units: 48 units

Required Courses:
49-802 - Innovation & Entrepreneurship –12 units
49-853 - Product Management – 6 units
49-854 - Business Models and Strategy – 6 units
49-855 - Venture Governance – 6 units
49-856 - Legal Issues in New Venture Creation – 6 units
Elective Course - 12 units of approved electives

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Spring Term #1 – Silicon Valley

Required Course Units: 36 units
Minimum Term Units: 48 units
Maximum Term Units: 60 units (with approval)

Required Courses:
49-804 – The Leadership Challenge – 6 units
49-850 - Grand Challenge Innovation – 12 units
49-851 – Financial Fundamentals for New Ventures – 6 units
49-852 – Agile Marketing for New Ventures – 6 units
49-857 – Dynamic Global Teams – 6 units
Elective Course – 12 units of approved electives

Summer Term #1 – Silicon Valley

Required Course Units: 3 units
49-859 - Master of Science in Technology Ventures - Internship/Practicum – 3 units

Fall Term #2 – University of Strathclyde

Required Course work at University of Strathclyde

Spring Term #2 – University of Strathclyde

Required Course work at University of Strathclyde

Summer Term #2 – University of Strathclyde

Required Course work at University of Strathclyde

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Required Degree Units

Students must complete a minimum of 147 units and successfully complete all required courses to be eligible for graduation.

For dual-degree students, 48 units are double-counted between the MS in Engineering and MSTV degree requirements, and 99 units are unique to the MSTV degree. The average grade of 147 units applied to the MSTV degree shall be at least a B average (3.0 QPA).

For dual-degree students with the University of Strathclyde, 48 units transfer back to the MSTV degree. The average grade of 147 units applied to the MSTV degree shall be at least a B average (3.0 QPA).

Individual course grades below a C (2.0 QPA) are considered unsatisfactory for the degree requirement. Degree(s) will be certificated upon completion of the MSTV degree requirements.

Integrated Innovation Institute - Course Descriptions

49-750, Software Product Definition – 12 units
Students develop and refine a compelling and realistic vision for a new product. They learn to understand user and customer needs, to document those needs, and to envision creative solutions.

After completing this course, students will be able to:

- Use contextual inquiry and work modeling techniques, including interviewing, to understand problems faced by individuals and organizations
- Define and apply personas, goals, and scenarios to envision a high quality user experience in a new system

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- Define the 'whole product' required to provide a complete solution, systematically, from a customer's point of view
- Define a business vision that explains how product development will contribute to achieving the goals of the customers and end user

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-751, Requirements Analysis – 12 units
Project teams analyze, document, and plan the management of functional, technical, and business requirements for a software system and then create a product release strategy.

After completing this course, students will be able to:

- Derive key functional, data, technical, and business requirements from scenarios
- Analyze and document functional and nonfunctional requirements for a software system
- Identify risks inherent in potential solutions
- Estimate market size and to evaluate competitive products and services
- Formulate the features for a minimum viable product and a road map for subsequent release
- Present analyses and plans to a management audience

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-752, Product Definition and Validation - 12 units
Students learn techniques for envisioning creative solutions to real problems. They develop and refine a compelling and realistic vision for a new product. They practice techniques to understand and validate user and customer needs, and to identify market opportunities. They analyze, document, and plan the management of functional, technical, and business requirements for a software system and then develop a product release strategy.

49753 - User-Centered Research Methods for Product Innovation – 12 units

Building great products and services begins with having a deep knowledge of the problem you are solving and the people for whom you are designing. From controlled lab studies to field research, a/b testing to participatory design, learn a host of Human-Computer Interaction research methods and analysis techniques to get you the right insights and on the path to crafting innovative ideas.

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49-760, Foundations of Software Management - 12 units
Students apply fundamental methods, models, and frameworks to assess real software companies from a variety of perspectives - marketing, strategy, finance, operations - to understand how businesses organize and make decisions. Working individually and in groups, students develop skills for managing teams and employee performance. Students practice personal leadership.

After completing this course students will be able to:

- Use contextual inquiry to understand user 'pain' and establish product goals
- Use the Goal-Question-Metric technique to establish strategic measures
- Characterize a software business in terms of markets and products
- Read and understand basic financial statements
- Assess a company's strategy in light of competitors, market and macro factors
- Make a presentation to an executive audience

49-761, Elements of Software Management - 12 units
Through seminar discussions and individual investigation, students assess real software businesses from marketing, business strategy, financial, and overall business perspectives, applying fundamental methods, models, and frameworks.

After completing this course students will be able to:

- Characterize a software business in terms of markets and products
- Understand basic financial statements
- Assess a company's strategy in light of competitors, market and macro factors
- Make a presentation to an executive audience

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Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-762, Software Product Strategy – 12 units
Students analyze market opportunities for a software product, evaluate its technical feasibility, then expand the product definition and create a product roadmap. Prerequisites: Admission to the Silicon Valley Software Management program and Requirements Analysis (49751).

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-763, The Business of Software – 12 units
The Business of Software course is focused on the processes and the economics of bringing software products and services to market, with an emphasis on partnership and sales strategies. The previous course, Software Product Strategy (SPS), addressed the technical feasibility of implementing the product and the marketing strategy. BSW picks up where SPS leaves off, starting with teams creating a partnership plan and a sales strategy for their products. The final step involves the creation of budgets and revenue models for the proposed product as a way to determine the viability and business opportunity for the envisioned product. The course concludes with student presentations that recommend for or against continuing with product development.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-766, Agile Marketing for High Tech Innovation – 12 units
Agile Marketing for High-Tech Innovations will cover how to formulate marketing strategies that lead to successful products. It will include how marketing strategies are adapted for high tech innovations and products including addressing strategic market planning, functional expectations and tactical considerations when using marketing tools. Topics include: strategic market planning, market orientation, types of alliances needed for moving from innovation to product acceptance, understanding high-tech customers, product distribution options, technology/product management considerations for

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marketing effectively, pricing, marketing communications, breakthrough versus incremental innovation marketing and measuring marketing effectiveness.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-767, Organizational Behavior for High Tech Knowledge Industry – 12 units
Using innovative conceptual frameworks, students learn the fundamentals of organizational behavior as it relates to the unique challenges of high tech enterprises, concluding with a team project focused on a specific organizational problem for a selected company.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-768, Special Topics: Finance for Entrepreneurial Ventures – 12 units
The course seeks to blend finance and economics to help entrepreneurs to understand the relationship between venture finance and evaluation of business risk. It starts with a workshop on the accounting tools that are necessary for entrepreneurs to make a business case for their software start-ups. In the process students will acquire a range of business understanding and skills necessary to build a new company and plan for equity participation for founders, employees, and venture capitalists. The workshop on accounting fundamentals, is followed by some introductory finance, and then students work through the process of converting operating, human resource, capital, and marketing plans into a set of financial projections that enables a start-up to be valued and funded. Students will learn:

- How early stage startups reduce uncertainty about the viability of their ventures by experimentation, planning, and decide under what conditions scaling early may be beneficial;
- Understand the sources of finance for entrepreneurial activity and their role in maximizing gain while controlling personal risk;
- How to put together a financial plan and pitch for their Start-Up in a professional manner.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time sudents. Remote students still attend class synchronously.

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49-770, Metrics for Software Managers - 12 units
As members of a project team, students analyze and propose metrics initiatives for a fictional software organization with specific software management problems, aligning the initiatives with business and stakeholder goals.

After completing this course students will be able to:

- Define a metrics program at the software project level
- Define a metrics program for a product portfolio

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-771, Process and Project Management – 12 units
Students define the optimal software development method for a given project, by identifying a set of Agile, Lean and/or disciplined practices suited for the project's specific needs. They also develop project's estimates and multilevel plans based on their recommended method. Prerequisites: Foundations of Software Engineering (18652) or Metrics for Software Managers (49770) or consent of instructor.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-774, Product Management - 12 units
While Product Manager has been a key role in the high-tech industry for over 10 years, the Product Management training in this space was relatively limited. This course connects the knowledge and skills students learned from previous Software Management courses, and guides students to leverage this learning to position, design, develop, launch, measure, and grow products, particularly in the internet/software sectors. The course covers a product managers' role and the application of product ideation & positioning, feature design and documentation, product development process, go-to-market, measurement/optimization, and growth.

49-775, The First-Time Manager - 12 units

This course is intended for experienced software developers who have newly been given management responsibilities. The course addresses management styles, managing people (reviewing, mentoring, hiring, firing), managing teams (task assignments, collaboration, conflict resolution), managing schedules and deliverables, reporting to higher management, working with other groups in the organization, and communicating with clients and partners outside the organization.

49-780, Human Computer Interaction & User Experience - 12 units
This graduate level short course exposes Software Engineering and Management professionals to the field of Human Computer Interaction (HCI) and User Experience (UX). In the modern marketplace, the winners are those who enable real people to harness the power of technology innovations in delightful ways. Delighting customers through technology requires a strong foundation in HCI and a focus on UX. This course is primarily for those who come from a technical or business background but are interested in gaining relevant knowledge and basic skills in HCI/UX in an interactive, fast-paced, and engaging format.

The goals for the course are:

- To provide an overview across the breadth of HCI/UX disciplines to understand the relevant roles, responsibilities, processes, methodologies, concepts, tools, and deliverables expected of them.
- Through increased knowledge and understanding, establish empathy with HCI/UX practitioners in order to establish productive working relationships.
- To provide a theoretical & practical foundation for the HCI & UX practice within modern product development.
    - Understand the underlying history & theory through relevant readings, discussions, and presentations.
    - Gain practical experience through team-based project work, presentations, and critique.
    - Work together in cross-functional teams using a User-Centered Design (UCD) approach.
- To create a greater appreciation for the intellectual, emotional, and practical value of HCI & UX.

49-781, Introduction to Machine Learning – 12 units

The landscape of software products has changed over the last decade with the advent of data science as an interdisciplinary field, and its broad and deep applicability has created opportunities for delivering interesting and innovative capabilities based on deep understanding of data. This course helps current and future product managers understand the distinction between data-driven and conventional products and learn to identify new product capabilities made possible by quantitative data analysis and modeling. Regular hands-on exercises will expose them to techniques for analyzing data, developing insights, building models, and turning the outcomes from models into end-user value. The course project will require students to go through the life cycle of a data-product and showcase their insight as a product feature. (Previously Data Analytics). Some class sessions in this course will be offered using a Flipped Classroom model where lectures will be distributed as videos for viewing offline, and class sessions are dedicated to clarifications, content review, and course assignments.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-782, Open Source Software – 12 units
This elective is designed to yield student proficiency regarding contemporary thinking and fundamental skills regarding Open Source Software. Emphasis is on understanding the impact of open source software on the software industry, including licensing and commercialization issues, corporate software evaluation techniques, and business models. Students install and use open source software (Linux, OpenOffice, Firefox, etc.) and work in teams in a problem-based seminar/workshop format. Team projects focus on creating evaluation criteria for specific categories of software, followed by evaluating open source software components according to the Business Readiness Rating framework. Team projects will be supplemented by recommended readings and presentations by invited outside speakers.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-783, Introduction to Cloud Computing – 12 units
This class is designed to familiarize you with the state of the art in cloud computing and big data analysis. This course is suitable for both students on a

technical track (engineering, science) as well as those on a management track who are passionate about big data powered products. You will study basic types of clouds, widely-used cloud computing systems and their strength and weakness, core concepts and technologies on distributed data storage, distributed processes and services, security practices, popular Big Data Analysis algorithms and machine learning use cases on cloud. You will acquire deeper understanding via both case studies from industry big players as well as a project-based hands-on application build and deployment on cloud (no technical pre-requisite). After completing the course students will be able to:

- Build a basic product on two well-known cloud systems
- Make architectural decisions on choosing the right cloud type, core technologies and services
- Make business decisions on cloud vendors and the right level of investment on cloud
- Critique some current industry cloud-based solutions

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-786, Software Engineering Management - 12 units
In this course, you will learn the software engineering paradigms that are widely adopted in modern software industry. You will be introduced to the Software Development Life Cycles (SDLC) and its supporting process and tools in each stage. Through team based projects, you will gain firsthand experience on best practices in the art of collaboration and software engineering management. In a high-performing team environment, you will be able to build cloud based mobile applications through iterative process of requirements definition, architecture design, implementation, integration, testing, measurement and deployment. If you have already taken 18-652, Foundations in Software Engineering, you are not eligible to register for this course.

49-787, Architecture & Programming Principles - 12 units
This course teaches how to build an architecture that stands the test of time and business, how to keep your code manageable and clean, how to ensure longevity of your design, and how to build interoperable systems. You will do hands-on individual design and coding exercises addressing architectural concepts like scalability, reliability and security, development essentials like reusable code,

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refactoring and technical debt, and current technologies like containers, APIs and data pipelines. Examples and exercises will be provided in Java, but you can write quizzes and assignments in any equivalent major programming language with instructor approval.

49-788, Introduction to IoT (Internet of Things) – 12 units
This course provides an overview of Internet of Things (IoT), especially focusing on software layer of building mobile applications to capture and process data generated by IoT devices and providing analytical insights. Students will access health and fitness information, motion data, explore home automation technologies and beyond. Through this course, students will understand and appreciate why information technology is entering the era of digital transformation from pure Internet to IoT.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-789, Architecture Principles for Product Managers – 12 units
Software products are becoming increasingly large and complex, and the responsibility of Software Product Managers has extended beyond core product functionality into non-functional aspects like cloud platform selection, scale and reliability decisions, interoperability with other products, and future extensibility considerations. For this, they rely heavily on their development team to architect and design products that are reliable, scalable, flexible, cost-effective and "future-proof." They are surprised when the product fails to met these expectations - discovered only when the rubber meets the road - often too late to make any fundamental changes. These failures may manifest themselves in the inability of a product to scale the next million users, to integrate with other software systems, to support an international user base or to be sold through channels. This course aims to get product managers technically savvy about the non-functional aspects of a software system, and enable them to be influential in the architectural and design phase of product development. It will review a variety of architectures archetypes and analyze them for relevance to specific business requirements. It will also review some well-known products and explore their architectural characteristics. As part of the course, students will conceptually architect a product and debate its pros and cons. This course is designed for

students who have some experience with product management and can relate to the challenges addressed in it. No experience with coding is necessary.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-790 / 49-796 - Software Management Independent Study – Variable Units
Working with the faculty, realize that the faculty are most interested in Independent Study projects that further their own research goals. You may not be successful on your first inquiry, so please be patient. We want you to have a good Independent Study experience, so faculty are encouraged to say "no" if they don't have the cycles to mentor a project. Once you and the faculty have agreed upon the independent study, send the independent study form to the director of your program.

49-791 - Software Management Capstone Project – Variable Units
Student teams continue work on their product or business idea. Student teams may refine or rework ideas, or continue to extend the work started in previous semesters. A plan, including milestones and deliverables, which is developed by the team must be submitted to and approved by the faculty advisor at the start of this course.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-792 - Software Management Practicum – Variable Units
The practicum involves application of the SM program concepts in an actual business environment. Acting as consultants to one or more customers, student teams must scope a project; develop a project plan and detailed statement of work. Practicum topics are typically proposed by outside companies, which are looking to work with our students, but there are other options available as well. Students must demonstrate all deliverables to the customer(s), whose assessment of the work is a major component of the grade. More than a simple internship, the practicum involves real responsibility, teamwork, accountability, and rigor.

49-793 - Practical Training in Software Management – 3 units

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This course is for SM students who are pursuing an internship. Internships work is conducted on-site at local software companies. Special permission is required to be enrolled in this course, therefore, eligible students should contact the program director.

49-794 – Strategies for your Software Industry Career – 3 units
This workshop continues the self-assessment started in the New Student Orientation for the MS-SM program, and continues with career exploration activities. Students who are searching for their first job or internship in the software industry and those who are seeking to make a career shift will benefit from this course. A discover of careers available in today's software industry will be conducted through student research and guest speakers (including alumni) who present a view into their typical workday. Students develop an understanding of the wide variety of companies operating in the software industry, and the various jobs available within these companies. Students also learn how they can apply their skills to non-software companies for whom software systems are a major aspect of business success. The outcomes for students include a personal brand statement that articulates skills valued by employers, discovery of their work preferences and aptitudes, a list of target companies to engage, and a plan to develop the materials (e.g. resume, interview preparation) required to conduct a successful job or internship search based on their new awareness and understanding of specific opportunities they wish to pursue. This course prepares students for 39-699 Career and Professional Development for Engineering Masters Students.

49-795 - Special Topics: Introduction to Artificial Intelligence – 12 units
The principles and practices around artificial intelligence (AI) is increasingly critical to unlock the value of data, and transform business and ultimately human experience. It is so pervasive today that we use it daily probably without knowing it. This course will present students AI business case studies, the most popular AI techniques, algorithms, application recipes, best practices, and offer hands-on experience in implementing them to solve real-world problems. This course covers the spectrum of real-world AI implementations from natural language processing, speech recognition, facial recognition, landmark detection, and social network analysis to technical depth of popular algorithms, neural network backpropagation methods, probabilistic and non-probabilistic methods. Students will accumulate firsthand experience on Google and Microsoft AI platforms, AI

model design and training. This course is designed with the easy-to-follow approach by showing the step-by-step implementation of the core technologies. It presents recipes in major use cases to offer students a leap start on building AI solutions. With the willing-to-learn attitude, students with either technical or business background will succeed in this course.

49-800, Commercializing Intellectual Property – 12 units
The course focuses on the innovation of products based on emerging technologies that are ready for technology transfer, but have not moved past the "research lab". The course will follow a rigorous product innovation process that begins with identifying opportunities for products using these technologies, understanding the needs of the potential customer and other stakeholders, and developing concepts that illustrate the potential product. The course will include understanding new technologies, extensive customer research, product innovation methods, and initial business execution planning that includes market definition and execution planning. The results of this course may follow into 96-809, Enterprise Innovation, in the spring term, to further develop the concept and execution plan into a viable market opportunity. For this year, technologies will be based on CMU research ready for tech transfer.

49-801, Enterprise Innovation – 12 units
This course explores how business enterprises are being re-invented for today's digital era. Many firms are approaching a critical inflection point. The combined impacts of technology and globalization have revolutionized the way we operate. Software is transforming the way companies innovate; how they interact with customers and ecosystem partners, the way they collaborate and communicate, how they access and distribute information, and how they co-ordinate and control. Traditional approaches that assume "stability" have given way to "dynamic" recipes. The new imperative is to swiftly navigate changing realities. Flexibility, versatility and the capacity to quickly adapt to evolving situations have become the critical challenges. The course is based on the new edition of Prof. Evans' book "Super-Flexibility for Knowledge Enterprises" (co-authored with Prof. Bahrami from Haas School of Business, UC Berkeley). Specifically, we will focus on the new rules of "super-flexibility" needed for continuous recalibration and adaptation.

49-802, Innovation & Entrepreneurship – 12 units

This course focuses on entrepreneurship and innovation from the vantage point of high-tech companies in Silicon Valley. We will explore these topics in the context of the Creation Phase - focusing on founding a new start-up and raising seed funding; and the Scaling Phase - focusing on growing a venture where startups typically undergo B, and C rounds of funding; We will examine common mistakes and misconceptions in starting a new entrepreneurial business, and meet entrepreneurs, angel investors, and venture capitalists from Silicon Valley to learn, first hand, the challenges of conceiving, creating, and growing a new venture.

In the second part of the IE course, our focus will be on the Consolidation Phase, when growing ventures evolve into established global corporations We will examine critical pain points facing this group of companies, the impact of organizational complexity, the challenge of managing a multi-business enterprise, and expanding the global footprint. This is the phase when technology companies find it more challenging to innovate and often shift their growth focus to searching for acquisitions. Invited guests will share their experiences and lessons learned, and give us a first-hand perspective on realities facing this critical group of innovative companies.

49-804, The Leadership Challenge – 6 units
This course studies the emerging contexts for leadership - key attributes and skills, key development points, and key actions. Leadership will be discussed in changing contexts such as agile/lean environments, emerging technology such as mobility, big data, and global issues. Other topics include decision making under uncertainty, leadership and followership, acting as a connector in an ecosystem. A leader is someone who will take you somewhere that you didn't think you could go; what does this mean for teams, businesses and you personally? There will be key readings, case studies, and a retrospective.

49-807, Exponential Innovation – 12 units
This semester course explores the new paradigms of innovation and competitiveness. This disruption is happening because technologies such as computing, sensors, artificial intelligence, and 3D printing are advancing exponentially and converging. For more than 100 years, the processing power of computers has doubled every 18 months. Now it has come to the point where our smartphones are more powerful than yesterday's supercomputers

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were. Faster computers are now being used to design faster computers; and computers and the information technology that they enable are absorbing other fields. In order to thrive in today's era of exponentially advancing technologies, students will need to understand the pace of change and learn to take advantage of the upheaval it will bring. Innovation has globalized; business models and technology developed in one country can easily be exported to another there are massive opportunities for small groups of people to create an outsized positive impact on the world. This class teaches students how to watch for convergence and disruption and to think like the startups that are building the future of nearly every industry. The class combines lectures, discussions, group activities, and guest speakers to teach students this exciting rapid change to technology.

Note: Optional Distance Education Section is available for MSSM Remote Part-Time students. Remote students still attend class synchronously.

49-808, ST: Integrated Innovation for Large-Scale Problems – 12 units
This course focuses on team-based innovation across design, business, engineering and software with the potential for large-scale impact. Students working across geographic locations will take on a complex problem in an emerging field, and methodically come up with unexpected ideas and opportunities to tackle and solve it. The semester will consist of a series of four modules where students will research current signals and market indicators; identify opportunities for innovation; and formulate, prototype, integrate and resolve a solution. Students will work both individually and collaboratively and will learn and apply innovation, entrepreneurship and conceptualization skills in scaling existing products and services into new markets and in evolving new products in existing markets. Students will be supported in this exploration by regular guest talks from leading academics and industry professions who will provide their insights and guidance on developing solutions for complex problems.

49-851, Financial Fundamentals for New Ventures – 6 units
This course will aid high tech teams in their financing decisions for startup considerations and entrepreneurial management. The course will review the basics of financials such as the balance sheet, the P&L and a cash flow statement.

It will then address the creation of pro forma financials to support financing for new business ventures. This will include the development of business management understanding, the relationship between venture finance and business risk evaluation, and the process of valuing of the opportunity. Teams will create a venture pitch for their startup.

49-852, Agile Marketing for New Ventures – 6 units
This course will cover how to formulate marketing strategies that lead to successful products. It will include how marketing strategies are adapted for high tech innovations and products including addressing strategic market planning, functional expectations and tactical considerations. Topics include: strategic market planning, positioning, types of alliances needed for moving from innovation to product acceptance, breakthrough versus incremental innovation marketing, and measuring marketing effectiveness.

49-853, Product Management – 6 units
The course covers a product managers role in the application of product ideation and positioning, feature design and documentation, product development process, go-to-market, measurement/optimization, and growth. The course begins with a brief overview of the product management role, and then goes step by step into managing the process of building a product. In each class, students are required to discuss the reading materials, participate in the discussion sessions, and dive into in-class practices. The course will explore the Product Managers role and responsibilities across the product life cycle; techniques to understand and validate customer needs and product success; application of the knowledge and skills needed to research, position, design, develop, launch, optimize, and grow products; new product development and delivery methodologies and their impact on product and customer; and the key attributes of a successful Product Manager (PM) through direct dialogue with Silicon Valley PMs.

49-854, Business Models and Strategy – 6 units
This course is about the development of executable strategies for entrepreneurial efforts. In order for entrepreneurs to be successful, the ability to create a business model and roadmap for execution is essential. Strategy is about making decisions and having alternatives for courses of actions. This course will focus on effective approaches and measures in order to make things

happen under tight time and financial considerations. The course will explore how to apply the tools of strategy and business models in order to deliver new business creation. Topics include applying an evaluation process for the validity of a business concept, understanding the drivers for a strategic roadmap for new business execution, using a toolkit to shape a strategy with scenarios for choices of action, identifying the key measures of success. Through teams, students will form specific approaches for selected new business concepts and share them in class discussions.

49-855, Venture Governance, 6 units
The goal of the course is to teach founders of a high-tech startup venture the requirements and process to be a director and how to manage their Board of Directors and Advisory Boards. The boardroom is where the governance of the venture occurs. The course will propose frameworks for understanding the complex dynamics among directors, executives, investors and shareholders. The key elements of the work boards do includes: strategic reviews, selecting, evaluating and compensating CEOs and other senior executives, company re-organizations, new director selection, managing top executive succession and dealing with various corporate crises. The role of the Boards is crucial in the value creation phase of a technology ventures trajectory. Conceptual frameworks will be taught to effectively manage this crucial aspect of a ventures governance in real time. This course will cover the following topics: board participation and voting rights, Board of Directors responsibilities and liabilities, advisory board mentoring duties and shareholding vesting, managing Board of Directors, Directors and Officers Insurance and Compensation of Board Members, Board of Directors role during venture scaling, fundraising, firing hiring CEOs and company officers, board members role during the Merger and Acquisitions transaction and during IPOs, and joining other boards.

49-856, Legal Issues in New Venture Creation, 6 units
A critical part of creating a new venture is to provide the legal structure for both compliance and to prepare the venture for future success. For start-ups the legal profile of the company sets up the framework for growth. The course will cover basic legal requirements of incorporation, and additional options that need to be determined by the founders including equity distribution, board structure, employee stock option vesting, triggers for contingencies such as firing or acquisition and other issues. Another critical legal issue for both startups and

established enterprises surrounds protecting intellectual property to immunize the company's strategic advantage as it gains velocity in the global market and encounters competition. Students will learn about various Intellectual Property tools and strategies to protect their product innovations and to understand the competitive marketplace, both in the US and globally.

49-857, Dynamic Global Teams – 6 units
Dynamic teamwork and collaboration is a critical success factor and a major source of competitive advantage and frustration for companies worldwide. Many startups have engineering teams based in low cost parts of the world. Established companies have disturbed teams working in R&D and Engineering in different geographies. Mobile and remote communication technologies have transformed the global business landscape. Super-flexible teams drive and execute entrepreneurship and innovation. This course will focus on profiles of dynamic collaborative teams, what it takes to balance different priorities, create trust and alignment, interact with diverse stakeholders, and perform under time pressures and resource constraints, all under complex, fast-moving and unpredictable global markets. This course will study critical success factors in driving innovation and explore how super-flexibility enables rapid, real time adaptation. The course will describe practical action steps for organizing and managing super-flexible teams, study and apply fundamental findings in cognitive psychology that support adaptability and creativity of teams, introduce methods for training cross-functional teams to excel at innovation, and learn how to use practical tools and techniques that can turn ideas into action.

49-859 - Master of Science in Technology Ventures - Internship/Practical Training – 3 units
This course is for students in the MSTV program who are pursuing an internship. Internship work can be conducted on-site with a company or thru sponsored projects at the Integrated Innovation Institute. At the end of the summer, students will submit a paper reflecting on their internship experience and how it relates to the MSTV curriculum. This course is only offered during the summer.

49-881 - Start Up Creation in Practice – 12 units
For MSTV students with the goal of creating a new start up as they are enrolled in the MSTV degree, they have the option of using up to 24 units of their electives in the practice of creating a new venture (12 units per semester). Similar to an

independent study, but focused specifically on new venture creation, students will work on developing their technology-focused idea into a potentially viable company through this course. Students can work individually or through a team with other MSTV students. Each student (team) must have an approved faculty advisor.

49-882 - Special Topics: Emerging Technology: Artificial Intelligence (AI) – 6 units
Artificial Intelligence (AI) is a collection of multiple technologies that enable machines to sense, comprehend and act, and learn, either on their own or to augment human activities. AI has introduced new sources of growth, changing how work is done and reinforcing the role of people to drive growth in business. It is one of the hottest technologies that students may encounter in their future jobs. The course leverages the knowledge, experience, and network of the faculty, provides students with the fundamental knowledge, analytical skills, and strategic thinking needed to assess a job opportunity, analyze an application, and discover the business opportunities in the AI applied sectors.

49-884 – Internet of Things (IoT) Leadership– 6 units
IoT is dramatically enhancing our lives by automating non-value-added activities previously performed by humans; and by significantly improving our work and living environments through the combination of smart hardware and AI applications. All aspects of modern life will eventually be affected by IoT. Given the novel combination of innovation, technologies, processes, and commercialization opportunities for IoT, product managers and engineers can benefit from comprehensive knowledge of what it takes to conceive, develop, and commercialize these solutions. Given IoT's impact on society, it is essential to learn and appreciate what has already been deployed in various industries as examples of what is possible and serve as inspiration and learning.

Carnegie Mellon University - Schedule of Classes

https://enr-apps.as.cmu.edu/open/SOC/SOCServlet/search

Student Affairs & Career Services Resources

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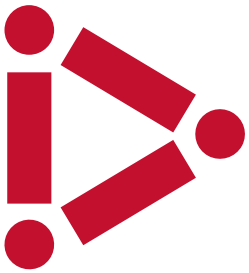
Student Affairs:
Students on the Silicon Valley campus can meet with the Assistant Dean of Student Affairs, Lauren Schachar, for on-site connection to various student services resources. These resources include questions regarding public transportation, health, personal concerns, student organizations, activities and general campus information. Lauren Schachar's office is located in B23 Room 217A, and can be reached by phone at 650-335-2844 or email at lauren.schachar@sv.cmu.edu.

Public Transportation:
Students are given a VTA clipper card (Smart Pass) during orientation, which provides them with free access to the local VTA bus system and the local light rail. If students live near a Caltrain station or require Caltrain to get to school or work, they can apply for a Caltrain Go Pass at the Student Affairs office, located in Building 23, Room 215B.

Health/Personal Concerns:
The Assistant Dean of Student Affairs is the point person for any student who is in distress or experiencing a crisis. Student Affairs consults with CMU's Counseling and Psychological Services (CaPS) in Pittsburgh to support students in these circumstances. The director also works closely with CaPS to provide training for SV faculty on identifying and supporting students in distress.

To further promote student access to physical and mental health services, the campus contracted with One Medical to provide students with local, timely access to health care. All students, staff, and faculty are now provided with a membership to One Medical, which provides same day and next day appointments at any of their locations. There are three main locations near the SV campus. The company also provides 24/7 support via their mobile app, including video consultations with a doctor. All full time students are also required to have health insurance. CMU's student health insurance department helps students to enroll, waive (if



they have insurance that meets the university requirements) and navigate and use insurance.

Student Organizations and Activities:
Students are encouraged to join student organizations during orientation and welcome week by requesting information (through an online form) and meeting the student organizations on campus. The online form is provided during the Action lab at new student orientation and can also be found on our website at http://sv.cmu.edu/student-services/student-organizations.html.

Student activities are promoted through a weekly CMU-SV Student Newsletter sent by the Assistant Dean of Student Affairs, Lauren Schachar. Students can find out about opportunities, events and activities through the newsletter, the student events calendar (which they can access once they have their school google accounts set up) and through the digital displays and posters on campus.

Career Services: The Career and Professional Development Services Center (CPDC) serves to provide students with guidance during their job and internship searches. The services available to students include resume reviews, mock interviewing, salary negotiation, career exploration consultation, internship and job consultation, workshops/events and employer relations. The CPDC is also heavily involved in organizing campus-wide job fairs and bringing employers to campus.
Handshake is Carnegie Mellon's online recruiting system. Through Handshake, employers can request accounts to post jobs, request interviews and information sessions, and review student resumes. Students and alumni can apply to positions, sign up for interviews and find contact information for thousands of recruiters. Handshake can be accessed through the CPDC website.

Students in Silicon Valley can meet with Associate Director of Career Services Leigh Mason. Appointments can be made through Handshake. Career Consultants hold open office hours, which are communicated at the beginning of each semester.

Job Search Guidelines:
Departments strives to play a supportive role in the career pursuits of students, but maintains academics as a priority. It is not acceptable for students to skip classes or assignments in order to attend job interviews. Students should conduct job searched in a manner that does not impede the academic progress through their graduate program. It is also important for students to have an understanding of how to conduct a job search. When applying for jobs, students are expected to exhibit certain ethical behavior, such as arriving on time for interviews, being truthful about their qualifications, and to honor their agreements with recruiters. Further, students should not continue looking and interviewing for a position after they have accepted an offer. The CPDC reserves the right to limit access for any users that do not follow their ethical job/internship search policy. Students who do not follow such guidelines may forfeit their on campus interviewing and/or resume submission privileges.

Student Grievances:
Grievances can be brought directly to the Assistant Dean of Student Affairs or the Director of Student Affairs. For students who wish to submit a concern online, they can do so at the online Student Suggestions Box at http://goo.gl/forms/BySlZMoB6txYDKz02.

Integrated Innovation Institute - Graduate Student Handbook
Please review the link below for more information on degree requirements, student services, career services/placement resource and student achievements for graduation.

- https://www.cmu.edu/iii/current-students/cmuiii_graduate_student_handbook_current_20_21.pdf

FACULTY

2020-21 Integrated Innovation Institute Faculty Members

Anglin, Deana
Adjunct Professor

- Doctor of Philosophy (PhD) in Human-Centered Computing
  Georgia Institute of Technology
- Master of Science in Human-Computer Interaction (IT)
  Rochester Institute of Technology
- Bachelor's in Computer Science, Math & Spanish
  Lawrence University

Bio
Dr. Deana Anglin is a Senior User Experience Researcher at Google with over 10 years of experience doing user-centered design research. As a designer of global products and services, Deana is most often found in-field learning about people across Asia, Africa, Europe and North America. Her work informs product strategy and innovation in new markets, most notably Google's food and home services delivery platform launched in India last year. She is also a UX mentor to emerging-market startups in Google's Launchpad accelerator program.
Deana received a PhD in Computing from Georgia Tech where she focused on design at the margins - designing with and for the refugee and immigrant community. Her research landed her several prestigious fellowships and awards from companies like Intel and Google. Her work is published at top venues such as CHI, Ubicomp and IFIP.

Areas of Expertise

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Technology Design for International and/or Emerging Markets, Service Design, Social computing, Mobile computing, Information and Communications for Development (ICTD)

Bodily, Brandon
Adjunct Professor

- Master of Science in Aerospace Engineering
  Purdue University
- Bachelor of Science in Mechanical Engineering
  Utah State University

https://www.linkedin.com/in/brandonbodily/

Bio

Brandon has spent 20+ years developing and implementing new materials and manufacturing processes for the aerospace industry. His experience includes internal research and design studies, manufacturing methods, and external customer-facing roles in the aerospace industry. Brandon has leveraged this unique experience to successfully develop solutions that satisfy the customer's design, engineering, and business needs, resulting in solutions that literally fly.

He currently works at the Arconic Technology Center, the world's premier light metals research center. The focus is on the development of aluminum alloys and manufacturing processes for large commercial aircraft. He leads a team of metallurgists, engineers, and technicians in identifying customer and technology needs and enabling the next generation of innovative materials and manufacturing processes.

When he isn't developing new products or thinking about airplanes, he is a dad and runner who likes to climb mountains.

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Aerospace Engineering, Manufacturing Methods, Aircraft Design

Dai, Xueying (Lake)
Adjunct Professor

- Master of Business Administration (MBA)
  University of Southern California, Marshall School of Business
- Bachelor of Science in Economics
  Beijing International Studies University

https://www.linkedin.com/in/lakedai/

Bio
Lake Dai is an entrepreneur, venture capitalist, and a partner at the venture capital firm, LDV Partners. Here at Carnegie Mellon, she is an adjunct faculty at our Silicon Valley campus, teaching students of our Software Management and Technology Ventures programs.

For 20 years, Lake has led product and engineering teams globally at Alibaba, Apple, Yahoo!, and Overture. She is a recognized expert in Search Engine, Ad Platform, Marketplace, Analytics, and Mobile Platforms and Applications, holding several U.S. patents in search algorithm, search tokenization, mobile data analytics, and mobile monetization.

In China, Lake was employee #84 at Alibaba, launching the first generation of profitable marketplace and travel products. At Yahoo! China, her team launched the first generation of web and vertical search products, tripling Yahoo!'s market share within one quarter.

In the U.S., as a co-founder Shinect, a non-profit acceleration program designed to connect Silicon Valley's entrepreneurs to China's market, she has been helping companies build successful products and profitable

businesses. She also mentors start-ups at various incubators including 500 Startups, Muckerlab, Lab360 and Shinect.

Lake is on the Advisory Board of Women In Technology International (WITI), the premiere global organization empowering women in business and technology. She is also a Board Governor and Chairwoman of the US Chapter of QianChengHui, a non-profit organization which fosters entrepreneurship for Alibaba alumni worldwide.

Dandavate, Uday
Adjunct Professor

- Master of Science in User Research
  The Ohio State University
- Master's Professional Certificate in Industrial Design
  National Institute of Design, Ahmedabad, India

https://www.linkedin.com/in/udaydandavate/

Bio

A design activist, poet, and ethnographer of social imagination, Uday Dandavate is also CEO of SonicRim Ltd., a San Francisco-based design research company specializing in co-creation. He has consulted for Fortune 100 companies such as Microsoft, Motorola, Google, AT&T, Whirlpool, Intel, Ford, Genentech, HP, Dell, Lenovo, BBCi, Honda, Samsung, and P&G translate leading-edge technologies into culturally, behaviorally, and socially relevant and meaningful experiences.
Uday has traveled extensively around the world, studying and connecting with all kinds of people and cultures, and watching and participating as they change over time.

In his professional capacity, as well as through blogging, teaching, speaking, and facilitating, Uday provokes fresh perspectives that help to humanize technologies and democratize design. Uday recently published

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an evocative collection of poems, "a window for a home without walls," that help communicate values and sensitivities about life, imagination and design to the readers around the world. Uday is currently involved in projects involved in application of machine learning and autonomous technologies to the future of mobility. He is also involved in helping develop innovative services for the healthcare industry.

Evans, John Stuart
Distinguished Service Professor

- Doctor of Philosophy (PhD) in Technology Policy
  Aston University
- Master of Science in Operations Research
  Aston University
- Visiting Scholar at the Graduate School of Business
  Stanford University

https://www.linkedin.com/in/stuart-evans-58857125

Bio
Dr. Stuart Evans is a board member, educator, author, and expert on dynamic high-tech ventures. As a Distinguished Service Professor, he shares his expertise by teaching related coursework for our degree programs in Silicon Valley, M.S. in Software Management and M.S. Technology Ventures. Additionally, Stuart is the Director of the CMU-Emirates iLab, a partnership between III and Emirates Airlines for innovative education and research specialized for the airline industry.

Stuart's professional career spans across many areas of entrepreneurship, featuring extensive experience within the tech ecosystem of Silicon Valley. He has conducted research for SRI International and Stanford Graduate School of Business; consulted with

Bain and Company; worked in investing for Sand Hill Venture Group; and served as executive management for
Shugart Corporation, a Xerox subsidiary. Prior to his time in Silicon Valley, he taught at The Cambridge University's Judge Business School.

In addition to his experience in academia and industry, Stuart has published widely on high-tech ventures. His latest book, Super-Flexibility for Knowledge Enterprises, puts forward a practical toolkit for dynamic adaptation in high-tech ecosystems. The book is based on 28+ years of collective field research and practical experience in Silicon Valley of both Stuart and his co-author Homa Bahrami, a professor of the University of California at Berkeley's Haas School of Business.

Areas of Expertise
High-Tech Entrepreneurship & Innovation, Dynamic Start-up Strategies, Venture Financing

Fang, Fang (Catherine)
Instructor of Integrated Innovation

- Doctor of Philosophy (PhD) in Computer Engineering
  Northwestern Polytechnic University
- Master of Science in Software Management
  Carnegie Mellon University
- Bachelor of Science in Information Management
  Peking University

https://www.linkedin.com/in/catherine-fang-008849/

Bio
Catherine Fang is an entrepreneurial product leader who is passionate about building intelligent software products powering both social networking at large-scale and enterprise platforms. She has 18 years of

product management, go-to-market strategy, and software development/architect experience managing products with globally distributed resources (U.S., UK, Hungary, India, China, Japan, Brazil, etc). Catherine specializes in areas including: machine learning-based social network content recommendations, global digital audience targeting strategy for content marketing and advertising, and audience look-alike modeling.

In addition to her role at the Integrated Innovation Institute, Catherine works as a Senior Product Manager for LinkedIn and is the co-founder and CEO of ECAdvisor, an educational platform for software product strategy consulting and personalized recommendations. Previously, she has worked in software and product roles at companies including Yahoo, BlueKai (acquired by Oracle), Sun Microsystem, and Stratify.

Areas of Expertise
Product Management, Go-to-Market Strategy, Software Development/Architecture

Kirmayer, Matt
Adjunct Professor

- Juris Doctor
  Rutgers University School of Law
- Master of Laws
  New York University School of Law
- Bachelor of Arts
  State University of New York at Albany

https://www.linkedin.com/in/mkirmayer/

Bio
Matt Kirmayer represents emerging technology companies and the investors who fund them across a range of industries, including software,

educational technology, digital media, social media, artificial intelligence systems and life sciences. Active in the technology and investment communities in Silicon Valley and the East Coast, Matt often works with emerging companies as their outside general counsel, managing legal, financial and operational issues, from formation and angel and capital investment through to exit, that arise when entrepreneurs enter the marketplace.

Matt has more than 25 years of experience in the emerging company and venture capital ecosystem, including numerous seed and venture financings for technology and life science companies. Matt also has a background in guiding clients in securities offerings and mergers and acquisitions.

As part of his commitment to gender equality, Matt sits on the advisory board of Astia, which is a nonprofit organization that invests in companies with women in positions of equity and influence. Matt is a mentor at the Lester Center for Entrepreneurship at the Haas School of Business at the University of California Berkeley and a Sky Advisor to SkyDeck, the unique accelerator at UC Berkeley.

Areas of Expertise
Corporate Law, Venture Capital

Ott, Adrian
Adjunct Professor

- Master of Business Administrative (MBA), Harvard Business School
  Carnegie Mellon University
- Bachelor of Science
  University of California, Berkeley

Bio

Adrian Ott is an award-winning entrepreneur, author, and former senior-level tech executive with a proven track record for visionary business strategies that result in exponential revenue. She has led billion-dollar high technology organizations and assisted innovative ventures to identify and commercialize new product opportunity. *Consulting Magazine* called her "One of Silicon Valley's most respected strategists." As CEO and founder of a technology services business in 2001, Harvard Business School and NAWBO recognized her as one of the most inspiring leaders in Silicon Valley.
In addition to teaching technology venture classes at Carnegie Mellon Silicon Valley, she serves on the National Faculty for the NSF Innovation Corps (National Science Foundation I-Corps). As a National Adjunct, she assists cohorts of promising technology entrepreneurs to commercialize innovations they have developed at top U.S. universities. She has also served in fiduciary and advisory board roles at private for-profit corporations.

Adrian is the award-winning author of two business books that won Best Business Book of the year accolades. She has contributed thought-leading articles to Fast Company, Harvard Business Review and has been featured in national business television, radio, and publications such as Forbes on the latest trends.

Prior to founding her own company, she was an HP executive for 15 years serving in functions such as product management, new ventures, strategic alliances, marketing, and software development. She was recognized in an annual report for "infusing HP with new revenue streams, new technologies, and new business models."

Areas of Expertise
Commercializing Technology, Go-To-Market Strategy and Business Models, Venture Management/Governance, Strategic Alliances

Mercier, Gladys
Program Director, M.S. Software Management

- Master of Business Administration (MBA)
  Carnegie Mellon University
- Master of Software Engineering
  Carnegie Mellon University
- Bachelor of Science in Computer Science
  University of Pittsburgh

https://www.linkedin.com/in/gmmercier/

Bio
Gladys M. Mercier has 12 years of software engineering experience with a focus on industrial automation systems for steel manufacturing. She has been a certified professional project manager (PMP) since 2002 and has served in a variety of roles throughout her career, including analyst, developer, designer, architect, tester, trainer, and team lead. Gladys joined Carnegie Mellon in Silicon Valley in 2003 and has played an instrumental role in the growth and success of the M.S. in Software Management (MSSM) program.

In addition to her role as MSSM's Program Director, Gladys teaches related coursework as a faculty member and is the academic advisor for both the MSSM program as well as the Information Networking Institute's MSIT-SM program.
Gladys grew up in Sacramento, California and attended college in Boston and Pittsburgh, PA. After earning her undergraduate at the University of Pittsburgh, Gladys launched her software career in the city's steel manufacturing industry. Her work allowed her to travel extensively, installing systems in many cities in the U.S. and Brazil.

Gladys has been a part of the Carnegie Mellon community for nearly 20 years. After earning her master's degree at CMU, Gladys developed and taught a project management course for Heinz College. When she moved back to California, she continued her CMU career by joining the Silicon Valley campus.

Gladys spends her free time both outside and on the ice. She studies landscape architecture, urban design, and California native plants. Her favorite pastime is playing ice hockey, traveling across the U.S. as part of winning teams and leagues. After living in Pittsburgh for 16 years (and during the Mario Lemieux era), Gladys continues to be a devoted Pittsburgh Penguins fan, despite the cheers of her San Jose Sharks-loving neighbors.

Areas of Expertise
Project Management, Software Engineering, Teamwork, Interpersonal Skills

Miller, David
Adjunct Professor

- Master of Science in Information Technology
  Carnegie Mellon University
- Bachelor of Science in Accounting
  Syracuse University

Bio
David Miller is an entrepreneur, a product team leader, an advisor and educator. David works with F500 companies as well as VC backed start ups to help find the elusive product market fit and build and manage teams of product managers, designers and developers.

Throughout his career, David has worked with companies big and small to bring game changing products to life. David has consulted or worked for companies including Comcast, Oracle, Nextel, Sprint, Prudential, GMAC Commercial Mortgage, SEI Investments, and Cushman & Wakefield. He personally founded three companies in the ad-tech, payment processing, and ride sharing industries.

Currently, with AgileEngine, an award-winning product development firm, David helps companies accelerate and hone their product development. By building hi performing on-shore/off-shore teams, David helps companies move faster and more efficiently to launch and maintain products, reduce backlogs, build integrations, scale and gain market share.

David's focus areas include product management leadership, mentorship, organizational design and conversations that focus on how to unlock creative potential. Also, how organizations create hi performing teams through an inclusive environment that values and honors respect for differences, humility, difficult dialog, managed conflict, hard decision making, resilience, empathy and risk-taking to meet the grand challenges of tomorrow.

Areas of Expertise
Entrepreneurship, Product Development, Product Management, Hi Performing Teams, Corporate Innovation

Mohan, Shantha
Executive in Residence, iLab

- Doctor of Philosophy (PhD) in Operations Management
  Tepper Business School (GSIA), Carnegie Mellon University

- Bachelor of Engineering in Electronics and Communication Engineering
  College of Engineering, Guindy (CEG), Chennai, India

https://www.linkedin.com/in/shanthamohan/

Bio
In her current role as Executive In Residence at the Integrated Innovation Institute, Shantha co-delivers courses, contributes to curriculum design, and mentors students in their projects and practicums.

Shantha is a senior software engineering leader and entrepreneur, with proven track record of growing and mentoring technical teams and generating ROI for customers across the globe. Retail Solutions Inc., the company she co-founded, is a leader in Retail Analytics in the Consumer Packaged Goods domain. She ran product development for the company and was responsible for scaling the product development team across the world and deliver multiple analytic applications. Prior to Retail Solutions, she has over 20 years of experience focusing on mission-critical systems to support semiconductor and other high value added manufacturing. At Consilium, now part of Applied Materials, she managed development of three generations of Manufacturing Execution Systems. Such software systems are mission critical, highly scalable, and highly available systems, and companies such as Intel and Infineon depend upon them for their manufacturing.

Outside CMU, she mentors startups and provides career advice in Product Management and software development careers. Her book “Roots and Wings – Inspiring stories of Indian Engineering Women” is forthcoming.

Areas of Expertise

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Software Enterprises, Entrepreneurship, Product Management, Global software development

Root, Sheryl
Program Director, M.S. Technology Ventures

- Master of Business Administration
  Stanford University
- Undergraduate Degree
  University of California

https://www.linkedin.com/in/sheryl-root-703b792/

Bio
Based at CMU Silicon Valley, Sheryl Root is Program Director of III's M.S. in Technology Ventures program and an Associate Professor of the Practice for the M.S. in Software Management program. In her role as director and faculty, Sheryl both develops curriculum and teaches courses that merge technology with entrepreneurship.

Outside of CMU, Sheryl is the owner of RootAnalysis, a consulting firm specializing in corporate strategy and marketing. For more than 13 years, Sheryl's firm has worked with C-level Silicon Valley executives at high-tech companies, such as HP-Compaq, Oracle/PeopleSoft, Hyperion, Philips, Novell, and many startup organizations.

Prior to joining academia, Sheryl had an extensive career in the software industry, including a 20-year tenure working for Hewlett-Packard (HP). While at HP, she exceled in a number roles, including Director of Business Strategy, Director of Marketing Operations for Services, Director of the Software Initiative, and Manager of Unix environments. Specializing in the area of software, she led internal teams of consultants

for HP operations across the globe, advancing the company's process practices in software engineering and business management.

Sheryl is a leader, board member, and advocate for many world–renowned institutes and organizations. She is Chairman of the Advisory Board for Women in Technology International (WITI), a member of the Board of Advisors for the Stanford Business School Sloan Program, and board member of Netswitch Technology Management. She has coached numerous startups to achieve success in high-tech industries. Additionally, she is a frequent speaker in high-tech subject areas such as agile marketing, strategy, women in STEM, career planning, leadership, new business models, and organizational structures.

Outside of work, Sheryl is an connoisseur of wines and previously owned her own vineyard. In a previous life, she used to race cars.

Areas of Expertise
Business Models & Strategy, Leadership, Agile Marketing, Product Management, Team Dynamics

Shaikh, Karimulla
Instructor of Integrated Innovation

- Doctor of Philosophy (PhD) ABD, Computer-Aided Engineering & Management
  Carnegie Mellon University
- Master of Science in Computer-Aided Engineering
  Indian Institute of Technology, Madras
- Bachelor of Technology
  Indian Institute of Technology, Madras

https://www.linkedin.com/in/karimullashaikh

Bio
Karim has built his career over the last 20 years as a seasoned product development executive at both startups and publicly-traded companies. He currently leads product development at Virtual Power Systems, a startup focused on intelligent software-defined power for data centers. Prior to that, he was Senior Vice President of Product Development at SDL Language Technologies, a global leader in delivering machine translation and translation management systems to Fortune 100 companies. His experience leading product management and software engineering spans a wide range of domains.

While he enjoys getting into the technical guts of scalable and reliable cloud products for enterprises and professionals, Karim is also passionate about building high-performance teams by simplifying people and process interactions.

Areas of Expertise
Cloud Software, Enterprise Product Development, Machine Learning, Solving Large Scale Problems

Steier, David
Distinguished Service Professor, Heinz College

- Doctor of Philosophy (PhD), Computer Science
  Carnegie Mellon University
- Bachelor of Science in Computer Science
  Perdue University

https://www.linkedin.com/in/davidsteier/

Bio
David Steier joined the CMU faculty as an Adjunct Professor at the Integrated Innovation Institute in 2018. He is also a Distinguished Service Professor in the Heinz College School of Information Systems and

Management, where he teaches courses on data science for product management, managing analytics projects, designing smart systems and artificial intelligence.

Prior to joining CMU, David was Managing Director in Deloitte Consulting's Data Science practice. At Deloitte, David helped clients use advanced data analytics and visualization in a variety of industries including health care, banking, retail, manufacturing, telecommunications, media and the public sector. Prior to Deloitte, David was Director in the Center for Advanced Research at PwC, Senior Director of Technology and Business Development at Kanisa, and Managing Director at Scient. Beyond the general topics of data science and artificial intelligence, David's research interests are in data-driven approaches to behavioral change, particularly in health and wellness.

In addition to his CMU affiliation, David is also a Lecturer at the University of California Berkeley's School of Information, where he co-instructs the data science capstone class in the Masters in Information and Data Science program.

Areas of Expertise

Analytics, Big Data, data visualization, data mining, health care informatics, fraud detection, anomaly detection, machine learning, human-computer interaction, artificial intelligence

Taborga, Jorge
Adjunct Professor

- Doctor of Philosophy (PhD) in Organizational Systems
  Saybrook University
- Master of Science in Computer Science
  Texas A&M University

- Bachelor of Science in Computer Science
  Texas A&M University

Bio

Jorge Taborga is an accomplished leader in organizational transformation and growth in high tech, healthcare, and cloud services. Across his career, he has led company-wide strategies; developed numerous hardware and software products, and cloud services; re-engineered company-wide business processes; implemented enterprise-wide IT systems; integrated a large number of company acquisitions; and built and mentored many engineering and IT organizations.

Jorge was recently an Executive Vice President at Omnicell, Inc., where he was responsible for product development of this medical devices company. Prior to this assignment, he was this company's Vice President of Manufacturing, Quality, and Information Technology. Before Omnicell, Jorge delivered management consulting services to large enterprises and startups in the areas of strategic planning, go-to-market strategies, business case development, organizational development, supply chain optimization, and large system implementations. He was the Senior Vice President of Technology Operations at Terraspring and fusionOne, both cloud service startups delivering innovations in cloud storage and infrastructure as a service. Jorge also was Vice President and CIO at Bay Networks. Before that, he was Director of Enabling Technologies for Quantum Corporation, leading the business and systems transformation of that company. Earlier in his career, Jorge held a number of product development and leadership positions with ROLM and IBM

In addition to his role at the Integrated Innovation Institute, Jorge is consulting with high growth companies on team and organizational adaptability. He is also lecturing Organization Development topics in the US and China.

Areas of Expertise
Hardware and software product development, organizational and team adaptability, organizational behavior, change and transformation, and M&A post-merger integration

Thomas, Ravi
Associate Professor of the Practice

- Doctor of Philosophy (PhD) in Economics
  University of California, Berkeley
- Bachelor of Science in Mathematical Economics & Econometrics
  The London School of Economics & Political Science

https://www.linkedin.com/in/ravi-thomas-8b14a65

Bio
Based at Carnegie Mellon's Silicon Valley campus, Ravi specializes in teaching entrepreneurial and new venture coursework for our M.S. in Software Management and M.S. in Technology Ventures programs. He also mentors CMU-based startups as the director of VentureBridge program, a program open to CMU students and alumni seeking to launch their own high-tech businesses.

Ravi has held senior-level executive positions at several startups. He co-founded Jareva Technologies and served as CFO and a board member. During his time with Jareva, Ravi engaged in all aspects of the company from its founding as a service business, to its repositioning as a software product company, to its revenue stage and successful exit through an acquisition by Veritas. Prior to founding Jareva, he was the CFO of PostX, a company in the secure messaging arena. As CFO, he was involved in raising over $30 million for PostX and Jareva through venture capitalist firms including Mayfield, Hummer Winblad, and Labrador. Additionally, Ravi is a Consulting Chief Financial Officer for several startups. Previously,

he was CFO of University Associates, LLC (UA LLC). UA LLC was formed by the Regents of the University of California and the FHDA Community Colleges holds the master lease on 77 acres of NASA Research Park at Moffett Field.

Prior to joining his first startup, Ravi was an Assistant Professor at the Fox School of Business at Temple University, where he taught graduate and undergraduate courses in microeconomics, economics of information, and public finance. He has also taught at Swarthmore College and was a Visiting Fellow at the International Monetary Fund.
Areas of Expertise
Entrepreneurship, New Venture Strategy

Wasserman, Anthony
Professor of the Practice, Software Management

- Doctor of Philosophy (PhD) in Computer Sciences
  University of Wisconsin, Madison
- Bachelor of Arts in Mathematics and Physics
  University of California, Berkeley

https://www.linkedin.com/in/tonywasserman

Bio
Anthony I. (Tony) Wasserman has been a Professor in the Software Management program at Carnegie Mellon University's Silicon Valley campus since 2005. At CMU-SV, he created the Center for Open Source Investigation, a center that serves as a focus for his research.

Previously, Tony was the founder and CEO of Interactive Development Environments (IDE), a company that was one of the first 100 dot-coms and created the innovative multiuser platform for Software through Pictures (StP). He later served as VP of Engineering for a dot-com startup

and as VP for Bluestone Software, a developer of a Java EE application server. His work at Bluestone included creating mobile web applications in 2000, as the very first smartphones were entering the marketplace. Early in his career, Tony was Professor of Medical Information Science at the University of California - San Francisco, leaving to start IDE.

Tony is a Life Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and a Fellow of the ACM, honored for his contributions to integrated software engineering environments. From 2010 to 2016, He served on the Board of Directors of the Open Source Initiative (OSI) and since 2015 has been the chair of IFIP Working Group 2.13 (Open Source Systems), a group belonging to the International Federation of Information Processing's Technical Committee on Programming. He is an advisor to several startups, has served as a judge at numerous startup competitions, and is a frequent speaker at both research and practitioner-oriented conferences around the world.

Tony has served as a Visiting Professor at the Vrije Universiteit (Amsterdam), the Université de Genève, and the National University of Singapore. He has visited more than 70 countries. Tony enjoys photography and posts many of his photos on Flickr.

Areas of Expertise
Software Engineering, Open Source Software, Software Development Methods & Tools, Entrepreneurship, Product Marketing & Management

Additional Information about Integrated Innovation faculty and staff can be found here: https://www.cmu.edu/iii/innovators/index.html

ADMISSIONS INFORMATION

Information about Integrated Innovation Institute's Admissions requirements can be found here: https://www.cmu.edu/iii/degrees/admissions/index.html

Transfer Credits & Articulation Agreements

The Integrated Innovation Institute does not accept transfer credits from other institutions for any of its graduate degree programs. Additionally, the Integrated Innovation Institute does not have any transfer or articulation agreements.

Prior Experiential Learning Credit Policy

The Integrated Innovation Institute does not award credit for prior experiential learning experiences before starting a degree program.

International Student Resources

Carnegie Mellon's Office of International Education (OIE) advises international students and scholars regarding immigration/visa and acculturation issues, issues visa documents with which international students and scholars may apply for US visas. Visa documents are issued, per federal regulations, upon request from students who are admitted to full-time programs and who have sufficient, demonstrated financial resources. OIE complies with federal reporting requirements with respect to students/scholars on CMU visa documents and educates students with respect to their own responsibilities for maintaining legal status in the US.

All F and J students/scholars are required to attend a mandatory Orientation and Immigration Check-In upon arrival to their CMU campus or location. The OIE orientation provides legally-required information regarding maintaining status. For those students who participate in Optional Practical Training (OPT) or Curricular Practical Training (CPT), mandatory information/application sessions are provided. These sessions are presented remotely, as needed, by a Carnegie Mellon OIE

Designated School Official (DSO). Individual students who have immigration questions or concerns meet with designated OIE advisor during individual, scheduled advising appointments.

For more information, students may view the website or call OIE:
https://www.cmu.edu/oie/foreign-students/index.html
By phone: 1(412) 268-5231

English Language Proficiency Information
Admission to Carnegie Mellon University graduate programs requires demonstration of completed, relevant undergraduate degree programs, as demonstrated by an original transcript from the degree-granting institution during the admission process. Domestic students who graduate from an accredited college or university in the US have demonstrated their English language facility and skill by their success and graduation from competitive undergraduate US institutions.

TOEFL or IELTS Requirements
Applicants whose native language (mother tongue) is not English must provide TOEFL, IELTS, or DuoLingo scores. The Integrated Innovation Institute requires a minimum score of 95 for IBT (with no sub-score below a 23), a minimum score of 6.5 for IELTS, and a minimum score of 105 for DuoLingo

Language of Course Instruction
All instruction occurs in English.

NOTICE CONCERNING TRANSFERABILITY OF CREDITS AND CREDENTIALS EARNED AT OUR INSTITUTION

The transferability of units you earn at Carnegie Mellon University is at the complete discretion of the institution to which you may seek to transfer. Acceptance of the degree you earn in the Program is also at the

complete discretion of the institution to which you may seek to transfer. If the units or degree that you earn at this institution are not accepted at the institution to which you seek to transfer, you may be required to repeat some or all of your coursework at that institution. For this reason, you should make certain that your attendance at this institution will meet your educational goals. This may include contacting an institution to which you may seek to transfer after attending Carnegie Mellon University to determine if your credits, or degree will transfer. The Integrated Innovation Institute does not accept transfer credits from other institutions for any of its graduate degree programs.

STUDENT'S RIGHT TO CANCEL (WITHDRAWAL/LEAVES OF ABSENCE)

A student has the right to cancel the student's Enrollment Agreement by either taking a leave of absence from the Program (leaving Carnegie Mellon University temporarily with the firm and stated intention of returning) or by withdrawing from the Program (leaving Carnegie Mellon University with no intention of returning). If the student withdraws or take a leave of absence from Carnegie Mellon University, the student may be eligible for a tuition adjustment or a refund of certain fees (excluding any Application Fee, Registration Fee and Enrollment Deposit).

To cancel the student's Enrollment Agreement and take a leave of absence or withdraw, the student must complete Carnegie Mellon University's Leave of Absence or Withdrawal form, as applicable, and return it to Carnegie Mellon University's Registrar's Office, at 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213. The Leave of Absence and Withdrawal forms, and additional information about leaves of absence and withdrawal, can be found on Carnegie Mellon University's website at https://www.cmu.edu/hub/registrar/leaves-and-withdrawals/.

If the student notifies Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is the earliest of:

- The date the student began the student's withdrawal or leave of absence process at Carnegie Mellon University;
- The date the student notified the student's home department at Carnegie Mellon University;
- The date the student notified the associate dean of the student's College at Carnegie Mellon University; or
- The date the student notified the Carnegie Mellon University Dean of Student Affairs.

If the student does not notify Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is:

- The midpoint of the relevant semester in which the student withdraws or takes a leave of absence;
- The last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day the student turned in a class assignment.

REFUND POLICY

A. Refunds in General. Students who withdraw from the Program or take a leave of absence after having paid the current semester's tuition and fees or receiving financial aid are subject to the following refund and repayment policies. No other charges are refundable.

B. Exit Counseling. All borrowers of Federal student loans must complete a Federally mandated exit counseling session when graduating or dropping to less than half-time enrollment status, including by withdrawing or taking a leave of absence.

Exit counseling prepares students for repayment. Students must complete an exit counseling session in its entirety, with complete and correct information; otherwise, the student's degree, diploma and official transcripts may be withheld. Information about exit counseling sessions can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/financial-aid/exit-counseling.html.

C. Withdrawals/Leaves On or Before 10th Class Day (during the Cancellation Period). Students who withdraw or take a leave of absence on or before the 10th class day of the relevant semester will receive a refund of 100% of tuition and fees (excluding any Application Fee or Registration Fee and Enrollment Deposit).

D. Withdrawals/Leaves after 10th Class Day (after the Cancellation Period). Students who withdraw or take a leave of absence after the 10th class day of the relevant semester but before completing 60% of the semester will be assessed tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. STRF will be adjusted accordingly with any adjustment of tuition. There is no tuition adjustment after 60% of the semester is completed. There is no refund of University fees after the 10th class day of the relevant semester.

E. Tuition Adjustment Appeals. Students may appeal to have tuition adjustments for their leave of absence or withdrawal if they feel that they have extenuating circumstances. These

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appeals will be reviewed in the context of Carnegie Mellon University's tuition adjustment policy, as stated above. These appeals must be made in writing to Carnegie Mellon University's Registrar using Carnegie Mellon University's Tuition Appeal Adjustment form. Information about Carnegie Mellon University's tuition adjustment policy and tuition adjustment appeals can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/tuition/adjustment.

F. Repayment to Lenders/Third Parties. If any portion of refundable tuition and/or fees was paid from the proceeds of a loan or third party, the refund may be sent to the lender, third party or, if appropriate, to the Federal or state agency that guaranteed or reinsured the loan, as required by law and/or Carnegie Mellon University policy. Any amount of the refund in excess of the unpaid balance of the loan shall be first used to repay any student financial aid programs from which the student received benefits, in proportion to the amount of the benefits received, and any remaining amount shall be paid to the student.

G. Responsibility for Loan. If the student obtains a loan to pay for an educational program, the student will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If the student has received Federal student financial aid funds, the student is entitled to a refund of moneys not paid from Federal student financial aid program funds. If the student is eligible for a loan guaranteed by the Federal or state government and the student defaults on the loan, both of the following may occur: 1) The Federal or state government or a loan guarantee agency may take action against the student, including applying

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any income tax refund to which the person is entitled to reduce the balance owed on the loan. 2) The student may not be eligible for any other Federal student financial aid at another institution or other government assistance until the loan is repaid.

PROBATION & DISMISSAL POLICIES

University Policy: http://www.cmu.edu/policies/student-and-student-life/suspension-required-withdrawal-policy.html

Policy Statement

University Suspension is a forced, temporary leave from the university. There are three types of suspension for students that apply to both graduate and undergraduate students:

Academic Suspension is the result of poor academic performance or violation of academic regulations and is imposed by the student's college or academic department (see university and college academic policies). *Disciplinary Suspension* is the result of serious personal misconduct and is imposed by the Office of Student Affairs (see The Word/Student Handbook).

Administrative Suspension is the result of failure to meet university financial obligations or failure to comply with federal, state or local health regulations and is imposed by Enrollment Services. (See Student Accounts Receivable Collection Policy and Procedures for financial obligations. Contact Student Health Services for information about health regulations.)

Suspended students may not:

- register for courses
- attend classes

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- live in student or fraternity/sorority housing
- use campus facilities, including athletic facilities, library and computer clusters
- participate in student activities
- be members of student organizations
- have student jobs
  (Note: students on academic suspension may have a summer campus job if they accepted the job before they were suspended.)

Employment
Although suspended students may not hold student jobs, students on academic suspension may, under certain circumstances, have a non-student job with the university; students on disciplinary or administrative suspension may not.

To have a non-student job, students on academic suspension must receive approval from their associate dean (undergraduate students) or department head (graduate students) to ensure that the job will not violate their suspension terms. Students in violation of this will lose their degree student status, meaning they would have to reapply for admission to Carnegie Mellon through either Undergraduate Admission or the appropriate graduate department.

Transfer Credit
Suspended students may take courses elsewhere; however, they may receive transfer credit only if their college's and department's policies allow this.

Appeals
To appeal any action of this policy, the student may write to the following people:

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Academic Suspension - associate dean (undergraduate students) or department head (graduate students);

Disciplinary Suspension - dean of student affairs;

Administrative Suspension - vice president for enrollment, vice president for business and planning, and the dean of student affairs, in consultation with the student's associate dean.

Returning from Suspension
In order to return from a suspension, a student must have the following approval:

Academic Suspension - associate dean (undergraduate students) or department head (graduate students);

Disciplinary Suspension - dean of student affairs;

Administrative Suspension - vice president for campus affairs or his designate.

ATTENDANCE & RESIDENCY POLICIES

Class Attendance

Students are expected to attend all classes outlined in a course syllabus as part of their Integrated Innovation Institute degree. All absences must be approved and arranged with the course professor on an individual basis. Please note that the Integrated Innovation Institute does not support excessive course absences for job interviewing and networking events. Excessive course absences may influence a student's ability to pass a course and/or complete their degree.

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LEAVE OF ABSENCE
University Policy: https://www.cmu.edu/policies/student-and-student-life/student-leave.html

Policy Statement
Students must sometimes interrupt their studies for a variety of reasons (financial, academic or personal). Students choosing to take a leave of absence must first contact their department advisor to discuss their plans while on leave to work out any conditions that may be necessary for a smooth return to Carnegie Mellon.

A student may leave Carnegie Mellon by either withdrawing from the university (this means leaving the university with no intention of returning) or by taking a leave of absence (this means leaving the university temporarily, with the firm and stated intention of returning).

A Leave of Absence Form must be completed by all students requesting a leave of absence. A Withdrawal Form must be completed by all students who are withdrawing. Notifying instructors or no longer attending classes does not complete the process. Forms are available on The HUB website. Not completing the leave form results in tuition being charged to midpoint of the semester or the last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day a student turned in a class assignment.

Students are required to fill out all information on the form, including all comment sections relating to reasons for their leave of absence. After completion of the form, students must take it to their home department and dean's office for appropriate signatures. The process of taking a leave will not be complete until all necessary signatures are on the leave form. Under certain circumstances, students may also need the Dean of Student Affairs to sign off on the leave form. International students who are here on a F1 or J1 visa must consult the Office of International

Education for information on possible visa implications prior to going on leave.

Students on leave are not permitted to live in university housing, attend classes or maintain employment as students at Carnegie Mellon while their leave is in effect.

Doctoral candidates in ABD (All But Dissertation) status who wish to take a leave of absence should refer to the Doctoral Student Status policy.

Leaves during the academic semester will take effect as of the date signed by the student's dean. After the Leave of Absence or Withdrawal Form is received by the University's Registrar's Office, it will be reviewed for the appropriate tuition refunds (see Enrollment Services: Tuition and Fees Adjustment Policy) and grade implications. The recording of student courses and grades for taking a leave in a semester follows the deadlines for semester or mini courses, as follows:

- On or before the university deadline to drop classes with W (withdrawal) grades: all courses or grades are removed.
- After the university deadline to drop classes but before the last day of classes: W (withdrawal) grades will be assigned to all classes. (W grades apply to all undergraduate students, and graduate students in the Carnegie Institute of Technology, the Mellon College of Science or the Tepper School of Business.)
- After the last day of classes: Permanent grades assigned by the instructor will be recorded.

Procedural Steps for Student Leaves can be viewed here: https://www.cmu.edu/hub/registrar/leaves-and-withdrawals/index.html

STUDENT HOUSING

The CMU campus in Silicon Valley does not offer any on-campus housing or off-campus housing assistance. Students need to find their own housing. There is availability of housing, however, as many apartment complexes and/or room rentals are located within a commutable distance from the campus. Housing costs vary, but the average price for a 2 bedroom apartment is $3300-$3800/month. Most students choose to have roommates. While our student affairs office cannot act as a real estate agency or rental broker for you, we are happy to offer our advice or suggestions on locations that may be of interest to you. For questions, please contact the Director of Student Affairs at student-services@sv.cmu.edu

STUDENT RECORD RETENTION POLICY

University Policy: https://www.cmu.edu/es/docs/record-retention-policy.pdf

The policy of Carnegie Mellon University is to ensure the safety, accessibility, confidentiality, and good condition of the permanent record of every Carnegie Mellon student, past and present.

Carnegie Mellon University (CMU), established in 1900, holds all permanent records of our students (current and former) in the University Registrar's Office. We maintain original paper records in an offsite secure climate-controlled underground storage facility along with a microfilmed copy of each record. In addition, a copy of microfilmed records also resides in the University Registrar's Office in Pittsburgh, PA. This includes all students globally, include those students studying at our California teaching location and instructional sites. CMU has established the University Registrar's Office as the official data steward of all student records.

Historical Records 1906-1989

For every student enrolled at Carnegie Mellon University as a new or continuing student prior to the fall semester, 1989, and dating back to 1906, the University Registrar's Office of Carnegie Mellon University maintains a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not within the student's official transcript. The official transcript provides brief personal information to identify the student as unique. It contains courses, units and grades; semester and cumulative grade point averages; all degrees earned; transfer credit or advanced placement and dean's list indications.

The University Registrar's Office has established and maintains within a microfiche copy of good, readable, and reproducible quality of the student's permanent record in a secured records unit. A secondary permanent microfilm copy of all records will be maintained in good condition in the climate-controlled, fire-proof, limited-access security at an offsite facility.
Modern Records 1989-Current
For every student enrolling at Carnegie Mellon University as a new or continuing student beginning in fall semester, 1989, the University Registrar's Office of Carnegie Mellon University will establish and maintain within an electronic data file in the University Student Services Suite (S3, our student information system) a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not. The University Registrar's Office staff will, under the direction of the University Registrar, add to the electronic record such new information as pertains to the student's demographic and academic record as it becomes available, semester-by-semester, and as the student progresses in his/her career at Carnegie Mellon University.

Daily, the Carnegie Mellon University Computing Services Division will perform a backup of all databases that have been altered during that day. Weekly, the Computing Services Division will perform a complete

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backup of all records within the student data file. The Computing Services Division staff will store the daily backups in the climate-controlled, fire-proof, limited-access security facility in the Computer Operations center in Cyert Hall on the Carnegie Mellon University campus. Upon successful completion of the monthly backup, the Computing Services Division staff will securely transfer the weekly and monthly backups from the preceding month to climate-controlled, fire-proof, secured vault at an offsite facility.

Cessation of Operations
In the unlikely event that CMU (which has existed for more than 100 years) ceases to exist, it will make appropriate arrangements to comply with clauses (1) and (2) for all its students consistent with the Commonwealth of Pennsylvania statutes and law. I have an informal plan and agreement with the University of Pittsburgh's University Registrar's Office, that should either school cease, we would exchange student records.

STUDENT RIGHTS
University Policy: https://www.cmu.edu/policies/student-and-student-life/students-rights.html

Statement
The primary right of students is to pursue their education so long as they maintain their eligibility to remain a member of the community by meeting its academic standards and so long as they observe the regulations imposed by the university for the governance of the academic community.

The second right of students is to be recognized as members of the student body, with all the privileges pursuant thereto as to use of physical plant, university services and facilities.

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Every student has the constitutional rights and responsibilities of any citizen under the law. Conversely, a responsibility of any student is to respect these rights of any other member of the university community.

A student has the right to expect that academic and professional processes should be flexible and periodically open to review and to participate constructively with faculty and administration in those processes by which the university community maintains the excellence of the standards of its curriculum and methods of instruction and the viability of its total educational program.

The student has the right to recourse through the procedures outlined in The Word/Student Handbook against unreasonable academic action.

Summary of Graduate Student Appeal and Grievance Procedures
University Policy: https://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html

Introduction
Set forth below is a summary of the processes available to graduate students who seek review of academic and non-academic issues. Generally, graduate students are expected to seek informal resolution of all concerns within the applicable department, unit or program before invoking formal processes. When an informal resolution cannot be reached, however, a graduate student who seeks further review of the matter is to follow these formal procedures. To the extent that these processes are set forth in official University policies, links to those statements of policy and more detailed description of processes and procedures are included. Where a graduate student's concerns implicate multiple policies or processes, the University reserves the right

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to decide which process shall apply in order to avoid duplicative and potentially conflicting processes and decisions, or in appropriate circumstances, the order in which multiple reviews may occur.

These appeal and grievance procedures shall apply to students in all graduate programs of the University. Students should refer to the online handbooks (or hard copy handbooks if applicable) for their particular programs for more detailed information about the administration and academic policies of the program. To the extent that these policies conflict in any way with policies, processes and procedures adopted at the College, Department or Program level, the policies set forth herein shall govern.

Appealing Final Grades

Final grades will be changed only in exceptional circumstances and only with the approval of the instructor and the department, unit or program. Grading is a matter of sound discretion of the instructor and final grades are rarely changed without the consent of the instructor who assigned the grade. The following circumstances are the unusual exceptions that may warrant a grade appeal: (a) the final grade assigned for a course is based on manifest error (e.g. a clear error such as arithmetic error in computing a grade or failure to grade one of the answers on an exam), or (b) the faculty or staff member who assigned the grade did so in violation of a University policy. A graduate student who believes a final grade was assigned pursuant to (a) or (b) above should first present the case informally to the faculty or staff member responsible for the course in which the student believes an inappropriate grade has been awarded. If the student is not satisfied with the resolution at this first step, the student shall submit a formal, written appeal, with appropriate documentation, within the first fourteen (14) days of the semester following the awarding of the final grade under challenge, to the head of the department in which the course was offered. The department head

(or the program head if the department head chooses to delegate the decision to him/her) will issue a written decision on the appeal within 30 days, or as soon thereafter as practical. If the student is not satisfied with the decision of the department head (or program head), the student may submit a formal, written appeal, with appropriate documentation, within seven (7) days to the Dean of the college in which the course is offered. The Dean shall render a decision within 30 days, or as soon thereafter as practical. The decision of the Dean shall be final and not appealable.

Summary of Levels of Appeal for Final Grades:

- Informal discussion with the faculty member
- Formal written appeal to the department head (or the program head if the department head chooses to delegate the decision to him/her)
- Formal written appeal to the Dean
- Dean issues final non-appealable decision

See also Carnegie Mellon University Grading Policies

Appeal of Academic Actions

An "Academic Action" is an action by a program, unit or department based on a graduate student's academic performance or failure to satisfy academic program requirements. Examples of Academic Actions include, but are not limited to, academic probation, academic suspension, and dismissal/drop. Each college, department, or program may set its own academic requirements and standards for acceptable academic performance. These standards and benchmarks for performance are set forth in the online and/or hard copy handbooks for individual graduate programs.

Graduate students will be notified of an academic action in writing by the applicable department, unit, or program head or director, or designated committee. Graduate students are encouraged to seek informal

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resolution of any concerns related to academic actions informally within the department, unit or program before filing a formal appeal.

Graduate students who wish to appeal an Academic Action must submit a formal, written appeal, with appropriate documentation, to the Dean of the College within seven (7) calendar days after receipt of written notice of the academic action by the department, unit, or program head or director, or designated committee. The Dean may delegate review of the matter to another individual or committee, including but not limited to one of the Associate Deans, the College Council or a specially constituted grievance committee who shall make a recommendation to the Dean. The Dean shall render a decision on the appeal within thirty (30) days or as soon thereafter as practical.

Graduate students who wish to appeal the written decision of the Dean must submit a formal written appeal, with appropriate documentation, to the Provost within fourteen (14) calendar days after receipt of the Dean's decision. A copy of the appeal must also be submitted to the Assistant Vice Provost for Graduate Education and to the Dean. The Provost may delegate review of the matter to another individual or committee, including but not limited to the Vice Provost for Education who shall make a recommendation to the Provost. The Provost shall render a decision on the appeal within thirty (30) days or as soon thereafter as practical. Decisions by the Provost are final and not appealable.

Generally, sanctions resulting from an Academic Action (e.g. probation, suspension, or dismissal /drop) take effect immediately, regardless of whether an appeal is filed. In exceptional circumstances, however, the appropriate Dean or the Provost may elect to hold sanctions in abeyance pending the resolution of an appeal.

Summary of Levels of Appeal for Academic Actions:

- Seek informal resolution within department, unit, or program

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- Formal written appeal to the Dean
- Decision rendered by the Dean
- Formal written appeal to the Provost
- Provost issues final non-appealable decision

Appeal from Academic Disciplinary Actions
"Academic Disciplinary Action" refers to penalties or sanctions imposed for violation of academic policies against cheating, plagiarism or unauthorized assistance as defined by the University's official Policy on Academic Integrity.

The procedures for appeal from an Academic Disciplinary Action are set forth in the University's official policy on Academic Disciplinary Actions for Graduate Students. Graduate students who wish to appeal an Academic Disciplinary Action must state in writing to the Provost their intention to do so within seven (7) calendar days after the date on which the penalty is communicated to the student (the "penalty date"), and then must present their written appeal with appropriate documentation to the Provost no later than fourteen (14) calendar days after said penalty date. The Provost will then take action on the appeal. Graduate students who wish to appeal the Provost's decision must state in writing to the President their intention to do so within seven (7) calendar days of the decision of the Provost. For more details, please review the policy and procedures on Academic Disciplinary Actions for Graduate Students.

Generally, sanctions resulting from an Academic Disciplinary Action take effect immediately, regardless of whether an appeal is filed. In exceptional circumstances, however, the appropriate Dean or the Provost may elect to hold sanctions in abeyance pending the resolution of an appeal.

Summary of Levels of Appeal for Academic Disciplinary Actions:
- Academic disciplinary penalty imposed by faculty and/or department

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- Formal written appeal to the Provost
  o Provost issues decision
- Formal written appeal to the President (when policy permits)
  o President issues final non-appealable decision

Community Standards Violations
As members of the University community, Carnegie Mellon students are expected to respect the rights of all students, faculty and staff and adhere to the policies outlined in the Student Handbook contained in The Word, the University Policies website, and any applicable college, department or graduate program handbooks.

If a student has observed a violation of university policy or law, or feels harmed by another student's misconduct (e.g. affecting his/her welfare, property, safety or security) he/she should file a report with the Dean of Student Affairs and/or University Police as appropriate.

The procedures for adjudicating community standards violations and for appealing the results are available in The Word under Community Standards.

For more information about community standards and disciplinary procedures, please visit the Community Standards website.

Summary of Levels of Appeal for Community Standards Violations:

Harassment
Carnegie Mellon is firmly committed to intellectual honesty, freedom of inquiry and expression and respect for the dignity of each individual. Acts of harassment or intimidation by a student toward any member of the campus community will not be tolerated. Graduate students with concerns or grievances related to harassment or intimidation by another student should contact the Dean of Student

Affairs for resolution. Acts of harassment or intimidation by a student may be referred to the University Committee on Discipline.
Graduate Students with concerns or grievances related to alleged harassment or intimidation by a staff member, faculty member or other member of the campus community should contact the University Ombudsman and Assistant Vice President for Diversity and Equal Opportunity Services (412) 268-1018 for resolution.

Sexual Harassment and Sexual Assault
Graduate student grievances or concerns relating to sexual harassment will be handled according to the University's Policy against Sexual Harassment and Sexual Assault. Any member of the university community, whether faculty member, student, or staff member, who believes she or he has been the victim of sexual harassment and/or sexual assault or is aware of such conduct, is encouraged to make contact with any of the individuals identified in the Policy against Sexual Harassment and Sexual Assault under Resources: People Who Handle Complaints and Oversee Compliance with this Policy and in the appendices. They will make certain that your complaint is communicated to the appropriate resource for handling.

Intellectual Property Disputes
Disputes concerning rights to intellectual property must be resolved according to the procedures set forth in the University's Intellectual Property Policy.

Research Misconduct
Carnegie Mellon University is responsible for the integrity of research conducted at the University. As a community of scholars, in which truth and integrity are fundamental, the University has established procedures for the investigation of allegations of misconduct of research with due care to protect the rights of those accused, those making the allegations, and the University. The procedures for handling allegations of research

misconduct are set forth in the Policy for Handling Alleged Misconduct in Research at Carnegie Mellon University.
For graduate students found responsible for research misconduct, the President of the University may impose specific sanctions up to and including expulsion. The imposition of sanctions is subject to the procedures for approval and/or appeal prescribed for community standards violations, available at https://www.cmu.edu/student-affairs/theword/community-standards/index.html

Return from Leave of Absence
Graduate students who wish to return to Carnegie Mellon following a leave of absence must follow the procedures set forth in the Student Return Policy.
Generally, graduate students must negotiate their return to the University with their home academic department and follow any applicable departmental policies. If a department chooses to deny a student's return from a leave of absence, the student may appeal to the Dean of the College.

Suspension/Required Withdrawal
A University Suspension is a forced, temporary leave from the university. There are three types of suspension for students that apply to both graduate and undergraduate students:

- Academic Suspension is the result of poor academic performance or violation of academic regulations and is imposed by the student's college or academic department (see university and college academic policies).
- Disciplinary Suspension is the result of serious personal misconduct and is imposed by the Dean of Student Affairs (see The Word/Student Handbook).
- Administrative Suspension is the result of failure to meet university financial obligations or failure to comply with federal, state or local health regulations and is imposed by Enrollment

Services. (See Student Accounts Receivable Collection Policy and Procedures for financial obligations. Contact Student Health Services for information about health regulations.)

Graduate students who wish to appeal a suspension or required withdrawal may write to the following individuals depending on the type of suspension:

- Academic Suspension – The applicable department, unit, or program head;
- Disciplinary Suspension – Dean of Student Affairs
- Administrative Suspension –Vice President for Enrollment, Vice President for Business and Planning, and the Dean of Student Affairs, in consultation with the student's Associate Dean

For more details see the Student Suspension / Required Withdrawal Policy.

General Grievances

The following grievance procedures are to be used for graduate student problems or concerns that are not covered by any of the policies or procedures set forth above. As such, these grievance procedures may not be used as a substitute for procedures contemplated under any other policy, including but not limited to, policies regarding academic actions; academic disciplinary actions; community standards; harassment; sexual harassment; intellectual property; research misconduct or any other policy.

Graduate students are expected to discuss any concerns or grievances initially with the faculty or staff member(s) involved. Students are strongly encouraged to seek informal resolution of grievances through consultations within the academic unit, department or program. Students may also seek assistance with the informal resolution of a grievance through the designated college ombudsperson or the Assistant Vice Provost for Graduate Education.

If a grievance cannot be resolved informally with the faculty or staff member involved within the academic department, a student may submit a formal, written grievance to the head of the department, unit or program. If there is more than one student with a grievance on a particular matter, each student must submit a separate grievance. The department, unit, or program head, or director or designated committee will issue a written decision on the grievance within thirty (30) days or as soon thereafter as practical.

Graduate students who wish to appeal from the decision rendered at the department, unit or program level must submit a formal, written appeal to the Dean of the College within seven (7) calendar days after receipt of written notice of the decision by the department, unit, or program head, or director or designated committee. The Dean may delegate review of the matter to another individual or committee, including but not limited to one of the Associate Deans, the College Council or a specially constituted grievance committee who shall make a recommendation to the Dean. The Dean shall render a decision on the appeal within thirty (30) days or as soon thereafter as practical.

Graduate students who wish to appeal the written decision of the Dean must submit a formal written appeal to the Provost within seven (7) calendar days after receipt of the Dean's decision. A copy of the appeal must also be submitted to the Assistant Vice Provost for Graduate Education and to the Dean. The Provost may delegate review of the matter to another individual or committee, including but not limited to the Vice Provost for Education who shall make a recommendation to the Provost. The Provost shall render a decision on the appeal within thirty (30) days or as soon thereafter as practical. Decisions by the Provost are final and not appealable.

Summary of Levels of Appeal for General Grievances:

- Seek informal resolution within department, unit, or program
- Formal review by the appropriate department, unit, or program head, or director or designated committee.
- Formal written appeal to the Dean
- Formal written appeal to the Provost
- Provost issues final non-appealable decision

DEGREE & DIPLOMA DISTRIBUTION PROCESS

Based on the graduating semester, final diplomas are distributed to students through two channels – in person or direct mail. The full outline for this process and timeline for distribution can be reviewed here: https://www.cmu.edu/hub/registrar/graduation/diplomas/deadlines-and-distribution.html

COST OF ATTENDANCE

	# of Semesters	Entire Program	First Semester
MSSM (full time-12 month)	*3*	$80,192	$26,947
MSSM (full time- 16 month)	*3*	$83,611	$26,947
MSSM (part time local)	*6*	$83,601	$13,866
MSSM (part time remote)	*6*	$82,167	$13,633
MSTV	*2*	$58,319	$2,413*
MSTV (Dual Degree with University of Strathclyde)	*3*	$55,658	$26,947
* Students complete 3-unit internship in first semester			

Additional details regarding cost of attendance per degree can viewed here: https://www.cmu.edu/iii/degrees/admissions/cost.html

FINANCIAL ASSISTANCE

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There is no university funding provided for students at the Integrated Innovation Institute. Teaching or research assistantships are available to Ph.D. students only. All enrolled students, or their employers, are responsible for payment in full for tuition and expenses. Some students do secure external funding. You are welcome to explore the HUB website for information about graduate student financial aid, the Office of Graduate Education and the College of Engineering websites for external funding opportunities.

Meeting the cost of a graduate education is a significant investment. Carnegie Mellon University is committed to making it financially possible for graduate students to enhance educational development and reach their career goals. There are many financial aid resources available to students pursuing graduate studies at Carnegie Mellon University. Carnegie Mellon University participates in a number of Federal and state financial aid programs. Information about these financial aid programs can be found on Carnegie Mellon University's website, at http://www.cmu.edu/finaid/index.html

If you obtain a loan to pay for the MS in Software Management or MS in Technology Ventures programs, you will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If you have received federal student financial aid funds, you are entitled to a refund of moneys not paid from federal student financial aid program funds.

Carnegie Mellon University does not have a pending petition in bankruptcy, is not operating as a debtor in possession, and has not filed a petition in bankruptcy within the preceding 5 years, nor has Carnegie Mellon had a petition in bankruptcy filed against it within the preceding 5 years that resulted in re-organization under Chapter 11 of the United States Bankruptcy Code.

Carnegie Mellon University Consumer Information

Below is a summary of consumer information made available to all Carnegie Mellon University prospective and current students as required by the Higher Education Act of 1965, as amended. Required Disclosure have been categorized into five topics. Each disclosure gives a brief description of information that is required to be disclosed and explains how it can be obtained. This information may be changed from time to time as required.

If you need assistance or would like a paper copy, contact the Student Financial Aid Office, 5000 Forbes Avenue, Warner Hall, Pittsburgh, PA. If you wish to speak with a representative about the information contained here, please contact Associate Director Catherine Demchak at (412) 268-1353.

Information about the Institution:

Accreditation Information

Carnegie Mellon University is accredited by the Middle States Commission on Higher Education (MSCHE), 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104 (www.msche.org). The Commission may be contacted by telephone at 267-284-5000 or via email at info@msche.org or espanolinfo@msche.org (Spanish/Español). The university's current "Statement of Accreditation Status" can be found at, https://www.msche.org/institution/.

State Approvals

Carnegie Mellon University is licensed to operate in the states listed below. Individuals may contact the relevant agency for more information or information about how to file a complaint.

California

Bureau for Private Postsecondary Education
P.O. Box 980818
West Sacramento, CA 95798-0818
Telephone: 888-370-7589
Email: bppe@dca.ca.gov
Website: www.bppe.ca.gov

New York
New York State Education Department
Office of Higher Education
Room 977 Education Building Annex
Albany, NY 12234
Telephone: 518-486-3633
Email: hedepcom@nysed.gov
Website: www.highered.nysed.gov

Pennsylvania
Pennsylvania Department of Education
Office of Postsecondary and Higher Education
333 Market Street, 12th Floor
Harrisburg, PA 17126-0333
Telephone: 717-783-8228
Email: ra-collunivseminfo@pa.gov
Website: www.education.state.pa.us

Washington, D.C.
Office of the State Superintendent of Education
Government of the District of Columbia
810 First Street NE 9th Floor
Washington, DC 20002
Telephone: 202-727-6436
Email: osse@dc.gov
Website: osse.dc.gov

Inquiries regarding the university's accreditation status or authorization to operate in any of the above states may be directed to: Associate Vice President / Director of Enrollment Services, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh PA 15213, telephone: 412-268-5399, email: krieg@andrew.cmu.edu.

Distance Education, State Authorization and Reciprocity Agreement (SARA)

The State Authorization Reciprocity Agreement (SARA) is an agreement among member states, districts, and territories in the United States, which establishes national standards for interstate offering of postsecondary distance education courses and programs. It is intended to standardize the process of offering online courses and programs by postsecondary institutions located in states other than the state in which the enrolled student(s) are residing. SARA is overseen by a national council (NC-SARA) and administered by four regional education compacts.

Carnegie Mellon University has been approved by the Commonwealth of Pennsylvania to participate in NC-SARA and was accepted as a SARA institution on May 2, 2017; additionally, Carnegie Mellon secured approval through NC-SARA on May 18, 2017. Carnegie Mellon University is listed as an approved, participating institution on the NC-SARA website (http://www.nc-sara.org/). At this time, 49 of the 50 United States are SARA members. California is not a member of SARA; however, Carnegie Mellon is able to offer online education to California residents.
Except where prohibited by applicable law, students who reside outside of the United States generally are not restricted from enrolling in our online programs. Some online programs do require in-person attendance at one of Carnegie Mellon's teaching locations (e.g., Carnegie Mellon's Pittsburgh, Pennsylvania campus) for short portions of the program. Students interested in enrolling in a specific online program are

encouraged to contact the person designated by the online program for questions about the program's requirements or enrollment.

Copyright Infringement Policies

Carnegie Mellon University takes copyright violation seriously. Besides raising awareness about copyright law, it takes appropriate action in support of enforcement as required by policy and law. United States copyright law (http://www.copyright.gov/) "protects the original works of authorship fixed in any tangible medium of expression, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device".
The University's Fair Use Policy (http://www.cmu.edu/policies/administrative-and-governance/fair-use.html) states that all members of the University must comply with US copyright law and it explains the fair use standards for using and duplicating copyrighted material. In addition, the policy prohibits the duplication of software for multiple uses, meeting the Digital Millennium Copyright Act (DMCA) (http://www.copyright.gov/legislation/dmca.pdf) requirements. The DMCA criminalizes the development or use of software that enables users to access material that is copyright protected. Furthermore, the Computing Policy (http://www.cmu.edu/policies/information-technology/computing.html) prohibits the distribution of copyright protected material via the University network or computer systems, unless the copyright owner grants permission.

The Higher Education Opportunity Act of 2008 (Public Law 110-315) Section 488, requires institutions of higher education to annually inform students that "unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject the students to civil and criminal liabilities". Carnegie Mellon does this by publication of a news article on Computing Services' website or via mass mail communication each semester. The law goes on to require

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institutions "to provide a summary of penalties for violation of Federal copyright laws, including disciplinary actions that are taken against students who engage in unauthorized distribution of copyrighted materials using the institution's information system." Copyright protected materials can include, but are not necessarily limited to:

- Music
- Movies or other videos
- Literary works
- Software
- Digital images or libraries

Cost of Attending the University

Actual tuition and fee charges can be found on the Student Financial Services' website at https://www.cmu.edu/sfs/tuition/index.html. For estimated books and supplies, room and board, and personal/miscellaneous expenses view the cost of attendance for, Graduate program at https://www.cmu.edu/sfs/tuition/graduate/index.html.

Descriptions of Academic Programs

Information on the university's graduate academic programs and degree offerings is available from the various schools/colleges and admitting offices. Links to those programs can be found at https://www.cmu.edu/academics/index.html.

Faculty

Information on the university's faculty and instructional personnel is available from individual schools/colleges. This information can be found on the university's academics website at https://www.cmu.edu/academics/index.html.

Facilities & Services for Disabled Students

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The Office of Disability Resources provides responsive and reasonable accommodations to students who self-identify as having a disability, including physical, sensory, cognitive and emotional disabilities. If you would like to learn more about the services and accommodations provided by the Office of Disability Resources, visit their website at https://www.cmu.edu/disability-resources/students/. To discuss your accommodation needs, please email us at access@andrew.cmu.edu or call us at 412-268-6121 to set up an appointment.

Student Privacy & FERPA

One of the most significant changes a parent or guardian experiences in sending a student to college is the difference in privacy standards for educational records. Carnegie Mellon values the student's right to privacy. The university adheres to a federal law called the Family Educational Rights and Privacy Act (also called FERPA or the Buckley Amendment) that sets privacy standards for student educational records and requires institutions to publish a compliance statement, including a statement of related institutional policies. For more detailed information, view the university's brochure at https://www.cmu.edu/hub/privacy/ferpa-brochure.pdf.

Return to Title IV Funds Policy and Procedural Statement

Policy Reason

The U. S. Department of Education requires that the university determine the amount of Federal Title IV aid earned by a student who withdrawals of fails to complete the period of enrollment. The university must determine the earned and unearned portions of Title IV aid as of the date the student ceased attendance based on the amount of time the student spent in attendance. Up through the 60% point in the period of enrollment, a pro rata schedule is used to determine the amount of Title IV funds the student has earned at the time of withdrawal. After the 60% point in the period of enrollment, a student has earned 100% of the Title

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IV funds he or she was scheduled to receive. For a student who withdraws after the 60% point-in-time, there are no unearned funds. Federal regulations can be found at:

Federal Student Aid Handbook, Volume 5
Chapter 1 Withdrawals and the Return of Title IV Funds 34 CFR 668.22

Policy and Procedural Statement

At Carnegie Mellon Title IV funds are awarded to a student under the assumption that the student will attend school for the entire period for which the assistance is awarded. When a student withdraws, the student may no longer be eligible for the full amount of Title IV funds that the student was originally scheduled to receive.

If a recipient of Title IV grant or loan funds withdraws from a school after beginning attendance, the amount of Title IV grant or loan assistance earned by the student must be determined. If the amount disbursed to the student is greater than the amount the student earned, the unearned funds must be returned. If the amount disbursed to the student is less than the amount the student earned, and for which the student is otherwise eligible, he or she is eligible to receive a Post-withdrawal disbursement of the earned aid that was not received.

Carnegie Mellon determines the Withdrawal Date and Date of Determination to complete the return calculation. A student's withdrawal date and date of determination varies depending on the type of withdrawal. When a student provides official notification to Carnegie Mellon through the Student Leave of Absence and Withdrawal Process, the withdrawal is defined as official withdrawal. When the student does not complete the Student Leave of Absence and Withdrawal Process and no official notification is provided by the student it is considered an unofficial withdrawal.

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Leave of Absence/Withdrawal Process
A student may leave Carnegie Mellon by either taking a leave of absence (leaving the university temporarily with the firm and stated intention of returning) or by withdrawing from the university (leaving the university with no intention of returning). Students choosing to take a leave of absence should first contact their academic advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon. A student deciding to leave the university should take the following steps:

- Complete a Leave of Absence or Withdrawal Form.
- The form must include **all** necessary signatures or the process will not be completed.
- Return the completed form to the University Registrar's Office, 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213.

Determination of Withdrawal Date

Official Withdrawals (Notification Provided by the Student)
Those withdrawals defined as official are processed in accordance with federal regulations. The Office of the Registrar provides information that identifies which students have processed a Student Leave of Absence and Withdrawal Form for each semester. This information includes the Date of Withdrawal, the Date of Determination, Withdrawal/Leave Status (LA, LS, & W2) and the semester of attendance. This information is maintained in the student's academic file and in the university's Student Information System.

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- Date the student began the withdrawal or leave of absence process;
- Date the student notified his or her home department;

- Date the student notified the associate dean of his or her college; or
- Date the student notified the dean of students.

Unofficial Withdrawal (No Official Notification Provided by the Student)
For a student who withdraws without providing notification to Carnegie Mellon, the institution determines the withdrawal date using defined criteria. This category of withdrawals includes students that drop out and students that do not earn a passing grade.
To identify the unofficial withdrawals the Registrar develops a preliminary list of students that did not complete the semester by reviewing the final student grade reports. The list includes all students with: a) semester units carried, b) 0 semester units passed, c) 0 quality points earned, and d) 0.0 QPA. The Registrar contacts the academic divisions about each student to determine if the student actually completed the semester and earned the grades (0.0) or failed to complete the semester and did not notify the university of their status.
For students who do not notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- The midpoint of the semester;
- The last date the student attended an academically-related activity such as an exam, Tutorial or study group, or the last day a student turned in a class assignment.

Date of Determination that the Student Withdrew
Carnegie Mellon is not required to take attendance and the Date of Determination that a student withdrew varies depending upon the type of withdrawal: Official or Unofficial.

1. For withdrawals where the student **provided *Official Notification*** the Date of Determination is: The student's withdrawal date, or the date of notification, whichever is later.

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2. For withdrawals where the student **did not provide *Official Notification*** the Date of Determination is: The date the institution becomes aware the student has ceased attendance.

For a student who withdrawals without providing notification to the institution, the institution must determine the withdrawal date no later than 30 days after the end of the enrollment period.

Calculation of Earned Title IV Assistance

The withdrawal date is used to determine the point in time that the student is considered to have withdrawn so the percentage of the period of enrollment completed by the student can be determined. The percentage of Title IV aid earned is equal to the percentage of the period of enrollment completed.

The amount of Title IV federal aid earned by the student is determined on a pro-rata basis up to the end of 60% of the semester. If the student completed 30% of a term, 30% of the aid originally scheduled to be received would have been earned. Once a student has completed more than 60% of a term, all awarded aid (100%) has been earned. The percentage of federal aid earned and the order in which the unearned aid is returned are defined by federal regulatory requirements.

The calculation of earned Title IV funds includes the following grant and loan funds if they were disbursed or could have been disbursed to the student for the period of enrollment for which the Return calculation is being performed:

- Pell Grant
- Iraq and Afghanistan Service Grant
- TEACH Grant (not available at Carnegie Mellon)
- FSEOG Grant

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- Federal Direct Loan

Institutional Charges
Institutional charges are used to determine the portion of unearned Title IV aid that the school is responsible for returning. Carnegie Mellon ensures that all charges for tuition, fees, room and board, as well as all other applicable institutional charges are included in the return calculation. Institutional charges do not affect the amount of Title IV aid that a student earns when he or she withdraws.
The institutional charges used in the calculation usually are the charges that were initially assessed the student for the period of enrollment. Initial charges are only adjusted by those changes the institution made prior to the student's withdrawal (for example, for a change in enrollment status unrelated to the withdrawal). If, after a student withdraws, the institution changes the amount of institutional charges it is assessing a student, or decides to eliminate all institutional charges, those changes affect neither the charges nor aid earned in the calculation.

Return of Unearned Funds to Title IV
If the total amount of Title IV grant and/or loan assistance that was earned as of the withdrawal date is less than the amount that was disbursed to the student, the difference between the two amounts will be returned to the Title IV program(s) and no further disbursements will be made.

If a student has received excess funds, the College must return a portion of the excess equal to the lesser of the student's institutional charges multiplied by the unearned percentage of funds, or the entire amount of the excess funds.

The funds will be returned in the order below as prescribed by federal regulations, within 45 days from the date of determination that a student withdrew.

- Unsubsidized Federal Stafford Loans
- Subsidized Federal Stafford Loans
- Federal PLUS loans
- Federal Pell Grants
- Federal Supplemental Educational Opportunity Grants (FSEOG)

Post-Withdrawal Disbursements
If the total amounts of the Title IV grant and/or loan assistance earned as of the withdrawal date is more than the amount that was disbursed to the student, the difference between the two amounts will be treated as a post-withdrawal disbursement. In the event that there are outstanding charges on the student's account, Carnegie Mellon will credit the student's account for all or part of the amount of the post-withdrawal disbursement up to the amount of the allowable charges.

Any amount of a post-withdrawal disbursement that is not credited to a student's account will be offered to the student within 30 days of the date that the institution determined that the student withdrew. Upon receipt of a timely response from the student, the College will disburse the funds within 90 days of the date of determination of the student's withdrawal date.

Return of Title IV Funds – Withdrawals for Programs Offered in Modules
The return of Title IV funds for programs offered in modules is defined in a separate policy statement at Carnegie Mellon. This document is included as an addendum to the Carnegie Mellon University Return to Title IV Funds Policy and Procedural Statement (see below).

Policies and Procedures

Federal Student Aid Handbook, Volume 5, Chapter 2 Withdrawals and the Return of Title IV Funds

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CFR 668.22 (a), (f) and (l)
Dear Colleague Letter GEN-11-14 July 2011

For all programs offered in modules, a student is a withdrawal for Title IV purposes if the student ceases attendance at any point prior to completing the payment period or period of enrollment (unless the institution has written confirmation from the student that that they will attend a module that begins later in the enrollment period).

The regulations require the institution to determine whether Title IV funds must be returned based on the number of days actually completed versus the number of days the student was scheduled to attend in the payment period. The regulations prevent students from enrolling in modules or compressed courses spanning the period, completing a portion of the period, and retaining all aid for the period.

A program is considered to be offered in modules if a course or courses in the program do not span the entire length of the payment period or period of enrollment. The rule impacts all programs offering courses shorter than an entire semester, including semester-based programs with a summer term consisting of two consecutive summer sessions.

The Student Financial Aid Office has established the following procedures associated with handling withdrawals from programs offered in modules. An Associate Director of Student Financial Aid has the primary responsibility for compliance and implementation of these regulatory requirements.

1. The institution will identify students enrolled for the summer session that are eligible for Title IV Aid.
    - Pell eligible students are identified
    - Students with summer loans are identified
    - The period of enrollment and enrollment status will be identified for each student

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2. All Leave/ Withdrawal Forms processed by the University Registrar's Office will be reviewed for the summer sessions to record the Withdrawal Date and Date of Determination to identify any student receiving federal funding.
3. The Student Financial Aid Office will identify any students that drop courses in the summer sessions.
    - During Summer I this is standard procedure
    - During Summer II this is reviewed after 10th day reporting
    - Any additional dropped courses will be reviewed through the 60% enrollment period
4. Students who are identified as official withdrawals or that officially drop all courses in a session will be reviewed to determine the amount of federal financial aid earned. If a Return of Title IV aid is required, existing institutional procedures will be followed.
5. At the end of the enrollment period the institution will determine if any students are identified as 'unofficial withdrawals.' If a Return of Title IV aid is required, existing institutional procedures will be followed.
6. If a student does not begin courses in all sessions, a Return of Title IV aid may not be required, but other regulatory provisions concerning recalculation may apply.
    - If a student completes both courses in module one, but officially drops courses in module two while attending module one the student is not a withdrawal.
    - Since the enrollment is less than half time, the student is no longer eligible for the loan and the funds must be returned.

The following information obtained from the Federal Student Aid Handbook, Chapter 2, Withdrawals and the Return of Title IV Funds, will be used to determine whether a student enrolled in a series of modules is a withdrawal.

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How to determine whether a student in a program offered in modules has withdrawn

Schools can determine whether a student enrolled in a series of modules is a withdrawal by asking the following questions.

1. ***After beginning attendance in the payment period or period of enrollment, did the student cease to attend or fail to begin attendance in a course he or she was scheduled to attend?***

- If the answer is no, this is not a withdrawal.
- If the answer is yes, go to question 2.

2. ***When the student ceased to attend or failed to begin attendance in a course he or she was scheduled to attend, was the student still attending any other courses?***

- If the answer is yes, this is not a withdrawal; however other regulatory provisions concerning recalculation may apply.
- If the answer is no, go to question 3.

3. ***Did the student confirm attendance in a course in a module beginning later in the period (for non-term and nonstandard term programs, this must be no later than 45 calendar days after the end of the module the student ceased attending)?***

- If the answer is yes, this is not a withdrawal, unless the student does not return.
- If the answer is no, this is a withdrawal and the Return of Title IV Funds requirements apply.

Contact
Questions regarding this policy or its intent should be directed to the Student Financial Aid Office at 412-268-1353.

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Satisfactory Academic Progress Policy and Procedural Statement

To be eligible for federal, state, and institutional financial aid, all students are required to maintain Satisfactory Academic Progress toward the completion of a degree. Each university determines its own policy in accordance with federal regulations set forth by the U. S. Department of Education regarding satisfactory progress standards to ensure student success. To maintain Satisfactory Academic Progress at Carnegie Mellon University, students must meet the following minimum standards for both of the qualitative (QPA) and quantitative (completion rate) measures:

Student Type	QPA (Qualitative)	Completion Rate (Quantitative)*
First Year Undergraduate	1.75	80%
Undergraduate Upper-class	2.00	80%
Heinz Graduate	3.00	80%
Other Graduate (excluding Tepper)	2.00	80%

**To calculate the completion rate, the cumulative number of completed units is divided by the cumulative number of units attempted. Advance Placement credits are excluded from both figures.*

In addition to the above mentioned Financial Aid Satisfactory Academic Progress standards, federal regulations require a student to complete their degree within a specified amount of time. The maximum timeframe cannot exceed 150 percent of the time published as needed for completion of the program.

Scope:

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This policy applies to Federal aid including Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Work-Study, Federal Direct Loans, and Federal Direct PLUS Loan programs; state grant aid; and Carnegie Mellon institutional aid including grants, loans, and scholarships.

Federal regulations can be found at,

Federal Student Aid Handbook, Volume 1
Chapter 1 School Determined Requirements
34 CFR 668.16(e)
34 CFR 668.32(f)
34 CFR 668.34

Evaluation:
Carnegie Mellon evaluates all students for Financial Aid Satisfactory Academic Progress annually, at the end of the spring semester. Students that are included in the review are undergraduates, graduates, both full-time and part-time.

Courses that do not count toward a student's degree cannot be used to determine enrollment status for financial aid purposes. Carnegie Mellon will count transfer credit hours that are accepted toward a student's educational program as both attempted hours and completed hours. Advanced Placement Non-Degree and Non-Credit courses are not counted as units passed or attempted. When a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student's QPA. For financial aid eligibility, only one repeat per course is permitted in the determination of enrollment status for courses previously passed.

If the student withdraws and is not assigned a W grade, then it will not be counted in the number of units attempted or completed. If the W grade is

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assigned, the units will be counted in the number of units attempted and will be counted as zero in the number of units completed.

If the student has incomplete units, the units will be counted as attempted and will be counted as zero in the number of units completed.

The Financial Aid Satisfactory Academic Progress evaluation is a cumulative review of all semesters, regardless of whether or not the student received financial aid during the academic year.

If the minimum requirements are not achieved, the student is ineligible to receive financial aid. In such a case, the student is notified and given an option to appeal their financial aid status. More information about the appeal process can be found at https://www.cmu.edu/sfs/financial-aid/special-circumstances/policies.html

A financial aid package will not be completed unless an appeal is received, approved and processed accordingly. If by chance a financial aid package is processed and released to the student, it is conditional and subjected to financial aid removal until an appeal is received, approved and processed accordingly.

Contact:
Accountable Department: Enrollment Services, Student Financial Aid.
Questions regarding this policy or its intent should be directed to the Student Financial Aid Office, phone: 412-268-1353.

Student Body Diversity
For Information about the diversity of the university student body, contact the Institutional Research and Analysis Office, https://www.cmu.edu/ira/index.html.

For information about the University's Diversity, Equity and Inclusion initiative, visit the Center for Student Diversity and Inclusion's website at https://www.cmu.edu/student-diversity/.

Written Arrangement Information

A U.S. Department of Education regulation requires disclosure of specific information to prospective and current students regarding written arrangements between Carnegie Mellon University (CMU) and any institution(s) that provides a portion of an educational program to students enrolled at CMU. CMU enters into such arrangements to enrich the educational experiences offered to its students. In accordance with the regulation, CMU provides this information at http://www.cmu.edu/hub/consumer-information/docs/written-arrangement.pdf.

Student Complaints & Consumer Information by State

As required for compliance with U.S. Federal Program Integrity Regulations, state official/agency contact information for each U.S. state/territory that could handle a student's complaint is provided at https://www.cmu.edu/hub/consumer-information/docs/complaints.pdf.

Gainful Employment Disclosures

As required by U.S. Department of Education regulations Gainful Employment Disclosures (Disclosures about CMU certificate programs that prepare students for specific occupations) can be found at https://www.cmu.edu/hub/consumer-information/.

Information about Student Financial Aid:

Meeting the cost of higher education is a significant investment. We are committed to providing a comprehensive financial aid program that makes it possible for admitted students to attend Carnegie Mellon.

Application Process & Timeline:

Graduate Students: To apply for financial aid for the 2018-2019 academic year, follow the steps below.

1. Free Application for Federal Student Aid (FAFSA)

The FAFSA is required if applying for federal financial aid programs. There are now two ways to complete the *Free Application for Federal Student Aid (FAFSA)* form: a redesigned https://studentaid.ed.gov/sa/fafsa website or a mobile app (available through Google Play, https://play.google.com/store/apps/details?id=com.fsa.mystudentaid or the Apple App Store, https://itunes.apple.com/us/app/mystudentaid/id1414539145).

We recommend using the IRS Data Retrieval Tool (DRT) (https://studentaid.ed.gov/sa/resources/irs-drt-text) to complete the FAFSA. The DRT transfer process has been improved to include stronger security and privacy protections; therefore, tax information transferred will not display on the form or Student Aid Report. Instead, the phrase "Transferred from the IRS" will appear in the fields.

Those selected for federal verification after FAFSA completion or those unable to use the IRS DRT will need to request an IRS Tax Return Transcript (https://www.irs.gov/individuals/get-transcript).

Additional information:

- Apply as soon as possible after October 1.
- Carnegie Mellon's federal code is 003242.
- Use 2017 tax information to complete the FAFSA.
- A Department of Education Federal Student Aid (FSA) ID is required. View FSA ID instructions at https://fsaid.ed.gov/npas/index.htm.
- Students must complete the FAFSA's electronic signature requirement.

2. MPN & Entrance Counseling

All first-time Federal Direct Loan borrowers are required to complete entrance counseling. The entrance counseling session provides

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information about borrower rights and responsibilities. CMU will be notified when a student has completed online entrance counseling. Funds will not be disbursed until the entrance counseling session has been completed. Students who completed a federal entrance counseling session while at CMU, do not have to complete another session.
Additional information:

- View entrance counseling instructions (https://www.cmu.edu/sfs/financial-aid/types/federal-loans/direct/mpn-entrance-counseling.html).
- Complete entrance counseling session at https://studentloans.gov.

3. Grad PLUS Loan

If you plan on borrowing a Federal Direct Graduate PLUS Loan, this is a two-part process and both parts must be completed in order for your loan to be originated. If you borrowed a Grad PLUS Loan last academic year, you are only required to complete the application portion of the process. The application portion of the process cannot be completed before June 1.
Additional information:

- View detailed Grad PLUS Loan instructions at https://www.cmu.edu/sfs/financial-aid/types/federal-loans/plus/instructions.html.
- The two-part process may be completed at https://studentloans.gov.

Financial Aid Eligibility Notification

Once a student completes all of the steps above, a financial aid package will be determined. The Student Financial Aid Office will notify the student by email that a financial aid award letter has been posted to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home). The letter contains information and further instructions regarding the student's eligibility and awards. If a student's circumstances change, then financial

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aid eligibility will be re-evaluated and the student will receive notification that a revised award letter is available in SIO.

Missing Documents
If we are unable to process a student's financial aid package due to missing documents, a Financial Aid Alert email will be sent to the student requesting the required documents by a specified date. Until the entire application process is completed and all required documents are submitted, our office may be unable to complete a student's financial aid package. Students may log in to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home) to view documents that have been received by our office. View instructions for submitting missing documents at https://www.cmu.edu/sfs/financial-aid/missing-documents/index.html.

Teacher Certification
Teacher certification students at the graduate level should be aware that federal regulations classify them as a grade level 5 undergraduate student for Federal Direct Student Loan purposes. Teacher certification students are, however, considered a graduate student by Carnegie Mellon for academic purposes.

Available Financial Aid
Scholarships & Grants

Graduate Students:
Graduate students interested in scholarships and grants may contact their program of interest or department. View more information on the Graduate Education Office website, http://www.cmu.edu/graduate/prospective-students/index.html. In addition, the Fellowships & Scholarships Office (http://www.cmu.edu/fso/) provides support to graduate students

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interesting in pursing certain external scholarships, like Fullbright and UK Awards.

Federal Work-Study
Federal Work-Study (FWS) is a need-based self-help award. If a student has been awarded FWS, the FWS award is the total that can be earned during the academic year as a work-study student.

Federal Loans
For many students and families, educational loans are a necessary part of the process of paying for college. Student Financial Aid certifies loans for students, as well as Federal Direct Parent PLUS Loans for parents of undergraduates and Federal Direct Grad PLUS Loans for graduate students.

Federal Direct Student Loan
The Federal Direct Student Loan is the most widely-used loan for college students and is available to both undergraduate and graduate students. There are two types of Federal Direct Student Loans, subsidized and unsubsidized, and eligibility for both is determined by completing the FAFSA.

Grad PLUS Loan
Eligible graduate students may borrow a Federal Direct Grad PLUS Loan to assist with educational expenses. Students may borrow any amount up to their calculated cost of attendance minus any other aid received.

Private Loans
Private loan programs offer competitive interest rates and borrower benefits. To increase chances of approval and possibly improve the rate you receive, students are strongly recommended to apply with a creditworthy co-signer.

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Student Outcomes

Retention and Graduation Rates

Institutional Research and Analysis Office offers up-to-date data on degrees conferred, enrollment reports, freshmen retention rates and race and ethnicity reports for annual degrees. Retention and Graduation rates can be found at https://www.cmu.edu/ira/retentiongradrates.html.

Intercollegiate Athletic Program Participation Rates and Financial Support Data (Equity in Athletics Disclosure Act)

Please visit the U.S. Department of Education's site, The Equity in Athletics Data Analysis (http://ope.ed.gov/athletics/#/) and select the "Get data for one schools" option. Enter "Carnegie Mellon University" in the "Name" field and select the "Continue" button at the bottom of the page. A printed copy of the report can be requested by calling the Department of Athletics, Physical Education, and Recreation at 412-268-8054 or by sending an email to Josh Centor, Associate Vice President for Student Affairs and Director of Athletics, Physical Education & Recreation, at jcentor@andrew.cmu.edu.

Health and Safety

Drug and Alcohol Abuse Prevention Program

Under the Drug Free Workplace Act of 1988 and the Drug Free Schools and Campuses Act of 1989, the Carnegie Mellon University is required to have an alcohol and other drug policy outlining prevention, education and intervention efforts and consequences for policy violations. The policy can be found at https://www.cmu.edu/policies/administrative-and-governance/alcohol-and-drug-policy.html.

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CMU Annual Security and Fire Safety Report

- A printed copy of the report can be requested by contacting University Police at 412-268-6232 or campuspd@andrew.cmu.edu.
- The annual security and fire safety report (Carnegie Mellon University Police Department Annual Reports) is also available online at http://www.cmu.edu/police/security-fire-reports/index.html.

Vaccination Policies

- CMU Prematriculation Immunization Policy can be found at http://www.cmu.edu/policies/student-and-student-life/immunizations.html.
- CMU University Health Services Health Requirements for Incoming Students can be found at https://www.cmu.edu/health-services/new-students/.

Other Information

Voter Registration

Please visit https://www.usa.gov/register-to-vote

Carnegie Mellon Ethics Hotline

The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to financial matters, academic and student life, human relations, health and campus safety or research. Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net (user name: tartans; password: plaid). All submissions will be reported to appropriate university personnel.

The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

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Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the university ombudsman, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-1018. Obtain general information about Carnegie Mellon University by calling 412-268-2000.

Carnegie Mellon University publishes an annual campus security and fire safety report describing the university's security, alcohol and drug, sexual assault and fire safety policies, and containing statistics about the number and type of crimes committed on the campus, and the number and cause of fires in campus residence facilities during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The annual security and fire safety report also is available online at www.cmu.edu/police/annualreports.

Information regarding the application of Title IX, including to admission and employment decisions, the sexual misconduct grievance procedures and process, including how to file a report or a complaint of sex discrimination, how to file a report of sexual harassment, and how the university responds to such reports is available at www.cmu.edu/title-ix. The Title IX coordinator may be reached at 5000 Forbes Ave., 140 Cyert Hall, Pittsburgh, PA 15213; 412-268-7125; or tix@cmu.edu.

Safeguarding Educational Equity / Sexual Misconduct Policy

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The University prohibits sex-based discrimination, sexual harassment, sexual assault, dating/ domestic violence and stalking. The University also prohibits retaliation against individuals who bring forward such concerns or allegations in good faith. The University's Sexual Misconduct Policy is available at https://www.cmu.edu/policies/administrative-and-governance/sexual-misconduct/index.html. The University's Policy Against Retaliation is available at https://www.cmu.edu/policies/administrative-and-governance/whistleblower.html. If you have been impacted by any of these issues, you are encouraged to make contact with any of the following resources:

- Office of Title IX Initiatives, https://www.cmu.edu/title-ix/ 412-268-7125, tix@cmu.edu
- University Police, 412-268-2323

STUDENT TUITION RECOVERY FUND

The State of California established the Student Tuition Recovery Fund (STRF) to relieve or mitigate economic loss suffered by a student in an educational program at a qualifying institution, who is or was a California resident while enrolled, or was enrolled in a residency program, if the student enrolled in the institution, prepaid tuition, and suffered an economic loss. Unless relieved of the obligation to do so, you must pay the state-imposed assessment for the STRF, or it must be paid on your behalf, if you are a student in an educational program, who is a California resident, or are enrolled in a residency program, and prepay all or part of your tuition.

You are not eligible for protection from the STRF and you are not required to pay the STRF assessment, if you are not a California resident, or are not enrolled in a residency program.

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It is important that you keep copies of your enrollment agreement, financial aid documents, receipts, or any other information that documents the amount paid to the school. Questions regarding the STRF may be directed to the Bureau for Private Postsecondary Education, 1747 North Market Blvd, Suite 225, Sacramento, CA 95834, (916) 574-8900 or (888) 370-7589.

To be eligible for STRF, you must be a California resident or are enrolled in a residency program, prepaid tuition, paid or deemed to have paid the STRF assessment, and suffered an economic loss as a result of any of the following:

1. The institution, a location of the institution, or an educational program offered by the institution was closed or discontinued, and you did not choose to participate in a teach-out plan approved by the Bureau or did not complete a chosen teach-out plan approved by the Bureau.
2. You were enrolled at an institution or a location of the institution within the 120 day period before the closure of the institution or location of the institution, or were enrolled in an educational program within the 120 day period before the program was discontinued.
3. You were enrolled at an institution or a location of the institution more than 120 days before the closure of the institution or location of the institution, in an educational program offered by the institution as to which the Bureau determined there was a significant decline in the quality or value of the program more than 120 days before closure.
4. The institution has been ordered to pay a refund by the Bureau but has failed to do so.
5. The institution has failed to pay or reimburse loan proceeds under a federal student loan program as required by law, or has failed to pay or reimburse proceeds received by the institution in excess of tuition and other costs.

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6. You have been awarded restitution, a refund, or other monetary award by an arbitrator or court, based on a violation of this chapter by an institution or representative of an institution, but have been unable to collect the award from the institution.
7. You sought legal counsel that resulted in the cancellation of one or more of your student loans and have an invoice for services rendered and evidence of the cancellation of the student loan or loans.

To qualify for STRF reimbursement, the application must be received within four (4) years from the date of the action or event that made the student eligible for recovery from STRF.

A student whose loan is revived by a loan holder or debt collector after a period of noncollection may, at any time, file a written application for recovery from STRF for the debt that would have otherwise been eligible for recovery. If it has been more than four (4) years since the action or event that made the student eligible, the student must have filed a written application for recovery within the original four (4) year period, unless the period has been extended by another act of law.
However, no claim can be paid to any student without a social security number or a taxpayer identification number.

Updated: 7/7/2021

Carnegie Mellon University | integrated innovation institute

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4612 Forbes Ave • Pittsburgh, PA • 15213

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INI Pittsburgh - Silicon Valley School Catalog

Academic Year 2021-2022 (August 30, 2021 to April 29, 2022) as defined by the Official Academic Calendar at https://www.cmu.edu/hub/calendar/docs/2122-academic-calendar.pdf

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Campus Information

Standard Disclosure

Carnegie Mellon University (CMU) is a private, non-profit institution, approved to operate in California by the California Bureau for Private Postsecondary Education. Approval to operate means compliance with state standards as set forth in the California Private Postsecondary Education Act of 2009. CMU is accredited through a voluntary, peer-review process coordinated by the Middle States Commission on Higher Education (MSCHE or Middle States). MSCHE is one of six regional accrediting agencies in the United States, each accrediting institutions of higher education within a specific geographic region. Middle States is recognized by the U.S. Department of Education. This recognition enables MSCHE's member institutions to establish eligibility to participate in federal financial aid programs (e.g., federal loans, grants, and work-study) administered by the U.S. Department of Education. CMU has been accredited by Middle States since 1921. More information regarding accreditation standards and processes and to view the University's re-accreditation reports on the Middle States Accreditation website at: http://www.cmu.edu/middlestates/.

Any questions a student may have regarding this catalog that have not been satisfactorily answered by the institution may be directed to the Bureau for Private Postsecondary Education at 1747 N. Market Boulevard, Suite 225, Sacramento, CA 95834, P.O. Box 980818, West Sacramento, CA 95798-0818, www.bppe.ca.gov, toll-free telephone number (888) 370-7589 or by fax (916) 263-1897.

As a prospective student, you are encouraged to review this catalog prior to signing an enrollment agreement. You are also encouraged to review the School Performance Fact Sheet, which must be provided to you prior to signing an enrollment agreement.

A student or any member of the public may file a complaint about this institution with the Bureau for Private Postsecondary Education by calling (888) 370-7589 toll-free or by completing a complaint form, which can be obtained on the bureau's internet website at www.bppe.ca.gov.

Carnegie Mellon University – Information Networking Institute

4616 Henry Street
Pittsburgh, PA 15213
Phone:(412) 268-7195; Fax: (412) 268-7196
https://www.cmu.edu/ini/

Branch Campus: Carnegie Mellon University – Silicon Valley

NASA AMES RESEARCH PARK, MS 23-11
Moffett Field, CA 94035
Phone: (650) 335-2886; Fax (650) 603-7032
www.cmu.edu/silicon-valley/

Class Location

Classes offered for the INI Pittsburgh - Silicon Valley MSIT-IS/MOB and MSMITE programs in California are held at:
Branch Campus: Carnegie Mellon University - Silicon Valley
NASA AMES RESEARCH PARK, MS 23-11
Moffett Field, CA 94035
Phone: (650) 335-2886; Fax (650) 603-7032
www.cmu.edu/silicon-valley/

INI Website California Private Postsecondary Education Act Section

The INI Pittsburgh-Silicon Valley School Catalog along with all other relevant documents and information is available under the California Private Postsecondary Education Act section on the INI website at https://www.cmu.edu/ini/academics/bicoastal/bppeact.html.

Welcome to the INI

The Information Networking Institute (INI) at Carnegie Mellon University (CMU) educates and develops engineers through technical, interdisciplinary master's degree programs in information networking, security and mobile and Internet of Things (IoT) engineering that incorporate business and policy perspectives.

With extraordinary agility, the INI has navigated the changing landscape of technology from wired communications in the 1980s to wireless, mobile and IoT in today's world. We were established in 1989 in response to a demand from industry for professionals skilled in both computing and communications. Looking at first principles in each of those domains, we designed a program that would prepare students for the world we saw coming in which distributed computing and communications would be indistinguishable.

What began as a small fledgling program has evolved over the past three decades to become an integral part of Carnegie Mellon's College of Engineering and home to nearly 300 students each year from around the world. Our students are provided with a distinctly interdisciplinary learning experience through an advanced, specialized curriculum in information networking and computer systems, complemented by coursework in business, management, and policy.

The INI Mission

- Educate and develop engineers through technical, interdisciplinary master's degree programs in information networking, security, and mobile and IoT engineering that incorporate business and policy perspectives. Our graduates contribute to technological advancements, pioneer engineering solutions, and lead enterprises in the global economy.
- Provide a teaching and learning environment that is welcoming, supportive, and inspiring for our students, faculty, staff, and alumni, regardless of their location in the world.
- Nurture a community of alumni, dedicated to the highest standards of ethics, who provide mentorship and encourage the proliferation of diverse opportunities for the global INI community.
- Pioneer collaborative and innovative educational initiatives that embody the entrepreneurial spirit of Carnegie Mellon University.

The INI Vision

- We will be the internationally recognized leader of technical, interdisciplinary graduate education in information networking, information security, and mobile and IoT engineering.

- We will attract the top-performing, most technical, curious and hardworking individuals to our programs and prepare them for leadership in their field and the larger societal context.
- We will attract, retain, nurture, and promote a diverse student population.
- Our graduates will be the most sought after by industry, academia and government in their respective fields.
- We will connect, engage, strengthen and serve our global community of alumni.

The INI Values

Excellence: We strive for the utmost quality in everything we do.
Integrity: We require the highest moral and ethical standards in our research, education and practice.

Diversity: We cultivate an inclusive culture that celebrates and values a diversity of opinion and intellectual perspective from all individuals, regardless of ethnic origin, race, religion, gender, age, disability, sexual orientation and self-identity.

Interdisciplinarity: We advance the future of information networking, mobility, and security through interdisciplinarity and believe that different intellectual perspectives spur innovation and problem solving.

Innovation: We demonstrate agility and create novel solutions in response to the demands of the global market.

Engagement: We encourage involvement in campus life, industry, government and professional organizations, and public outreach activities in order to provide important links to the broader community.

The CMU Mission

To create a transformative educational experience for students focused on deep interdisciplinary knowledge; problem-solving; leadership, communication and interpersonal skills; and personal health and well-being.

To cultivate a transformative university community committed to (a) attracting and retaining diverse, world-class talent; (b) creating a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish; and (c) ensuring individuals can achieve their full potential.

To impact society in a transformative way - regionally, nationally and globally - by engaging with partners outside the traditional borders of the university campus.

Programs Offered

Through bicoastal delivery in collaboration with the Silicon Valley campus, the INI offers the following programs:

M.S. in Information Technology-Information Security (MSIT-IS)

M.S. in Information Technology-Information Security – Applied Study (MSIT-IS Applied Study)

M.S. in Information Technology-Information Security – Advanced Study (MSIT-IS Advanced Study)

M.S. in Information Technology-Information Security – Applied Advanced Study (MSIT-IS Applied Advanced Study)

M.S. in Mobile and IoT Engineering (MSMITE)

M.S. in Mobile and IoT Engineering – Applied Study (MSMITE Applied Study)

M.S. in Mobile and IoT Engineering – Advanced Study (MSMITE Advanced Study)

M.S. in Mobile and IoT Engineering – Applied Advanced Study (MSMITE Applied Advanced Study)

These technical, interdisciplinary graduate degree programs provide students with an advanced, specialized curriculum combining computer science, electrical and computer engineering, software engineering, and information systems. It also exposes students to topics in business, management, and policy. The unique combination of rigorous technical topics, practical industry-oriented topics, and real-world project experience empowers students to be the movers and shakers of the tech industry, whether launching a tech start-up, joining an enterprise R&D team, or fighting cyber-crime.

MSIT-IS

The MSIT-IS program prepares students to become industry leaders in information security by blending education in information security technology with other topics essential for the effective development and management of secure information systems.

Program Learning Outcomes

Students who graduate from the MSIT-IS program gain an ability to:

- Demonstrate knowledge and skills related to security and privacy principles and state-of-the-art techniques for security and privacy in information systems including devices, networks, software, and services
- Evaluate trade-offs between technical security and privacy solutions and potential business and economic impacts
- Design and implement secure systems and services by applying knowledge and skills in information security and privacy
- Demonstrate the ability to scope, formalize, and execute practical team projects

Detailed outline of the requirements for completion of the INI Pittsburgh - Silicon Valley MSIT - IS program, including required courses, required internships, and the total number of units required for completion is provided below.

MSIT-IS Curriculum and Requirements

The curriculum consists of the following main components: core courses, program electives, practicum and study option requirements (if applicable).

The core courses establish the necessary background and a common competency level. The program elective units build upon the core, providing flexibility and breadth in coursework.

The capstone experience is the practicum, which requires students to apply their knowledge and skills to solve a real-world problem. All INI students are required to complete a summer internship.

All students starting an INI degree program in Spring 2021 and beyond will select one of four new study options: Standard option (123 units total), Applied option (129 units), Advanced Studies option (159 units), and Applied Advanced Studies option (165 units). Curricular requirements and program duration will depend on which study option they choose (see chart below). After Spring 2021, all students must declare their study option upon admission into the degree program.

Students who started their program in Fall 2020 may choose to opt into one of these study options or remain in their current degree 122-unit program.

MSIT-IS 122 Unit Program Curriculum:

For students who matriculated in Fall 2020 and choose to remain in the 122-unit program

Core Courses	Establish the necessary background and a common competency level	74 units
Program Electives	Build upon the core, providing flexibility and breadth in coursework	24 units

Practicum	Capstone experience in which student teams apply their knowledge and skills to solve a real-world problem for industry, government and research sponsors	24 units
Internship	All INI students are required to complete a summer internship	0 units
	Total	**122 units**

Core Courses [74 units]

NETWORKING CORE (12 UNITS):

- Choose One:

  14-740: Fundamentals of Telecommunications and Computer Networks

  14-760: Advanced Real-World Data Networks

  18-756: Packet Switching and Computer Networks

SECURITY CORE (12 UNITS):

- 14-741: Introduction to Information Security

BUSINESS & MANAGEMENT CORE (12 UNITS):

- 14-776: Fundamentals of Business and Management

MSIT-IS DEGREE-SPECIFIC CORE (36 UNITS):

Please refer to the MSIT-IS Core Courses list on the Course List page.

ACADEMIC AND PROFESSIONAL DEVELOPMENT (2 UNITS):

- 14-601: INI Academic and Professional Development 1
- 14-602: INI Academic and Professional Development 2

Practicum [24 units]:

- 14-798: INI Practicum Project

Program Electives [24 units]

Fulfilled by courses in INI, Electrical and Computer Engineering (ECE), School of Computer Science (SCS), Engineering & Public Policy (EPP), Entertainment Technology Center (ETC) or Integrated Innovation Institute (III), and/or approved courses in the Heinz College or Tepper School.

Some exceptions apply.

Internship (0 Units)

All students in a 122-unit program must complete an INI-approved internship.

Residency Requirement (0 Units)

All students must fulfill a residency requirement for at least one semester at CMU Silicon Valley in a student's second Fall semester.

MSIT-IS Study Option Program Curriculum

For students who matriculated in Fall 2020 and choose a new study option, and students who matriculate in Spring 2021 and onward:

MSIT-IS STUDY OPTIONS			**BREAKDOWN OF UNITS**
Standard [123 Units]	3 Semesters	No Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ APD 1 [3 Units]
Applied [129 Units]	3 Semesters	Required Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ Internship [3 Units] ○ APD 1 [3 Units] ○ APD 2 [3 Units]
Advanced Studies [159 Units]	4 Semesters	No Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ Advanced Studies [36 Units] - Research Thesis or Area of Concentration ○ APD 1 [3 Units]
Applied Advanced Studies [165 Units]	4 Semesters	Required Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ Advanced Studies [36 Units] - Research Thesis or Area of Concentration ○ Internship [3 Units] ○ APD 1 [3 Units] ○ APD 2 [3 Units]

Core Courses [72 units]

NETWORKING CORE (12 UNITS):

- Choose One:
  14-740: Fundamentals of Telecommunications and Computer Networks
  14-760: Advanced Real-World Data Networks
  18-756: Packet Switching and Computer Networks

SECURITY CORE (12 UNITS):

- 14-741: Introduction to Information Security

BUSINESS & MANAGEMENT CORE (12 UNITS):

- 14-776: Fundamentals of Business and Management

MSIT-IS DEGREE-SPECIFIC CORE (36 UNITS):

- Please refer to the MSIT-IS Core Courses list on the Course List page.

Practicum [24 units]:

- 14-798: INI Practicum Project

Program Electives [24 Units]

Fulfilled by courses in INI, Electrical and Computer Engineering (ECE), School of Computer Science (SCS), Engineering & Public Policy (EPP), Entertainment Technology Center (ETC) or Integrated Innovation Institute (III), and/or approved courses in the Heinz College or Tepper School. Some exceptions apply.

Academic & Professional Development 1 [3 Units]

Academic & Professional Development 2* [3 units]

*Applied and Applied Advanced Studies options only

Internship* (3 Units)

*Applied and Applied Advanced Studies options only

Residency Requirement (0 Units)

All students must fulfill a residency requirement for at least one semester at CMU Silicon Valley.

MSIT-IS Degree-Specific Core Courses

Degree-specific courses allow students to create a custom core curriculum for their degree in information security. Please refer to the Course List below. While we created a list of possible courses, it is not exhaustive, and students are allowed to select other degree-specific courses as

long as they are relevant to their track. If a student wants to pursue a degree-specific core course that is not included on the approved list, they should file a petition requesting permission to do so.

This list provides MSIT degree specific core courses that have been approved by the department. ***The INI cannot guarantee that courses will be offered each semester or in a specific semester as advertised below. Likewise, the location listed is not guaranteed as campus course offerings constantly change.*** Students must refer to the 'Schedule of Classes' to determine course availability. In addition, the INI cannot guarantee that a student will be offered a seat in a specific course. These apply to courses at the INI as well as other departments at Carnegie Mellon.

Note: Students should always register under the INI course number (14-XXX) if a course is cross-listed with other departments. The numbers for cross-listed courses are provided to the right of the course titles below.

Information Security Courses (Last updated: August 17, 2020)

Spring

05-836 Usable Security and Privacy (PIT, 12 units)
14-735 Secure Coding (PIT & Broadcast to SV, 12 units)
14-761 Applied Information Assurance (PIT, 12 units)
14-782 Information Security Risk Management I (PIT, 6 units)
14-784 Information Security Risk Management II (PIT, 6 units)
14-788 Information Security Policy and Management (PIT, 6 units)
14-814 Wireless Network Security (SV & Broadcast to PIT, 12 units) (cross-listed 18-637)
14-819 Introduction to Software Reverse Engineering (PIT & Broadcast to SV, 12 units)
14-822 Host-Based Forensics (PIT & Broadcast to SV, 12 units)
14-828 Browser Security (PIT & Broadcast to SV, 12 units)
14-850 INSuRE Cybersecurity Research (SV & Broadcast to PIT, 12 units)
15-811 Verifying Complex Systems (PIT, 12 units) 18-632 Introduction to Hardware Security (PIT & Broadcast to SV, 12 units)
18-731 Network Security (PIT & Broadcast to SV, 12 units)
18-732 Secure Software Systems (PIT & Broadcast to SV, 12 units)
18-733 Applied Cryptography (PIT & Broadcast to SV, 12 units)
19-733 Cryptocurrencies, Blockchains and Applications (PIT, 12 units) (cross-listed 17-703)
94-806 Privacy in the Digital Age (PIT, 6 units)
95-883 Ethical Penetration Testing (PIT, 6 units)

Fall

14-761 Applied Information Assurance (PIT, 12 units)
14-809 Introduction to Cyber Intelligence (PIT, 12 units)

14-817 Cyber Risk Modeling (SV & Broadcast to PIT, 12 units)
14-823 Network Forensics (PIT, 12 units)
14-829 Mobile and IoT Security (SV & Broadcast to PIT, 12 units) (cross-listed 18-638)
14-850 INSuRE Cybersecurity Research (SV & Broadcast to PIT, 12 units)
15-856 Introduction to Cryptography (PIT, 12 units)
18-734 Foundations of Privacy (PIT & Broadcast to SV, 12 units) (cross-listed 17-731)
18-737 Special Topics in Computer Systems (SV, 12 units) (Fall 2019 only)
19-608 Privacy, Policy, Law and Technology (PIT, 12 units) (cross-listed 17-733 & 95-818)
94-806 Privacy in the Digital Age (PIT, 6 units)
95-883 Ethical Penetration Testing (PIT, 6 units)

PIT: CMU Campus in Pittsburgh, PA
SV: CMU Campus in Silicon Valley, CA

When enrolled in courses that are broadcasted students at both locations attend the classes synchronously.

The MSIT-IS Curriculum is also available on the INI website at:

- 122-Unit Curriculum: https://www.cmu.edu/ini/academics/bicoastal/msit-is_curriculum_ms32.html
- Study Option Curriculum: https://www.cmu.edu/ini/academics/bicoastal/curriculum_msitis21-22.html

MSMITE

The MSMITE program prepares students to be at the forefront of the mobile and IoT engineering field with a multidisciplinary curriculum spanning both technical and business topics in mobile applications, services and devices.

Program Learning Outcomes

Students gain the ability to:

- Demonstrate knowledge and skills regarding processing on constrained hardware, designing software for embedded computing, application delivery, and user interactions
- Critically analyze historical and state-of-the-art mobile and IoT technologies relating to devices, networks, providers, data, and applications to identify trade-offs and develop design principles
- Apply mobile and embedded system skills and principles toward the design and development of products and services across a variety of vertical markets
- Evaluate trade-offs between technology solutions and potential business and economic impacts that influence or are influenced by mobile and IoT systems
- Demonstrate the ability to scope, formalize, and execute practical team projects

MSMITE Curriculum and Requirements

The curriculum consists of the following main components: core courses, program electives, practicum and study option requirements (if applicable).

The core courses establish the necessary background and a common competency level. The program elective units build upon the core, providing flexibility and breadth in coursework.

The capstone experience is the practicum, which requires students to apply their knowledge and skills to solve a real-world problem. All INI students are required to complete a summer internship.

All students starting an INI degree program in Spring 2021 and beyond will select one of four new study options: Standard option (123 units total), Applied option (129 units), Advanced Studies option (159 units), and Applied Advanced studies option (165 units). Curricular requirements and program duration will depend on which study option they choose (see chart below). After Spring 2021, all students must declare their study option upon admission into the degree program.

Students who started their program in Fall 2020 may choose to opt into one of these study options or remain in their current degree 122-unit program.

MSMITE 122 Unit Program Curriculum:

For students who matriculated in Fall 2020 and choose to remain in the 122-unit program

Core Courses	Establish the necessary background and a common competency level	74 units
Program Electives	Build upon the core, providing flexibility and breadth in coursework	24 units
Practicum	Capstone experience in which student teams apply their knowledge and skills to solve a real-world problem for industry, government and research sponsors	24 units
Internship	All INI students are required to complete a summer internship	0 units
	Total	**122 units**

Core Courses [74 Units]

NETWORKING CORE (12 UNITS):
- Choose One:
  14-740: Fundamentals of Telecommunications and Computer Networks
  14-760: Advanced Real-World Data Networks
  18-756: Packet Switching and Computer Networks

SECURITY CORE (12 UNITS):
- 14-741: Introduction to Information Security

BUSINESS & MANAGEMENT CORE (12 UNITS):
- 14-776: Fundamentals of Business and Management

MOBILE & IOT CORE (12 UNITS):
- Choose One:
  14-642: Introduction to Embedded Systems
  14-840: Mobile Hardware for Software Engineers

MSMITE DEGREE-SPECIFIC CORE (24 UNITS):
Please refer to the MSMITE Core Courses list on the Course List page.

ACADEMIC AND PROFESSIONAL DEVELOPMENT (2 UNITS):
- 14-601: INI Academic and Professional Development 1
- 14-602: INI Academic and Professional Development 2

Program Electives [24 Units]

Students have the opportunity to pursue a wide range of electives in which they have a special interest. Electives may not be taken as pass/no pass/audit.
Fulfilled by courses in INI, Electrical and Computer Engineering (ECE), School of Computer Science (SCS), Engineering & Public Policy (EPP), Entertainment Technology Center (ETC) or Integrated Innovation Institute (III), and/or approved courses in the Heinz College or Tepper School. *Some exceptions apply*.

Master's Practicum Course [24 Units]

- 14-798: INI Practicum Project

Internship [0 Units]

All students in 122-unit program must complete an INI-approved internship.

Residency Requirement [0 Units]

All students must fulfill a residency requirement for the fall semester in which they are enrolled at CMU Silicon Valley.

MSMITE Study Option Program Curriculum

For students who matriculated in Fall 2020 and choose a new study option, and students who matriculate in Spring 2021 and onward:

MSMITE STUDY OPTIONS			**BREAKDOWN OF UNITS**
Standard [123 Units]	3 Semesters	No Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ APD 1 [3 Units]
Applied [129 Units]	3 Semesters	Required Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ Internship [3 Units] ○ APD 1 [3 Units] ○ APD 2 [3 Units]
Advanced Studies [159 Units]	4 Semesters	No Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ Advanced Studies [36 Units] - Research Thesis or Area of Concentration

			○ APD 1 [3 Units]
Applied Advanced Studies [165 Units]	4 Semesters	Required Internship	○ Core [72 Units] ○ Electives [24 Units] ○ Practicum [24 Units] ○ Advanced Studies [36 Units] - Research Thesis or Area of Concentration ○ Internship [3 Units] ○ APD 1 [3 Units] ○ APD 2 [3 Units]

Core Courses [72 units]

NETWORKING CORE (12 UNITS):
- Choose One:
  14-740: Fundamentals of Telecommunications and Computer Networks
  14-760: Advanced Real-World Data Networks
  18-756: Packet Switching and Computer Networks

SECURITY CORE (12 UNITS):
- 14-741: Introduction to Information Security

BUSINESS & MANAGEMENT CORE (12 UNITS):
- 14-776: Fundamentals of Business and Management

MOBILE & IOT CORE CORE (12 UNITS):
- Choose One:
  14-642: Introduction to Embedded Systems
  14-840: Mobile Hardware for Software Engineers

MSMITE DEGREE-SPECIFIC CORE (24 UNITS):
- Please refer to the MSMITE Core Courses list on the Course List page.

Practicum [24 units]:
- 14-798: INI Practicum Project

Program Electives [24 Units]

Fulfilled by courses in INI, Electrical and Computer Engineering (ECE), School of Computer Science (SCS), Engineering & Public Policy (EPP), Entertainment Technology Center (ETC) or Integrated Innovation Institute (III), and/or approved courses in the Heinz College or Tepper School. Some exceptions apply.

Academic & Professional Development 1 [3 Units]

Academic & Professional Development 2* [3 units]

*Applied and Applied Advanced Studies options only

Internship* (3 Units)

*Applied and Applied Advanced Studies options only

Residency Requirement (0 Units)

All students must fulfill a residency requirement for at least one semester at CMU Silicon Valley in a student's second Fall semester.

MSMITE Course List (Last updated March 19, 2020)

This list provides MSMITE degree specific core courses that have been approved by the department.

The INI cannot guarantee that courses will be offered each semester or in a specific semester as advertised below. Likewise, the location listed is not guaranteed as campus course offerings constantly change. Students must refer to the 'Schedule of Classes' to determine course availability. In addition, the INI cannot guarantee that a student will be offered a seat in a specific course. These apply to courses at the INI as well as other departments at Carnegie Mellon.

Note: Students should always register under the INI course number (14-XXX) if a course is cross-listed with other departments. The numbers for cross-listed courses are provided to the right of the course titles below.

Spring

05-670: Digital Service Innovation (PIT, 12 units)
05-833: Gadgets, Sensors & Activity Recognition in HCI (PIT, 12 units)
05-872: Rapid Prototyping of Computer Systems (PIT, 12 units, cross-listed 05-540, 18-745, 18-540, 39-648)
08-735: Building User-focused Sensing Systems (PIT, 12 units)
14-642: Introduction to Embedded Systems (PIT, 12 units)
14-736: Distributed Systems: Techniques, Infrastructure and Services (PIT & Broadcast to SV, 12 units)
14-760: Advanced Real-World Data Networks (PIT & Broadcast to SV, 12 units)
14-841: Mobile & Pervasive Computing (SV, 12 units) (cross-listed 18-843)
17-781: Mobile and IoT Computing Services (PIT, 12 units)
18-651: Networked Cyber-Physical Systems (PIT, 12 units) 1
8-744: Connected Embedded Systems Architecture (SV, 12 units)
18-748: Wireless Sensor Networks (PIT, 12 units)
18-759: Wireless Networks (PIT, 12 units)
49-788: Mobile Apps for the Internet of Things (SV, 12 units)

Summer

49-788: Mobile Apps for the Internet of Things (SV, 12 units)

Fall

05-670: Digital Service Innovation (PIT, 12 units)
05-833: Gadgets, Sensors & Activity Recognition in HCI (PIT, 12 units)
08-736: Pervasive and Ubiquitous Computing (PIT, 12 units)
14-642: Introduction to Embedded Systems (PIT, 12 units)
14-829: Mobile and IoT Security (SV & Broadcast to PIT, 12 units) (cross-listed 18-638)
14-840: Mobile Hardware for Software Engineers (SV, 12 units) (cross-listed 18-644)
14-841: Mobile & Pervasive Computing (SV, 12 units) (cross-listed 18-843)
15-624: Logical Foundations of Cyber-Physical Systems (PIT, 12 units)
16-722: Sensing and Sensors (PIT, 12 units)
17-728: Machine Learning and Sensing (PIT, 12 units)
18-747: Wireless Device Architecture (SV, 12 units)

When enrolled in courses that are broadcasted students at both locations attend the classes synchronously.

The MS32 Curriculum is also available on the INI website at:
https://www.cmu.edu/ini/academics/bicoastal/msmite_curriculum_ms32.html

INI Courses

14-513: Introduction to Computer Systems (12 units)

This course provides a programmer's view of how computer systems execute programs, store information, and communicate. It enables students to become more effective programmers, especially in dealing with issues of performance, portability and robustness. It also serves as a foundation for courses on compilers, networks, operating systems, and computer architecture, where a deeper understanding of systems-level issues is required. Topics covered include: machine-level code and its generation by optimizing compilers, performance evaluation and optimization, computer arithmetic, memory organization and management, networking technology and protocols, and supporting concurrent computation. NOTE: students must achieve a C or better in order to use this course to satisfy the pre-requisite for any subsequent Computer Science course.

PREREQUISITES: None

14-642: Introduction to Embedded Systems (12 units)

This practical, hands-on course introduces students to the basic building-blocks and the underlying scientific principles of embedded systems. The course covers both the hardware and software aspects of embedded processor architectures, along with operating system fundamentals, such as virtual memory, concurrency, task scheduling and synchronization. Through a series of laboratory projects involving state-of-the-art processors, students will learn

to understand implementation details and to write assembly-language and C programs that implement core embedded OS functionality, and that control/debug features such as timers, interrupts, serial communications, flash memory, device drivers and other components used in typical embedded applications. Relevant topics, such as optimization, profiling, digital signal processing, feedback control, real-time operating systems and embedded middleware, will also be discussed. Prerequisites: 18-240.

PREREQUISITES: 18-240 and 15-513 and 18-213

14-699: Silicon Valley Residency (0 units)

This course is for INI bicoastal students who are fulfilling a semester of residency as part of degree requirements. Residency is defined as being physically present on the SV campus and physically attending class(es) for one full semester (16-month students; Fall 2) or for two full semesters (20-month students; Fall 2 Spring 2). Courses taken remotely will not fulfill the residency requirement.

PREREQUISITES: None

14-728: Independent Study (0-12 units)

If there is a special topic that interests a student and is relevant to their degree program, the student may negotiate an Independent Study mentored by a Carnegie Mellon faculty member. Through an Independent Study, students can either focus on learning a topic area that is not otherwise available at Carnegie Mellon, or they can assist the faculty advisor and relevant partners in exploring research and/or development opportunities in new areas. The student must provide compelling justification as to (1) why an Independent Study on this topic or project is relevant to their degree program and should be allowed, (2) why the chosen faculty member is an appropriate Independent Study advisor, and (3) the learning objectives and expected deliverables of the Independent Study. Specific proposal requirements and processes are detailed in the INI Student Handbook. This course is open to INI students only, and special permission is required to enroll. Eligible students should contact the INI Academic Affairs Office regarding Independent Study proposal submission.

PREREQUISITES: None

14-735: Secure Coding (12 units)

This course will enable students to understand how software coding defects lead to software vulnerabilities, develop secure software, and manage teams that develop secure software. This course provides a detailed explanation of common programming errors in C and C++ and describes how these errors can lead to code that is vulnerable to exploitation. The course covers secure software development tools and processes while focusing on low-level technical security issues intrinsic to the C and C++ programming languages and associated libraries. Proficiency in C and C++ are required. Prerequisites: None.

PREREQUISITES: None

14-736: Distributed Systems: Techniques, Infrastructure, and Services (12 units)

This course explores both foundational and contemporary topics in distributed systems, such as communication, coordinating time, synchronization, consensus, impossibility of agreement, replica management, file systems, distributed SQL and noSQL databases, CAP, ACID, BASE, distributed hashing, anonymous communication, models of computation, and higher-level tools. The course project work focuses on the implementation of scalable, fault-tolerant distributed systems.

PREREQUISITES: 14-513, 15-513, 18-613

14-740: Fundamentals of Telecommunications & Computer Networks (12 units)

14-740 is a graduate-level, first-course in computer and telecommunication networks. There is no pre-requisite of an undergraduate equivalent, but basic computer, programming and probability theory background is required. The primary objective of this course is for you to learn the fundamental principles underlying computer and telecommunication networks. Using a top-down approach, we will cover topics in the application, transport, network and link layers of the protocol stack. We will also go over advanced topics, including network management, traffic engineering, and router internals. Besides learning about the nuts and bolts, you will gain an understanding as well in engineering tradeoffs made and design principles used in computer and telecommunication networks. Another objective is for you to apply some of this knowledge in the context of systems projects. We will follow an aggressive pace in this course. Prerequisites: Graduate standing.

PREREQUISITES: None

14-741: Introduction to Information Security (12 units)

The growing importance of information systems, and their use to support safety-critical applications, has made information security a central issue for modern systems. The course introduces the technical and policy foundations of information security. The main objective of the course is to enable students to reason about information systems from a security engineering perspective. Topics covered in the course include elementary cryptography; access control; common software vulnerabilities; common network vulnerabilities; digital rights management; policy and export control law; privacy; management and assurance; and special topics in information security. Prerequisites: The course assumes a basic working knowledge of computers, networks, C and UNIX programming, as well as an elementary mathematics background, but does not assume any prior exposure to topics in computer or communications security.

PREREQUISITES: None

14-760: Advanced Real World Data Networks (12 units)

Students should already have an understanding of networking principles. This course examines how those principles are employed in a variety of real-world scenarios to solve problems that

face modern network engineers. This course explores the design, implementation, and application of the network technologies that compose modern and emerging infrastructure and the delivery of the ubiquitous services users expect. Topics may include, for example, 4G and 5G network infrastructures, IPv6, SDN and VFN, data centers, mesh and embedded networks.

PREREQUISITES: 15-641 or 18-441 or 18-741 or 14-740

14-761: Applied Information Assurance (12 units)

This course focuses on practical applications of Information Assurance (IA) policies and technologies in enterprise network environments. The course will include lecture and demonstrations but is designed around a virtual lab environment and scenario that provides for robust and realistic hands-on experiences in dealing with a range of information assurance topic areas. Students will be provided numerous practical opportunities to apply information security practices and technologies to solve real-world IA problems.

PREREQUISITES: None

14-776: Fundamentals of Business and Management (12 units)

This class will combine both economic and business topics. The class will contain applied microeconomics topics focused on resource allocation and efficiency in different market structures. We will explore perfect competition, monopoly and monopolistic competition and oligopic market structures. We will also explore macro-economic ideas so as to understand the context within which businesses operate. It is anticipated that these topics will occupy 1/3 of the class. The other 2/3 of the class will focus on business management from an applied, integrated view. The majority of the business topics will involve team-based work. We will cover 7 basic areas of management: Financial and Managerial Accounting Corporate Finance Marketing Operations Management Corporate Strategy Organizations Business Communications

PREREQUISITES: None

14-782: Information Security Risk Management I (6 units)

This course and its follow-on Information Security Risk Management II (14-784) examine information security as a risk management problem where the organization identifies information security risks, evaluates those risks, and makes risk mitigation and acceptance decisions given its resource constraints. In part one of this class students will learn foundational concepts in risk management and economic valuation and will be introduced standard risk management approaches for identifying, analyzing, and responding to risk, as well as the analytical tools for calculating the costs and benefits of investment security decisions. Learning Objectives: understand and use security risk management terminology; understand and apply tools for evaluating decisions under uncertainty; develop critical thinking and evaluation; demonstrate basic proficiency in qualitative and quantitative risk analysis methods (OCTAVE, FAIR); and understand and explain risk responses, including risk transfer and insurance

PREREQUISITES: None

14-788: Information Security Policy and Management (6 units)

The goal of this course is to provide an overview of security marketplace, an understanding of decision making when multiple parties are involved and the role of policy making in the context of information security. Policy is treated broadly and need not be necessarily government laws and regulations. Policy can be intra-organization. For example, it is an organization policy to disconnect an unpatched computer from its network. We will discuss the role of market and competition on security provision and then some of the key causes of market failure, namely externalities. We will then analyze how various policy tools can be applied to mitigate market failure. We will also discuss some key laws and regulation on product liability, and security standards. The course also aims to provide an overview of security industry (that is key trends, technologies and various strategies by vendors and users) as well. By the end of the course, the students are expected to know key managerial and policy issues surrounding information security provision and when and how policy intervention is needed. There is no textbook and all the reading material is provided on the first day of class. Some understanding of economics is expected. Students are expected to have read the relevant reading material before class and come prepared for discussion. All reading material can be downloaded from blackboard. Case material will be distributed in class.

PREREQUISITES: None

14-798: INI MSIT Project Practicum (24 units)

Fall: 24 units. This course provides the opportunity to consolidate and apply the skills and knowledge developed in previous coursework in a team-based approach to a real problem. A team of students works with a real-world client on a real-world problem of value to the client. Most important, this is an opportunity to apply the teams advanced engineering and management skills, including the specialized knowledge and skills needed to solve a real problem. In particular, team members must learn to work effectively with clients, quickly understand their problem, negotiate deliverables, and then select, adapt, and apply just the right amount of process and documentation to meet client's needs and effectively manage the project. Prerequisites: Graduate standing and instructor's permission.

PREREQUISITES: None

14-790: Special Topics: Engineering Human Values and Principles into Software

This is a project course where you and your team will architect a system with hardware and software. This class is about deciding *what* to build - not how to build it or actually building it. You will discover how human values and principles are embedded into the design of a software system. The entire class will work on the same concept, but your team will develop its own, unique software architecture. As the semester progresses, we will consider how regulatory, ethics, and business constraints impact your system definition. This course will cover some of the salient issues, including examples of how others have handled (or mishandled) them in industry. You will evaluate and refine your system definition throughout the semester. At the end, you will have a foundation to create software systems that incorporate human principles.

PREREQUISITES: None

14-809: Introduction to Cyber Intelligence

Cyber intelligence; a phrase often used, but interpreted by government agencies, private companies, and the general public in many different ways. For the purpose of this course, cyber intelligence is the acquisition and analysis of information to identify, track, and predict cyber capabilities, intentions, and activities to offer courses of action that enhance decision making. Students will explore a different aspect of the definition each week to develop an analytic framework capable of discerning the interdependencies of and external influences on cyber intelligence, as it relates to an organization's environment, data gathering, functional analysis, strategic analysis, and decision maker. The framework will demonstrate how traditional intelligence practices and emerging technologies influence cyber intelligence; empowering students to assess the likelihood of cyber threat actors executing attacks, the impact attacks have on an organization's business, and the risk threats pose because of an organization's known vulnerabilities.

PREREQUISITES: None

14-810 Special Topics: Network Security Engineering Analysis and Automation

In this course, students will learn the theory and practice of network defense including designing and optimizing network security architecture, network security configuration verification and automation (such as Firewalls, IPSec gateways, IDS, and NAT), adversary modeling and analysis using attack tactics, techniques and procedures (TTP), automated cyber threat hunting and mitigation, quantitative cyber risk assessment and mitigation, anomaly detection and adaptive intrusion response. The goal of the course is to enable students to develop the network security engineering analytical and programming skills by learning how to use the formal reasoning and data-driven analytics techniques and tools to systematically address key network security challenges including automated network security hardening, detecting security misconfigurations, measuring attack surface and risk, creating dynamic playbook for courses of actions, models for adaptive and active cyber defense. In addition, students will learn the about advanced solutions for emergent network defense such as cyber deception and cyber deterrence.

PREREQUISITES: None

14-811: Special Topics: Applied Adversarial Machine Learning

Machine learning (ML) algorithms are increasingly embedded in cybersecurity systems, like spam/malware filters and network intrusion detectors, and safety-critical applications, like autonomous vehicles. These ML systems are vulnerable to attack. For example, a spammer may try to evade a spam filter with a carefully crafted email, or alternatively may try to poison the filter's training data with bogus examples rendering the filter useless. In this course, students will learn how to implement ML algorithms, build practical ML systems, perform evasion and poisoning attacks, and defend against such attacks. The course will cover the following ML problems and tools: classification, dimensionality reduction, clustering, regression, and deep

neural networks. Grading will be based on biweekly Python programming assignments with written reports.

PREREQUISITES: Undergraduate Probability and Linear Algebra

14-812: Special Topics: Research Seminar in Privacy and Security (12 units)

This course is a graduate level research seminar that educates students about the latest breakthroughs and research challenges in security and privacy. The course helps to familiarize students with research terminology as well as the current topics in security and privacy. Students are expected to read recent and cutting-edge research papers in security and privacy, write critiques analyzing the research in the papers, present in class a summary of the research, and lead a class discussion. In addition, students will be working on a semester-long group research project where they are expected to conduct research on a project of their choice, present their research in class, and write a research paper. This course will enhance the research skills and critical thinking of students as they will learn how to criticize current research and how to handle open-ended problems. Students will also learn how to communicate and present technical challenges and participate in thought-provocative discussions.

PREREQUISITES: None

14-812: Special Topics: Visual Design for Engineers

This mini introduces non-designers to visual design. Visual design mixes the aesthetic focus in graphic design with the usability requirements of user interface design. In this course, students will exercise their creative side by designing the look & feel for a software application. Students will also learn some design theory so that they can better communicate with design professionals in the future. This course assumes that students have no background in visual design. We will cover topics ranging from color theory to icons and logos. Compared to other courses for non-designers, this course is more focused on the practical nuts and bolts of visual design. Students with prior experience in design or those seeking a course on the end-to-end design process should consider other options.

PREREQUISITES: None

14-813: Special Topics: Security and Privacy Enhancing Technologies (12 units)

Technologies threaten security and privacy, giving rise to opposing technologies specifically crafted to protect security and privacy, known as PETs. In this course we will learn how PETs fit into the larger computing landscape, including particular challenges faced by developers and users with PETs. We will evaluate consumer-facing tools as a class: what is their audience, how well do they work in practice, what usability issues do they present, and how well do they work technically? You will then work individually or in small teams of your choice to complete a project. You will select existing tools to perform an analysis of audience, usability, and technical reliability. After identifying deficiencies, you will suggest improvements, implement a subset of those improvements, then perform human subjects or other technical research to validate that

your proposed changes actually do improve upon the existing tools. This course is a mix of readings, participatory discussions, and hands-on projects.

PREREQUISITES: None

14-814: Wireless Security (12 units)

With the surge of mobile device use, embedded system deployment, and development of always-connected devices, the underlying wireless communication and network systems are becoming more critical for everyday use. Even though security and privacy have emerged as important focus areas for modern technology, the wireless links that connect our pervasive devices are still less understood from the perspectives of security and privacy than other system aspects. This course will focus on the challenges in providing secure communication and network services in a variety of wireless systems and current and past approaches to manage these challenges. Topic coverage will include vulnerabilities, attacks, security mechanisms, and trade-offs at various layers of the network protocol stack, from aspects of physical communication to application and service security issues; examples include jamming, MAC-layer misbehavior, selective packet dropping, decentralized trust and reputation, and cross-layer holistic attacks. Systems of interest include (but are not limited to) personal devices, connected vehicles, embedded and IoT systems, wireless infrastructure, and ad hoc networks. Class material will be largely based on recent and current research. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

PREREQUISITES:

(18-631 or 18-730 or 14-741 or 15-330 or 18-330) and (14-740 or 14-760 or 18-841 or 18-741 or 18-756 or 15-641)

14-817: Cyber Risk Modeling

There are too many cybersecurity risks to manage them all informally. You need a plan! Risk management and threat analysis are structured to craft better organizational security decisions. This course helps you learn how to prioritize risks, secure data assets, and to communicate your security knowledge. This is not a programming class but requires basic statistics (e.g. Monte Carlo analysis, which you will learn or review.) Major topics include: legal compliance, threat modeling, Mitre ATT&CK, the Common Vulnerabilities and Exposures database, and popular risk frameworks (STRIDE, PASTA, NIST, etc.) Those seeking roles where they will work with or become a CSCO, risk officer, or risk analyst will most benefit from this course.

PREREQUISITES: None

14-818: Special Topics: Interaction Design for Engineers

This mini introduces non-designers to interaction design. Interaction design focuses on the interface between users and products. In this course, students will learn how people process information and how that affects the user interface for a product. Each week, we will cover a topic in cognitive science or design theory, followed by hands-on exercises related to interaction

design. Topics range from human error to design affordances. This course assumes that students have no background in interaction design; the content is tailored to software engineers or engineering managers through examples and exercises. Students with prior experience in design or those seeking a course on the end-to-end design process should consider other options.

PREREQUISITES: None

14-819: Introduction to Software Reverse- Engineering (12 units)

The course is intended to provide an insight into the art and science of software and firmware reverse-engineering. It covers a variety of topics on how to approach complex problems of analyzing malicious code for the purpose of understanding its internals. By steadily advancing into the science of reverse-engineering, students will observe how a seemingly insurmountable problem of malware binary analysis gradually breaks down into tractable components that can be easily studied, interpreted and documented. The anatomy, behavior and manifestation of malware will be discussed. Students will receive hands-on experience with techniques analyzing, disassembling, debugging and monitoring malware in a controlled environment.

PREREQUISITES: (18-240) and (14-513 or 18-613)

14-820: Special Topics: Security and Fairness of Deep Learning

This course will provide an introduction to deep learning methods with emphasis on understanding and improving their security, privacy, and fairness properties. The course will cover basics of machine learning and introduce popular deep learning methods. It will delve into applications of deep learning methods in security, their susceptibility to adversarial manipulation, and techniques for making deep learning robust to adversarial manipulation. It will cover state-of-the-art methods for explaining black-box deep learning models to enhance their transparency. It will also examine methods for deep learning that are designed to respect individual privacy and fairness. Students will do homework assignments, critique weekly readings, and complete a course project on a topic of their choice. Prior knowledge of machine learning, deep learning, and security concepts are useful but not required.

PREREQUISITES: None

14-821: Special Topics: Legal and Ethical Background for Those Working in Cyber Ops (12 units)

In this online course, students learn about US and international laws they must comply with while working as cyber operations professionals. Learn how to stay on the right side of the law Starting with international law, we cover the formation of the United Nations, plus the Hague and Geneva Conventions. We study sources of US law including the three branches of government, the Constitution, and relevant case law in privacy. We address statutory laws that apply generally to computer professionals like the Computer Fraud and Abuse act and other Title 18 crimes, as well as laws specific to military applications like Titles 10 and 50. Woven throughout, we consider ethics and social responsibility, then conclude with specific issues

around ethical hacking. This is a text-based online course with online evaluation via quizzes, which you may take at your own pace. There are no projects or final exam, but please expect to invest substantial time into reading both legal and technical texts.

PREREQUISITES: None

14-822: Host Based Forensics (12 units)

Host Based Forensics provides a systematic introduction to the field of digital forensics. The course aims to familiarize students with the forensic process and to apply forensic principles with many tools of the trade. Upon completion of the course, a student should feel confident in participating in a digital forensic investigation. This course focuses on the forensic process (planning, acquisition, analysis, reporting) as it relates to host system forensics. Class periods will consist of lecture and exercise.

PREREQUISITES: 14-761

14-823: Network Forensics (12 units)

This course introduces concepts and techniques essential for studying network-based evidence applicable to legal investigations. Students will become familiar with a wide range of networking devices, techniques for capturing and analyzing network data, and with the practice of solid forensic methodologies to prepare and protect network based digital evidence. Students will be required to bring their laptops to each class, as they will need to access exercise materials online, use virtual machines in a hypervisor, and answer online quizzes.

PREREQUISITES: 14-761

14-828: Browser Security (12 units)

The Web continues to grow in popularity as platform for retail transactions, financial services, and rapidly evolving forms of communication. It is becoming an increasingly attractive target for attackers who wish to compromise user systems or steal data from other sites. Browser vendors must stay ahead of these attacks by providing features that support secure web applications. This course will study vulnerabilities in existing web browsers and the applications they render, as well as new technologies that enable web applications that were never before possible. The material will be largely based on current research problems, and students will be expected to criticize and improve existing defenses. Topics of study include (but are not limited to) browser encryption, JavaScript security, plug-in security, sandboxing, web mashups, and authentication. The course will involve an intensive group research project focusing on protocols/algorithms, vulnerabilities, and attacks as well as several individual homework and programming tasks. Groups will perform a sequence of cumulative tasks (literature review, analysis, simulation, design, implementation) to address aspects of their chosen topic, occasionally reporting their results to the class through brief presentations, leading to a final report.

PREREQUISITES: None

14-829: Mobile and IoT Security (12 units)

For many people, mobile and embedded devices have become an essential part of life and work. As such devices represent many and varied combinations of technologies, they have unique security and privacy issues that potentially impact users, developers, service providers, manufacturers, and regulators. This course will focus on various aspects of security and privacy that are faced by mobile and Internet of Things devices, including aspects of wireless communication and networking, mobile computing, data analytics, security, and privacy. The course will include studies of security and privacy aspects of networking (including telecom, enterprise, personal, etc.), applications, and data analytics as relevant to mobile and embedded/IoT devices. One of the main goals of the course is to improve knowledge and awareness of security issues faced by mobile application developers, embedded system builders, and smart system designers. Material will cover standards, best practices, and research challenges in both deployed and emerging systems. Topics of study include (but are not limited to) telecom protocols and vulnerabilities; mobile/IoT network security; security and privacy in edge computing; mobile application security; and location and activity privacy. In addition to individual homework assignments, students will participate in an intensive group project involving significant research, development, and experimentation. Graduate standing is required to register for this course.

PREREQUISITES: (18-631 or 18-730 or 14-741) and (14-740 or 18-756 or 15-641)

14-832: Cyber Forensics Capstone (12 units)

Spring: 12 units. The CyFIR concentration capstone course challenges students by placing them in a series of hands-on exercises based on real world scenarios. Students will work together in groups to respond to and investigate large-scale corporate and government intrusions. Instructors will teach advanced event correlation and reconstruction techniques as well as emerging data collection and analysis approaches. Using both host-based and network-based forensics techniques, students will learn to effectively synthesize data, utilize problem solving skills to draw investigative conclusions, and document their analysis. Additionally, students will be required to follow sound forensic methodologies to protect and prepare digital evidence throughout their mock investigations. Furthermore, students will learn to effectively summarize and communicate their forensic analysis through technical report writing and communication best practices. Upon completion of this course, students will be prepared to participate in and guide enterprise cyber security security incident response and forensic operations for large organizations. Prerequisites: 14761, 14822 and 14823.

PREREQUISITES: 14-761 and 14-822 and 14-823

14-840: Mobile Hardware for Software Engineers (12 units)

This course enables students to analyze the implications of mobile hardware capabilities and restrictions in order to plan and develop mobile applications. Students will be able to devise and interface simple hardware additions to mobile platforms such as cellphones, internet tablets and wireless sensors. The course covers the elements of embedded systems development, such as hardware fundamentals, real-time operating systems, interrupts, and cross-development, as well mobile topics such as power management, machine-to-machine communication, radio/RF subsystems and wireless protocols. Topics typically include: USB, GPIO, blue-tooth, cellular

networks, 802.11, Zigbee, RFID, NFC, cameras, audio, etc. Student teams will undertake small HW/SW interfacing projects to sharpen their experience. Unlike a conventional hardware course, the course would instead focus on the software implications, rather than the CPU and radio. Prerequisites: Some understanding of basic electrical terminology and Java programming required; C programming desired.

PREREQUISITES: None

14-841: Mobile and Pervasive Computing (12 units)

This is a course exploring research issues in the newly emerging field of mobile computing. Many traditional areas of computer science and computer engineering are impacted by the constraints and demands of mobility. Examples include network protocols, power management, user interfaces, file access, ergonomics, and security. This will be an advanced course in the truest sense --- most, if not all, the topics discussed will be ones where there is little consensus in the research community on the best approaches. The course will also offer significant hand-on experience in this area. Each student will have to present and lead the discussion on a number of papers. Students will work in groups of three under the guidance of a mentor on a hands-on project. Each student will also be required to write one of two documents: (a) a research proposal (similar in spirit to an NSF proposal) on an idea in mobile computing or (b) a short business plan for a commercial opportunity in mobile computing. Grading will be based on the quality of the presentations, the project, and the proposal or business plan. Prerequisites: 15-410 and senior or graduate standing.

PREREQUISITES: 15-605 or 15-410

14-848: Cloud Infrastructure: Design, Analysis and Implementation (12 units)

Cloud Computing can loosely be defined as the delivery of services via often on-demand and fluidly scalable shared resources. This course explores the design and implementation of the full-stack of hardware and software necessary to implement the infrastructure for elastic, global-scale computing and storage clouds. Upon completion of the course students are expected to be able to design, implement, and analyze the infrastructure underlying cloud-based services. Topics include Data Center Networking; Distributed File Storage; Distributed Key-Value storage, including NoSQL Databases; Virtualization, and the management thereof; Resource Scheduling and Elasticity; Map-Reduce engines, and higher-level Frameworks. The course involves discussion based upon recent and landmark papers, as well as existing tools and software systems. It has a very substantial programming project component in which students design, implement, and analyze various aspects of cloud infrastructure.

PREREQUISITES: None

14-850: INSuRE Cybersecurity Research (12 units)

This course engages students in real-world cybersecurity and information systems security problems of interest to government organizations and industry partners. Students will learn how to apply research techniques, think clearly about problems and constraints, formulate and analyze potential solutions, evaluate solutions through simulation and experimentation, and communicate

their results effectively. Working in small groups under the mentorship of technical clients from government and industry, teams of students will formulate, carry out, and present original research on current cybersecurity/information assurance problems of interest. Project topics come from lists supplied by government and industry partners. The course will be synchronized with similar offerings at several partner schools via videoconference, using resources provided through the INSuRE program. The course will be open to graduate students in computer science and engineering (e.g., INI, CS, ECE, Information Systems, etc.) who have background in information security / information assurance and have significant expertise in at least one relevant technical area. All students will be initially waitlisted for the course until instructors have the chance to verify student qualifications beyond the basic prerequisites.

PREREQUISITES: 18-730 or 14-741

Due to the interdisciplinary nature of our programs, INI students can take classes from various departments across CMU's campus while in SV. The list of these courses including descriptions is available on each individual department's website:

- Electrical & Computer Engineering (ECE): https://courses.ece.cmu.edu/
- School of Computer Science (SCS): http://www.cs.cmu.edu/course-listings-department
- H. John Heinz III College of Information Systems and Public Policy (Heinz): https://api.heinz.cmu.edu/courses_api/course_list/
- Integrated Innovation Institute (III): https://www.cmu.edu/iii/degrees/mssm/curriculum.html

Faculty

Due to the interdisciplinary nature of our programs, INI students can take classes and work with faculty members from various departments across CMU's campus while in SV. Faculty directories for each of these departments are available at:

- ECE: http://www.ece.cmu.edu/directory/index.html
- SCS: http://www.cs.cmu.edu/directory
- Heinz: http://www.heinz.cmu.edu/faculty-and-research/faculty-profiles/index.aspx
- III: https://www.cmu.edu/iii/innovators/faculty-staff/index.html

Below is the list of INI faculty members and their qualifications:

Mohamed Farag
Assistant Teaching Professor, INI

Doctor of Engineering, Engineering Management, 2019, George Washington University
M.S. in Computer Science, 2014, Maharishi International University
B.S. in Information Technology, 2011, Minoufiya University

Dena Haritos Tsamitis
Barbara Lazarus Professor in Information Networking

Ph.D. of Education, Higher Education Management, University of Pennsylvania
B.S., Information Science, University of Pittsburgh

Hanan Hibshi
Assistant Teaching Professor, INI

Ph.D. in Societal Computing, 2018, Carnegie Mellon University
M.S. in Information Security Technology and Management, 2011, Carnegie Mellon University
B.S. in Computer Science, 2003, King Abdul-Aziz University

Cynthia Kuo
Associate Professor of the Practice, INI

Ph.D. Engineering & Public Policy, 2008, Carnegie Mellon University
M.S. Engineering & Public Policy, 2006, Carnegie Mellon University
B.S. Symbolic Systems, 2000, Stanford University

Aleecia McDonald
Assistant Professor of the Practice, INI

Ph.D. in Engineering & Public Policy, 2010, Carnegie Mellon University
M.S. in Engineering & Public Policy, 2008, Carnegie Mellon University

M.S. in Public Policy and Management with a concentration in Internet Policy, 2006, Carnegie Mellon University
B.A. in Professional Writing, 1993, Carnegie Mellon University

Joanne Peca
Associate Professor of the Practice, INI

Ed.D. in Organizational Leadership, Northeastern University
M.S. in Information Systems, Drexel University
MBA Rider University
B.A. in Liberal Studies, Rider University

Patrick Tague
Associate Teaching Professor, INI
Associate Director, INI

Ph.D., Electrical Engineering, 2009, University of Washington
B.S. degrees in Mathematics and Computer Engineering, 2003, University of Minnesota

Sujata Telang
Associate Teaching Professor, INI

MBA (Master of Business Administration), 2010, Carnegie Mellon University
MSE (Master of Software Engineering), 2000, Carnegie Mellon University
M.S. in Advanced Education Studies, 2019, University of Glasgow
B.S. in Electronics and Power, 1982, University of Nagpur

David Varodayan
Associate Teaching Professor, INI

Ph.D. Electrical Engineering, 2010, Stanford University
M.S. Electrical Engineering, 2005, Stanford University
B.A.Sc. Engineering Science, 2003, University of Toronto

For more information on the INI faculty please refer to the INI website at INI: https://www.cmu.edu/ini/about/team/inifaculty.html

The INI also has a number of adjunct instructors who are leading experts in their fields:

David Belasco
Adjunct Instructor, INI, Carnegie Mellon University
Threat Analyst, Threat and Vulnerability Analysis, Software Engineering Institute, Carnegie Mellon University

B.S. in Computer Engineering, 2006, Pennsylvania State University

Jeffrey Gennari
Adjunct Instructor, INI, Carnegie Mellon University
Senior Member Technical Staff, CERT, Software Engineering Institute, Carnegie Mellon University

M.S. in Software Engineering, 2012, Carnegie Mellon University
M.S. in Information Science, 2004, University of Pittsburgh
B.S. in Information Science, University of Pittsburgh.

Rotem Guttman
Adjunct Instructor, INI, Carnegie Mellon University
Security Researcher, CERT, Software Engineering Institute, Carnegie Mellon University

M.S. in Information Security Technology and Management, 2012, Carnegie Mellon University
B.S. in Computer Science & Applied Physics, 2010, State University of New York at Albany

Christopher Herr
Adjunct Instructor, INI, Carnegie Mellon University
Senior Cyber Security Exercise Developer & Trainer, CERT, Software Engineering Institute, Carnegie Mellon University

M.S. Information Science and Security, 2010, University of Pittsburgh
M.S. Criminal Justice, 2008, University of Cincinnati
B.S./B.A. Economics, Physics and Astronomy, 2004, University of Pittsburgh

Matt Kaar
Adjunct Instructor, INI, Carnegie Mellon University
Cyber Security Exercise Developer & Trainer, CERT, Software Engineering Institute, Carnegie Mellon University

M.S. Information Security Technology and Management, 2006, Carnegie Mellon University
B.S. Computer Science, 2002, Georgia Institute of Technology

William Nichols
Adjunct Instructor, INI, Carnegie Mellon University
Infrastructure Engineer, Software Engineering Institute, Carnegie Mellon University

Ph.D. in Physics, Carnegie Mellon University

William Reed
Adjunct Instructor, INI, Carnegie Mellon University
Cyber Security Engineer - Exercise Developer, CERT, Software Engineering Institute, Carnegie Mellon University

M.S. Information Security and Assurance, 2015, Carnegie Mellon University

B.S. Computer and Information Sciences, General, 2004, Franciscan University of Steubenville

Gabriel Somlo
Adjunct Instructor, INI, Carnegie Mellon University
Cyber Security Engineer - Exercise Developer, CERT, Software Engineering Institute, Carnegie Mellon University

Ph.D. Computer Science, 2005, Colorado State University
M.S. in Computer Science, 1997, Colorado State University
B.S. in Computer Science, 1995, Tech. Univ. of Timisoara, Romania

Adam Welle
Adjunct Instructor, INI, Carnegie Mellon University
Senior Cyber Security Engineer, Software Engineering Institute, Carnegie Mellon University

M.S. in Computer Science, Johns Hopkins University
M.S. in Information Assurance, Johns Hopkins University
B.S. in Computer Science, Hawaii Pacific University

CMU University Policies

It is the responsibility of each member of the Carnegie Mellon community to be familiar with university policies and guidelines. In addition to this catalog, the following resources are available to assist you in understanding community expectations:

- The Word/Student Handbook: www.cmu.edu/student-affairs/theword//index.html
- Academic Integrity Website: www.cmu.edu/academic-integrity
- Graduate Education Website: http://www.cmu.edu/graduate/policies/index.html

The complete index of CMU university policies is available at: https://www.cmu.edu/policies/.

Some of the university policies most relevant to the INI students are also highlighted in this section.

Carnegie Mellon Code

Students at Carnegie Mellon, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical and moral conduct possible.

These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

As members of the Carnegie Mellon community, individuals are expected to uphold the standards of the community in addition to holding others accountable for said standards. It is rare that the life of a student in an academic community can be so private that it will not affect the community as a whole or that the above standards do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist.

The commitment of its faculty, staff and students to these standards contributes to the high respect in which the Carnegie Mellon degree is held. Students must not destroy that respect by their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from the university.

The Carnegie Mellon Code is also available online at: https://www.cmu.edu/student-affairs/theword/code/index.html.

CMU Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state, or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the university ombudsman, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-1018.

Obtain general information about Carnegie Mellon University by calling 412-268-2000.

The Statement of Assurance is also available online at: https://www.cmu.edu/student-affairs/theword/statement/index.html.

Admissions & Enrollment Policies

Deferral Policy

The INI's deferral policy is determined on a case-by-case basis.

Applicant's Responsibility: Follow the Application Instructions: In order to successfully complete your application, please follow the instructions and adhere to the deadlines. All requested/required application documents including unofficial transcripts, recommendations, essay/area of interest questions, etc., must be submitted online. An application may be "Incomplete" if the required documents are not provided by the posted deadlines or in the manner requested in the instructions.

Check Your Application Status: Applicants are able to check the status of their application online on the application status page. INI staff and faculty are not able to provide status updates.

The application submission package (https://www.cmu.edu/ini/admissions/guidetoapply.html) must include the material listed below.

To be considered for admission, you must submit the following documents:

- A completed Online Application Form (https://engineering.cmu.edu/education/graduate-programs/apply.html)
- Unofficial Transcripts from all schools attended. Students will be provided instructions about submitting official documents upon admission (see https://www.cmu.edu/ini/admissions/guidetoapply.html for more details).
    - Please note: Admitted applicants who accept enrollment must be prepared to show Proof of Graduation from their undergraduate program. Proof includes final official transcripts and degree certificate and/or diploma submitted no later than the end of July in the manner requested by the INI. Proof of graduation is a condition of enrollment. Submission of an application serves as an agreement to meet this requirement. Failure to submit proof of graduation can result in termination of enrollment.
- Three letters of recommendation (online only): The letters should be from faculty and/or recent employers who know you well and can speak to your technical abilities and quality of work. Letters may be submitted by your recommender(s) following the submission of your online application.
- Official GRE General Test scores (Note: Due to the impact of COVID-19 and the lack of available testing, the INI is *not* accepting GRE General Test scores for the Spring 2020, Fall 2021, or Spring 2022 application cycles.)
- Proof of English Language Proficiency is required for applicants whose native language/mother tongue is not English. Students may submit one of the following: TOEFL, IELTS or Duolingo English Test that is no more than two years old.
- Area of interest and short essay questions.

International Students

The INI admits students from other countries. All foreign students must obtain an F-1 or J-1 visa in order to attend CMU. Required documents are processed through the Office of International Education (OIE) which acts as sponsor of foreign students entering CMU. Incoming students are instructed to pay for delivery of their I-20 certificate or DS-2019 certificate if applicable.

All foreign students originating in countries where English is not the native language/mother tongue must demonstrate English language proficiency in one of the following ways:

1. Results from the internet-based Test of English as a Foreign Language (TOEFL), minimum acceptable score is 99;
2. Results from the International English Language Testing System (IELTS), minimum acceptable score is 7;
3. Results from a Duolingo English Test (select "CMU – College of Engineering")
4. Attendance at a U.S. University in a four-year undergraduate program. In this situation, students may submit expired test scores to fulfill the requirement; we encourage students to submit testing that is most reflective of current level of English proficiency.

Students may request a waiver of the test requirement; decisions are made on a case-by-case basis. For students who have had the English Proficiency testing waived or have not met our minimum scores as listed above, the INI submits to OIE a Verification of English Language Proficiency for Graduate Admissions form, signed by the INI Director and the Dean of the College of Engineering (CIT).

Failure to submit an approved English Proficiency test or to formally obtain a test waiver from the INI may result in the application being marked “Incomplete” and not reviewed for admission consideration.

Domestic Student Qualification

Admission to Carnegie Mellon University graduate programs requires demonstration of successful completion of an undergraduate degree program as specified by the graduate department. Successful completion must be demonstrated by submission of official academic records issued by the degree-granting institution during the matriculation process, in the manner requested by the department.

Language of Instruction

All instruction occurs in English.

Confidentiality of Communications

All information provided to students as a result of their application including subsequent correspondence is considered confidential and should not be communicated to other applicants. Please note that applicants are expected to comply with the confidentiality requirement as a condition of admission.

Transfer of Credit Policy

Up to 24 units of courses taken at another university, whether taken before or after entering the INI graduate program, may be transferred and count as electives, providing:

1. They fulfill an INI graduate program requirement;
2. They are graduate-level courses at the university where they were taken; and
3. They have not been used to fulfill requirements for any previously earned degree.

A grade of 'B' or better must be earned for the courses transferred. All transfer credits must be approved by the INI and the CIT Dean's Office, and the INI will determine how the transferred credits will be reflected in the student's degree requirements. The transfer credits will appear on the student's transcript as an INI elective and are not factored into the core or cumulative GPAs.

Transfer credit is not granted prior to admission to the graduate program and must be approved by the INI and the CIT Dean's Office after the student has satisfactorily completed at least 36 units of graduate courses at Carnegie Mellon. After matriculating to Carnegie Mellon, INI students should consult with their academic advisor before taking a course at another university.

Students should submit an INI petition, along with an official transcript and the course syllabus from the semester in which the course was completed to the INI AAO. Information regarding petitions can be found our website. Students may be required to show proof that the course(s) they want to transfer were not used to fulfill requirements for any previously earned degree. In addition, the student must complete the Graduate Transfer Credit Request Form, located with the CIT graduate student policies at: https://engineering.cmu.edu/education/academic-policies/undergraduate-policies/transfer-credit.html. The INI, not the student, will forward the appropriate information to the Dean's Office for approval.

The university's policy on Transfer Credit Evaluation and Assignment is available at the following link: http://www.cmu.edu/policies/

INI has not entered into an articulation or transfer agreement with any other college or university for that provides for the transfer of credits in the bicoastal MSIT-IS and MSIT-MOB/MSMITE programs.

The INI does not award credit for prior experiential learning to student enrolled in the MSIT-IS and MSIT-MOB/MSMITE programs.

Cancellation, Withdrawal, Leave of Absence, and Refund Policies

Student's right to cancel (withdrawal/leave of absence)

A student has the right to cancel the student's Enrollment Agreement by either taking a leave of absence from the Program (leaving Carnegie Mellon University temporarily with the firm and stated intention of returning) or by withdrawing from the Program (leaving Carnegie Mellon University with no intention of returning). If the student withdraws or take a leave of absence from Carnegie Mellon University, the student may be eligible for a tuition adjustment or a refund of certain fees (excluding any Application Fee, Registration Fee and Enrollment Deposit).

To cancel the student's Enrollment Agreement and take a leave of absence or withdraw, the student must complete Carnegie Mellon University's Leave of Absence or Withdrawal form, as applicable, and return it to Carnegie Mellon University's Registrar's Office, at 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213. The Leave of Absence and Withdrawal forms, and additional information about leaves of absence and withdrawal, can be found on Carnegie Mellon University's website at https://www.cmu.edu/hub/registrar/leaves-and-withdrawals/.

If the student notifies Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is the earliest of:

- The date the student began the student's withdrawal or leave of absence process at Carnegie Mellon University;
- The date the student notified the student's home department at Carnegie Mellon University;
- The date the student notified the associate dean of the student's College at Carnegie Mellon University; or
- The date the student notified the Carnegie Mellon University Dean of Student Affairs.

If the student does not notify Carnegie Mellon University of the student's intent to withdraw or take a leave of absence, the student's official date of withdrawal or leave of absence is:

- The midpoint of the relevant semester in which the student withdraws or takes a leave of absence;
- The last date the student attended an academically related activity such as an exam, tutorial or study group, or the last day the student turned in a class assignment.

Refund Policy

Refunds in General

Students who withdraw from the Program or take a leave of absence after having paid the current semester's tuition and fees or receiving financial aid are subject to the following refund and repayment policies. No other charges are refundable.

Exit Counseling

All borrowers of Federal student loans must complete a Federally mandated exit counseling session when graduating or dropping to less than half-time enrollment status, including by withdrawing or taking a leave of absence. Exit counseling prepares students for repayment. Students must complete an exit counseling session in its entirety, with complete and correct information; otherwise, the student's degree, diploma and official transcripts may be withheld. Information about exit counseling sessions can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/financial-aid/exit-counseling.html.

Withdrawals/Leaves on or before 10th Class Day (during the Cancellation Period)

Students who withdraw or take a leave of absence on or before the 10th class day of the relevant semester will receive a refund of 100% of tuition and fees (excluding any Application Fee or Registration Fee and Enrollment Deposit).

Withdrawals/Leaves after 10th Class Day (after the Cancellation Period)

Students who withdraw or take a leave of absence after the 10th class day of the relevant semester but before completing 60% of the semester will be assessed tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. STRF will be adjusted accordingly with any adjustment of tuition. There is no tuition adjustment after 60% of the semester is completed. There is no refund of University fees after the 10th class day of the relevant semester.

Tuition Adjustment Appeals

Students may appeal to have tuition adjustments for their leave of absence or withdrawal if they feel that they have extenuating circumstances. These appeals will be reviewed in the context of Carnegie Mellon University's tuition adjustment policy, as stated above. These appeals must be made in writing to Carnegie Mellon University's Registrar using Carnegie Mellon University's Tuition Appeal Adjustment form. Information about Carnegie Mellon University's tuition adjustment policy and tuition adjustment appeals can be found on Carnegie Mellon University's website at https://www.cmu.edu/sfs/tuition/adjustment.

Repayment to Lenders/Third Parties

If any portion of refundable tuition and/or fees was paid from the proceeds of a loan or third party, the refund may be sent to the lender, third party or, if appropriate, to the Federal or state agency that guaranteed or reinsured the loan, as required by law and/or Carnegie Mellon University policy. Any amount of the refund in excess of the unpaid balance of the loan shall be first used to repay any student financial aid programs from which the student received benefits, in proportion to the amount of the benefits received, and any remaining amount shall be paid to the student.

Responsibility for Loan: If the student obtains a loan to pay for an educational program, the student will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If the student has received Federal student financial aid funds, the student is entitled to a refund of moneys not paid from Federal student financial aid program funds. If the student is eligible for a loan guaranteed by the Federal or state government and the student defaults on the loan, both of the following may occur: 1) The Federal or state government or a loan guarantee agency may take action against the student, including applying any income tax refund to which the person is entitled to reduce the balance owed on the loan. 2) The student may not be eligible for any other Federal student financial aid at another institution or other government assistance until the loan is repaid.

Academic Standards

Grades

Below are the policies surrounding grades for students in the INI.

University Policy on Grades

The university policy on grading offers details concerning university grading principles for students taking courses and covers the specifics of assigning and changing grades, grading options, drop/withdrawals and course repeats. It also defines the undergraduate and graduate grading standards.

The CMU Grading Policy is available at: https://www.cmu.edu/policies/student-and-student-life/grading.html.

CIT Grading Policy

INI follows the CIT letter grade scale. The letter grade scale is 'A' (highest for CIT students), 'A-', 'B+', 'B', 'B-', 'C+', 'C', 'C-', 'D+', 'D', and 'R' (lowest). CIT students cannot receive an 'A+' grade on their transcript, even if a course is taken from another college where 'A+' is given. Grades lower than 'C', meaning C- or below, are considered failure in CIT and will not count toward degree requirements.

The CIT Registration, Grading and Credit Policies are available at: https://engineering.cmu.edu/education/academic-policies/graduate-policies/registration-grading-credit.html.

Incomplete Grade

Incomplete grades will be assigned at the discretion of the course instructor, per the university grading policy.

The CMU Grading Policy is available at: https://www.cmu.edu/policies/student-and-student-life/grading.html.

Withdrawal Grade/Withdrawing from Courses

Students can withdraw from a course after the add/drop deadline. Students should adhere to the withdrawal deadlines outlined in the Official CMU Academic Calendar available at: https://www.cmu.edu/hub/calendar/index.html. This will result in a 'W' on the transcript, which is not factored into the grade point average (GPA). To withdraw, the course withdrawal request form must be completed and submitted to the academic advisor for approval. If approved, the academic advisor will send the form to the HUB for processing.

Grade Point Average

In order to graduate, each student must have a GPA of at least 3.0 in both core GPA and cumulative GPA.

Academic Standing

Good academic standing is defined by having a core GPA and cumulative GPA of at least 3.0 or above. A student will receive a warning letter for a GPA lower than 3.0 in the most recently completed semester but will remain in good academic standing if core and cumulative GPAs meet the minimum requirement. If a student is not in good academic standing, it is their responsibility to consult with their academic advisor in a timely manner.

A student can be in good academic standing and on probation at the same time due to incidents unrelated to their academic performance.

Probation and Dismissal Policies

Academic Probation

Students who do not meet minimum performance criteria may be placed on academic probation. The purpose of academic probation is to provide the additional support and assistance necessary for adequate progress towards degree requirements. For more details about the College of Engineering's academic standards policy, please visit: http://coursecatalog.web.cmu.edu/schools-colleges/collegeofengineering/#academicstandardstextcontainer.

Throughout the semester, the INI reviews each student's academic performance and progress, including at tenth day of classes, mid-semester and end of semester. If a student is not enrolled in 36 units towards degree requirements each semester (excluding summer), the INI may place that student on academic probation until their performance in the program adheres with our stated course load policy.

Additionally, at the end of each semester, the INI AAO completes a review of each student's performance. GPA for academic review is computed based on the guidelines for graduation requirements. If a student has a core and/or cumulative GPA of less than 3.0, the student is immediately placed on academic probation.

Students who are notified that they are on academic probation are solely responsible for setting up a meeting with their academic advisor within 14 days. During the meeting, the student and their advisor must sign the letter and return it to the INI Director's Office within that timeframe. Students on academic probation may be subject to the following penalties:

- May have any existing INI scholarships and/or financial awards awarded by the INI rescinded
- Cannot be selected to receive awards, fellowships or scholarships
- May not formally represent INI as an officer or other position in a student club or campus organization

A student on academic probation will be removed from probation during the next end-of-semester academic review if their core and cumulative GPAs are 3.0 or higher at that time. The student's scholarship or financial award will be reinstated for future semesters if they are removed from probation; however, the amount that was rescinded will not be reapplied to the student's account.

A student may be permanently dropped from the INI if their core or cumulative GPA remains lower than 3.0 at the end of two consecutive full semesters. They will have an opportunity to appeal if this occurs. The first appeal must go to the Dean of the College of Engineering's office. A detailed summary of the graduate student appeals process can be found here: http://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html.

Courses that negatively affect the core GPA cannot be moved from the core requirement unless another completed course can replace the course with the lower grade.

Academic Integrity

Students at Carnegie Mellon are engaged in intellectual activity consistent with the highest standards of the academy. The relationship between students and instructors and their shared commitment to overarching standards of respect, honor and transparency determine the integrity of our community of scholars. The actions of our students, faculty and staff are a representation of our university community and of the professional and personal communities 19 that we lead. Therefore, a deep and abiding commitment to academic integrity is fundamental to a Carnegie Mellon education. Honesty and good faith, clarity in the communication of core values, professional conduct of work, mutual trust and respect, and fairness and exemplary behavior represent the expectations for ethical behavior for all members of the Carnegie Mellon community.

The INI adheres to Carnegie Mellon University's policy on academic integrity. Please review the University Policy on Academic Integrity: https://www.cmu.edu/policies/student-and-studentlife/academic-integrity.html. The policy includes the University expectations around academic integrity and provides definitions of cheating, plagiarism, and unauthorized assistance.

A review of the University's Academic Disciplinary Actions procedures (https://www.cmu.edu/student-affairs/theword/academic-discipline/index.html) is also recommended. These procedures outline the process for investigating, reporting, and

adjudicating violations of the University Policy on Academic Integrity. The procedures also outline the appeal process.

Academic Integrity Violations

When the INI is notified that a student has committed a violation of the Carnegie Mellon University Policy on Academic Integrity, the student will be subject to course-level action imposed by the instructor.

Additionally, the INI will send the student a notice of eligibility outlining the following: the student will no longer be eligible for financial awards and/or scholarships awarded by the INI, Teaching Assistant positions and metacurricular opportunities and recognition.

In accordance with university policy, a student who violates the academic integrity policy will not be permitted to drop the course in which the offense occurred in order to avoid penalty.

Details related to the academic integrity policy and the appeal process can be found here: http://www.cmu.edu/academic-integrity/headernav/policies.html.

The INI may recommend additional sanctions beyond course-level action.

If the student commits a second violation, the INI will recommend to the Academic Review Board that the student be permanently dropped from the INI and expelled from the university

Attendance policies

Students must be physically present and attend class at the start of the semester. If extenuating circumstances exist that prevent a student from arriving to campus at the start of the semester, the student must notify their academic advisor immediately. Not attending class from the start of the semester will have a detrimental effect on a student's progress in the program. The INI will make an effort to verify all students have arrived to begin their program and will consider a student as "withdrawn from the university" if he or she is not here by the tenth day of class.

Suspension/Required Withdrawal Policy

University suspension is a forced, temporary leave from the university. A student may be suspended for academic, disciplinary and administrative reasons. The INI adheres to Carnegie Mellon's policy on student suspension/required withdrawal policy. The complete policy is available at the following link: https://www.cmu.edu/policies/student-and-student-life/suspension-required-withdrawal-policy.html.

Student Rights and Grievance Procedures

The INI adheres to Carnegie Mellon's Students' Rights policy. The complete policy can be found at the following link: https://www.cmu.edu/policies/student-and-student-life/students-rights.html.

The INI adheres to Carnegie Mellon's Graduate Student Appeal and Grievance procedures. The summary of these procedures can be found at the following link: https://www.cmu.edu/graduate/policies/appeal-grievance-procedures.html.

Student Record Retention Policy

The INI adheres to the CMU Student Record Retention Policy.

Student Record Retention Policy

The policy of Carnegie Mellon University is to ensure the safety, accessibility, confidentiality, and good condition of the permanent record of every Carnegie Mellon student, past and present.

Carnegie Mellon University (CMU), established in 1900, holds all permanent records of our students (current and former) in the University Registrar's Office. We maintain original paper records in an offsite secure climate-controlled underground storage facility along with a microfilmed copy of each record. In addition, a copy of microfilmed records also resides in the University Registrar's Office in Pittsburgh, PA. This includes all students globally, include those students studying at our California teaching location and instructional sites. CMU has established the University Registrar's Office as the official data steward of all student records.

Historical Records 1906-1989

For every student enrolled at Carnegie Mellon University as a new or continuing student prior to the fall semester, 1989, and dating back to 1906, the University Registrar's Office of Carnegie Mellon University maintains a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not within the student's official transcript. The official transcript provides brief personal information to identify the student as unique. It contains courses, units and grades; semester and cumulative grade point averages; all degrees earned; transfer credit or advanced placement and dean's list indications.

The University Registrar's Office has established and maintains within a microfiche copy of good, readable, and reproducible quality of the student's permanent record in a secured records unit. A secondary permanent microfilm copy of all records will be maintained in good condition in the climate-controlled, fire-proof, limited-access security at an offsite facility.

Modern Records 1989-Current

For every student enrolling at Carnegie Mellon University as a new or continuing student beginning in fall semester, 1989, the University Registrar's Office of Carnegie Mellon University will establish and maintain within an electronic data file in the University Student Services Suite (S3, our student information system) a complete permanent record, whether the student is degree-seeking or non-degree seeking, whether enrolled for credit or not. The University Registrar's Office staff will, under the direction of the University Registrar, add to the electronic record such new information as pertains to the student's demographic and academic record as it becomes available, semester-by-semester, and as the student progresses in his/her career at Carnegie Mellon University.

Daily, the Carnegie Mellon University Computing Services Division will perform a backup of all databases that have been altered during that day. Weekly, the Computing Services Division will perform a complete backup of all records within the student data file. The Computing Services Division staff will store the daily backups in the climate-controlled, fire-proof, limited-access security facility in the Computer Operations center in Cyert Hall on the Carnegie Mellon University campus. Upon successful completion of the monthly backup, the Computing Services Division staff will securely transfer the weekly and monthly backups from the preceding month to climate-controlled, fire-proof, secured vault at an offsite facility.

Cessation of Operations

In the unlikely event that CMU (which has existed for more than 100 years) ceases to exist, it will make appropriate arrangements to comply with clauses (1) and (2) for all its students consistent with the Commonwealth of Pennsylvania statutes and law. I have an informal plan and agreement with the University of Pittsburgh's University Registrar's Office, that should either school cease, we would exchange student records.

The complete policy is available at https://www.cmu.edu/es/docs/record-retention-policy.pdf.

Financial Information

Fees and Charges for INI Pittsburgh - Silicon Valley MSIT – IS and MSMITE programs 2021-2022 (while on SV Campus)

Original Programs (122 units)
Standard Study Option for student who matriculated in Fall 2020
Standard Study Option for students who matriculated in Spring 2021 remotely
Applied Study Option for students who matriculated in Fall 2020
Applied Study Option for students who matriculated in Spring 2021 remotely

	Entire Program (SV Campus)	First Semester	
Program Tuition	$25,050	$25,050	Prorated upon withdrawal/leave of absence. See Refund Policy provisions of this Enrollment Agreement. The amount quoted covers only the estimated tuition for the portion of the program provided in California.
Required University Fees	$453	$453	Non-Refundable after the 10th class day of the relevant semester. See Refund Policy provisions.
Books and Supplies (estimated)	$1,106	$1,106	Estimated cost for entire program. Used, digital and rented books and other factors may reduce/increase actual cost. The amount quoted covers only the estimated cost for the portion of the program provided in California.
Student Tuition Recovery Fund (STRF)	$13	$13	Non-Refundable ($.50 for every $1,000 of net tuition rounded to the nearest $1,000). See information below about the STRF.

ESTIMATED TOTAL FEES/CHARGES FOR THE ENTIRE PROGRAM	$26,622
ESTIMATED TOTAL FEES/CHARGES FOR FIRST SEMESTER	$26,622
FEES/CHARGES DUE UPON ENROLLMENT	$0

Fees and Charges for INI Pittsburgh - Silicon Valley MSIT – IS and MSMITE programs 2021-2022 (while on SV Campus)

All Study Options for students who matriculated in Fall 2021 and opted to start the program on the CMU-SV Campus.

	Entire Program (SV Campus)	First Semester	
Program Tuition	$50,100	$25,050	Prorated upon withdrawal/leave of absence. See Refund Policy provisions of this Enrollment Agreement. The amount quoted covers only the estimated tuition for the portion of the program provided in California.
Required University Fees	$906	$453	Non-Refundable after the 10th class day of the relevant semester. See Refund Policy provisions.
Books and Supplies (estimated)	$2,212	$1,106	Estimated cost for entire program. Used, digital and rented books and other factors may reduce/increase actual cost. The amount quoted covers only the estimated cost for the portion of the program provided in California.
Student Tuition Recovery Fund (STRF)	$27	$13	Non-Refundable ($.50 for every $1,000 of net tuition rounded to the nearest $1,000). See information below about the STRF.

ESTIMATED TOTAL FEES/CHARGES FOR THE ENTIRE PROGRAM	$53,445
ESTIMATED TOTAL FEES/CHARGES FOR FIRST SEMESTER	$26,822
FEES/CHARGES DUE UPON ENROLLMENT	$200

Fees and Charges for INI Pittsburgh - Silicon Valley MSIT – IS and MSMITE programs 2021-2022 (while on SV Campus)

Standard Study Option for students who matriculated in Spring 2021 in person.
Applied Study Option for students who matriculated in Spring 2021 in person.
Advanced Study Option for students who matriculated in Fall 2020.
Applied Advanced Study Option for students who matriculated in Fall 2020.

	Entire Program (SV Campus)	First Semester	
Program Tuition	$50,100	$25,050	Prorated upon withdrawal/leave of absence. See Refund Policy provisions of this Enrollment Agreement. The amount quoted covers only the estimated tuition for the portion of the program provided in California.
Required University Fees	$906	$453	Non-Refundable after the 10th class day of the relevant semester. See Refund Policy provisions.
Books and Supplies (estimated)	$2,212	$1,106	Estimated cost for entire program. Used, digital and rented books and other factors may reduce/increase actual cost. The amount quoted covers only the estimated cost for the portion of the program provided in California.
Student Tuition Recovery Fund (STRF)	$27	$13	Non-Refundable ($.50 for every $1,000 of net tuition rounded to the nearest $1,000). See information below about the STRF.

ESTIMATED TOTAL FEES/CHARGES FOR THE ENTIRE PROGRAM	$53,245
ESTIMATED TOTAL FEES/CHARGES FOR FIRST SEMESTER	$26,622
FEES/CHARGES DUE UPON ENROLLMENT	$0

Fees and Charges for INI Pittsburgh - Silicon Valley MSIT – IS and MSMITE programs 2021-2022 (while on SV Campus)

Advanced Study Option for students who matriculated in Spring 2021 in person.
Applied Advanced Study Option for students who matriculated in Spring 2021 in person.

	Entire Program (SV Campus)	First Semester	
Program Tuition	$51,353	$25,050	Prorated upon withdrawal/leave of absence. See Refund Policy provisions of this Enrollment Agreement. The amount quoted covers only the estimated tuition for the portion of the program provided in California.
Required University Fees	$929	$453	Non-Refundable after the 10th class day of the relevant semester. See Refund Policy provisions.
Books and Supplies (estimated)	$2,267	$1,106	Estimated cost for entire program. Used, digital and rented books and other factors may reduce/increase actual cost. The amount quoted covers only the estimated cost for the portion of the program provided in California.
Student Tuition Recovery Fund (STRF)	$27	$13	Non-Refundable ($.50 for every $1,000 of net tuition rounded to the nearest $1,000). See information below about the STRF.

ESTIMATED TOTAL FEES/CHARGES FOR THE ENTIRE PROGRAM	$54,576
ESTIMATED TOTAL FEES/CHARGES FOR FIRST SEMESTER	$26,622
FEES/CHARGES DUE UPON ENROLLMENT	$0

Financial Aid

Carnegie Mellon University Consumer Information

Below is a summary of consumer information made available to all Carnegie Mellon University prospective and current students as required by the Higher Education Act of 1965, as amended. Required Disclosure have been categorized into five topics. Each disclosure gives a brief description of information that is required to be disclosed and explains how it can be obtained. This information may be changed from time to time as required.

If you need assistance or would like a paper copy, contact the Student Financial Aid Office, 5000 Forbes Avenue, Warner Hall, Pittsburgh, PA. If you wish to speak with a representative about the information contained here, please utilize the contact information found here: https://www.cmu.edu/hub/consumer-information/.

Information about the Institution:

Accreditation Information
Carnegie Mellon University is accredited by the Middle States Commission on Higher Education (MSCHE), 3624 Market Street, 2nd Floor West, Philadelphia, PA 19104 (www.msche.org). The Commission may be contacted by telephone at 267-284-5000 or via email at info@msche.org or espanolinfo@msche.org (Spanish/Español). The university's current "Statement of Accreditation Status" can be found at, https://www.msche.org/institution/.

State Approvals
Carnegie Mellon University is licensed to operate in the states listed below. Individuals may contact the relevant agency for more information or information about how to file a complaint.

California

Bureau for Private Postsecondary Education
P.O. Box 980818
West Sacramento, CA 95798-0818
Telephone: 888-370-7589
Email: bppe@dca.ca.gov
Website: www.bppe.ca.gov

New York

New York State Education Department
Office of Higher Education
Room 977 Education Building Annex
Albany, NY 12234
Telephone: 518-486-3633
Email: hedepcom@nysed.gov
Website: www.highered.nysed.gov

Pennsylvania

Pennsylvania Department of Education
Office of Postsecondary and Higher Education
333 Market Street, 12th Floor
Harrisburg, PA 17126-0333
Telephone: 717-783-8228
Email: ra-collunivseminfo@pa.gov
Website: www.education.state.pa.us

Washington, D.C.

Office of the State Superintendent of Education
Government of the District of Columbia
810 First Street NE 9th Floor
Washington, DC 20002
Telephone: 202-727-6436
Email: osse@dc.gov
Website: osse.dc.gov

Inquiries regarding the university's accreditation status or authorization to operate in any of the above states may be directed to: Associate Vice President / Director of Enrollment Services, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh PA 15213, telephone: 412-268-5399, email: krieg@andrew.cmu.edu.

Distance Education, State Authorization and Reciprocity Agreement (SARA)

The State Authorization Reciprocity Agreement (SARA) is an agreement among member states, districts, and territories in the United States, which establishes national standards for interstate offering of postsecondary distance education courses and programs. It is intended to standardize the process of offering online courses and programs by postsecondary institutions located in states other than the state in which the enrolled student(s) are residing. SARA is overseen by a national council (NC-SARA) and administered by four regional education compacts.

Carnegie Mellon University has been approved by the Commonwealth of Pennsylvania to participate in NC-SARA and was accepted as a SARA institution on May 2, 2017; additionally, Carnegie Mellon secured approval through NC-SARA on May 18, 2017. Carnegie Mellon University is listed as an approved, participating institution on the NC-SARA website (http://www.nc-sara.org/). At this time, 49 of the 50 United States are SARA members. California is not a member of SARA; however, Carnegie Mellon is able to offer online education to California residents.

Except where prohibited by applicable law, students who reside outside of the United States generally are not restricted from enrolling in our online programs. Some online programs do require in-person attendance at one of Carnegie Mellon's teaching locations (e.g., Carnegie

Mellon's Pittsburgh, Pennsylvania campus) for short portions of the program. Students interested in enrolling in a specific online program are encouraged to contact the person designated by the online program for questions about the program's requirements or enrollment.

Copyright Infringement Policies

Carnegie Mellon University takes copyright violation seriously. Besides raising awareness about copyright law, it takes appropriate action in support of enforcement as required by policy and law. United States copyright law (http://www.copyright.gov/) "protects the original works of authorship fixed in any tangible medium of expression, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device".

The University's Fair Use Policy (http://www.cmu.edu/policies/administrative-and-governance/fair-use.html) states that all members of the University must comply with US copyright law and it explains the fair use standards for using and duplicating copyrighted material. In addition, the policy prohibits the duplication of software for multiple uses, meeting the Digital Millennium Copyright Act (DMCA) (http://www.copyright.gov/legislation/dmca.pdf) requirements. The DMCA criminalizes the development or use of software that enables users to access material that is copyright protected. Furthermore, the Computing Policy (http://www.cmu.edu/policies/information-technology/computing.html) prohibits the distribution of copyright protected material via the University network or computer systems, unless the copyright owner grants permission.

The Higher Education Opportunity Act of 2008 (Public Law 110-315) Section 488, requires institutions of higher education to annually inform students that "unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject the students to civil and criminal liabilities". Carnegie Mellon does this by publication of a news article on Computing Services' website or via mass mail communication each semester. The law goes on to require institutions "to provide a summary of penalties for violation of Federal copyright laws, including disciplinary actions that are taken against students who engage in unauthorized distribution of copyrighted materials using the institution's information system." Copyright protected materials can include, but are not necessarily limited to:

- Music
- Movies or other videos
- Literary works
- Software
- Digital images or libraries

Cost of Attending the University

Actual tuition and fee charges can be found on the Student Financial Services' website at https://www.cmu.edu/sfs/tuition/index.html.

For estimated books and supplies, room and board, and personal/miscellaneous expenses view the cost of attendance for,

Graduate program at https://www.cmu.edu/sfs/tuition/graduate/index.html.

Descriptions of Academic Programs

Information on the university's graduate academic programs and degree offerings is available from the various schools/colleges and admitting offices. Links to those programs can be found at https://www.cmu.edu/academics/index.html.

Faculty

Information on the university's faculty and instructional personnel is **available from individual schools/colleges. This information can be found on the university's academics website at** https://www.cmu.edu/academics/index.html**.**

Facilities & Services for Disabled Students

The Office of Disability Resources provides responsive and reasonable accommodations to students who self-identify as having a disability, including physical, sensory, cognitive and emotional disabilities. If you would like to learn more about the services and accommodations provided by the Office of Disability Resources, visit their website at https://www.cmu.edu/disability-resources/students/. To discuss your accommodation needs, please email us at access@andrew.cmu.edu or call us at 412-268-6121 to set up an appointment.

Student Privacy & FERPA

One of the most significant changes a parent or guardian experiences in sending a student to college is the difference in privacy standards for educational records. Carnegie Mellon values the student's right to privacy. The university adheres to a federal law called the Family Educational Rights and Privacy Act (also called FERPA or the Buckley Amendment) that sets privacy standards for student educational records and requires institutions to publish a compliance statement, including a statement of related institutional policies. For more detailed information, view the university's brochure at https://www.cmu.edu/hub/privacy/ferpa-brochure.pdf.

Return to Title IV Funds Policy and Procedural Statement

Policy Reason

The U. S. Department of Education requires that the university determine the amount of Federal Title IV aid earned by a student who withdrawals of fails to complete the period of enrollment. The university must determine the earned and unearned portions of Title IV aid as of the date the student ceased attendance based on the amount of time the student spent in attendance. Up through the 60% point in the period of enrollment, a pro rata schedule is used to determine the amount of Title IV funds the student has earned at the time of withdrawal. After the 60% point in the period of enrollment, a student has earned 100% of the Title IV funds he or she was

scheduled to receive. For a student who withdraws after the 60% point-in-time, there are no unearned funds. Federal regulations can be found at:

Federal Student Aid Handbook, Volume 5

Chapter 1 Withdrawals and the Return of Title IV Funds 34 CFR 668.22

Policy and Procedural Statement

At Carnegie Mellon Title IV funds are awarded to a student under the assumption that the student will attend school for the entire period for which the assistance is awarded. When a student withdraws, the student may no longer be eligible for the full amount of Title IV funds that the student was originally scheduled to receive.

If a recipient of Title IV grant or loan funds withdraws from a school after beginning attendance, the amount of Title IV grant or loan assistance earned by the student must be determined. If the amount disbursed to the student is greater than the amount the student earned, the unearned funds must be returned. If the amount disbursed to the student is less than the amount the student earned, and for which the student is otherwise eligible, he or she is eligible to receive a Post-withdrawal disbursement of the earned aid that was not received.

Carnegie Mellon determines the Withdrawal Date and Date of Determination to complete the return calculation. A student's withdrawal date and date of determination varies depending on the type of withdrawal. When a student provides official notification to Carnegie Mellon through the Student Leave of Absence and Withdrawal Process, the withdrawal is defined as official withdrawal. When the student does not complete the Student Leave of Absence and Withdrawal Process and no official notification is provided by the student it is considered an unofficial withdrawal.

Leave of Absence/Withdrawal Process

A student may leave Carnegie Mellon by either taking a leave of absence (leaving the university temporarily with the firm and stated intention of returning) or by withdrawing from the university (leaving the university with no intention of returning). Students choosing to take a leave of absence should first contact their academic advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon. A student deciding to leave the university should take the following steps:

- Complete a Leave of Absence or Withdrawal Form.
- The form must include **all** necessary signatures or the process will not be completed.
- Return the completed form to the University Registrar's Office, 5000 Forbes Ave., Warner Hall A12, Pittsburgh, PA 15213.

Determination of Withdrawal Date

Official Withdrawals (Notification Provided by the Student)

Those withdrawals defined as official are processed in accordance with federal regulations. The Office of the Registrar provides information that identifies which students have processed a Student Leave of Absence and Withdrawal Form for each semester. This information includes the Date of Withdrawal, the Date of Determination, Withdrawal/Leave Status (LA, LS, & W2) and the semester of attendance. This information is maintained in the student's academic file and in the university's Student Information System.

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- Date the student began the withdrawal or leave of absence process;
- Date the student notified his or her home department;
- Date the student notified the associate dean of his or her college; or
- Date the student notified the dean of students.

Unofficial Withdrawal (No Official Notification Provided by the Student)

For a student who withdraws without providing notification to Carnegie Mellon, the institution determines the withdrawal date using defined criteria. This category of withdrawals includes students that drop out and students that do not earn a passing grade.

To identify the unofficial withdrawals the Registrar develops a preliminary list of students that did not complete the semester by reviewing the final student grade reports. The list includes all students with: a) semester units carried, b) 0 semester units passed, c) 0 quality points earned, and d) 0.0 QPA. The Registrar contacts the academic divisions about each student to determine if the student actually completed the semester and earned the grades (0.0) or failed to complete the semester and did not notify the university of their status.

For students who do not notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- The midpoint of the semester;
- The last date the student attended an academically related activity such as an exam, Tutorial or study group, or the last day a student turned in a class assignment.

Date of Determination that the Student Withdrew

Carnegie Mellon is not required to take attendance and the Date of Determination that a student withdrew varies depending upon the type of withdrawal: Official or Unofficial.

1. For withdrawals where the student **provided *Official Notification*** the Date of Determination is: The student's withdrawal date, or the date of notification, whichever is

later.
2. For withdrawals where the student **did not provide *Official Notification*** the Date of Determination is: The date the institution becomes aware the student has ceased attendance.

For a student who withdrawals without providing notification to the institution, the institution must determine the withdrawal date no later than 30 days after the end of the enrollment period.

Calculation of Earned Title IV Assistance

The withdrawal date is used to determine the point in time that the student is considered to have withdrawn so the percentage of the period of enrollment completed by the student can be determined. The percentage of Title IV aid earned is equal to the percentage of the period of enrollment completed.

The amount of Title IV federal aid earned by the student is determined on a pro-rata basis up to the end of 60% of the semester. If the student completed 30% of a term, 30% of the aid originally scheduled to be received would have been earned. Once a student has completed more than 60% of a term, all awarded aid (100%) has been earned. The percentage of federal aid earned and the order in which the unearned aid is returned are defined by federal regulatory requirements.

The calculation of earned Title IV funds includes the following grant and loan funds if they were disbursed or could have been disbursed to the student for the period of enrollment for which the Return calculation is being performed:

- Pell Grant
- Iraq and Afghanistan Service Grant
- TEACH Grant (not available at Carnegie Mellon)
- FSEOG Grant
- Federal Direct Loan

Institutional Charges

Institutional charges are used to determine the portion of unearned Title IV aid that the school is responsible for returning. Carnegie Mellon ensures that all charges for tuition, fees, room and board, as well as all other applicable institutional charges are included in the return calculation. Institutional charges do not affect the amount of Title IV aid that a student earns when he or she withdraws.

The institutional charges used in the calculation usually are the charges that were initially assessed the student for the period of enrollment. Initial charges are only adjusted by those changes the institution made prior to the student's withdrawal (for example, for a change in enrollment status unrelated to the withdrawal). If, after a student withdraws, the institution

changes the amount of institutional charges it is assessing a student, or decides to eliminate all institutional charges, those changes affect neither the charges nor aid earned in the calculation.

Return of Unearned Funds to Title IV

If the total amount of Title IV grant and/or loan assistance that was earned as of the withdrawal date is less than the amount that was disbursed to the student, the difference between the two amounts will be returned to the Title IV program(s) and no further disbursements will be made.

If a student has received excess funds, the College must return a portion of the excess equal to the lesser of the student's institutional charges multiplied by the unearned percentage of funds, or the entire amount of the excess funds.

The funds will be returned in the order below as prescribed by federal regulations, within 45 days from the date of determination that a student withdrew.

- Unsubsidized Federal Stafford Loans
- Subsidized Federal Stafford Loans
- Federal PLUS loans
- Federal Pell Grants
- Federal Supplemental Educational Opportunity Grants (FSEOG)

Post-Withdrawal Disbursements

If the total amounts of the Title IV grant and/or loan assistance earned as of the withdrawal date is more than the amount that was disbursed to the student, the difference between the two amounts will be treated as a post-withdrawal disbursement. In the event that there are outstanding charges on the student's account, Carnegie Mellon will credit the student's account for all or part of the amount of the post-withdrawal disbursement up to the amount of the allowable charges.

Any amount of a post-withdrawal disbursement that is not credited to a student's account will be offered to the student within 30 days of the date that the institution determined that the student withdrew. Upon receipt of a timely response from the student, the College will disburse the funds within 90 days of the date of determination of the student's withdrawal date.

<u>Return of Title IV Funds – Withdrawals for Programs Offered in Modules</u>

The return of Title IV funds for programs offered in modules is defined in a separate policy statement at Carnegie Mellon. This document is included as an addendum to the Carnegie Mellon University Return to Title IV Funds Policy and Procedural Statement (see below).

<u>Policies and Procedures</u>

Federal Student Aid Handbook, Volume 5, Chapter 2 Withdrawals and the Return of Title IV Funds
CFR 668.22 (a), (f) and (l)

Dear Colleague Letter GEN-11-14 July 2011

For all programs offered in modules, a student is a withdrawal for Title IV purposes if the student ceases attendance at any point prior to completing the payment period or period of enrollment (unless the institution has written confirmation from the student that that they will attend a module that begins later in the enrollment period).

The regulations require the institution to determine whether Title IV funds must be returned based on the number of days actually completed versus the number of days the student was scheduled to attend in the payment period. The regulations prevent students from enrolling in modules or compressed courses spanning the period, completing a portion of the period, and retaining all aid for the period.

A program is considered to be offered in modules if a course or courses in the program do not span the entire length of the payment period or period of enrollment. The rule impacts all programs offering courses shorter than an entire semester, including semester-based programs with a summer term consisting of two consecutive summer sessions.

The Student Financial Aid Office has established the following procedures associated with handling withdrawals from programs offered in modules. An Associate Director of Student Financial Aid has the primary responsibility for compliance and implementation of these regulatory requirements.

1. The institution will identify students enrolled for the summer session that are eligible for Title IV Aid.
    - Pell eligible students are identified
    - Students with summer loans are identified
    - The period of enrollment and enrollment status will be identified for each student
2. All Leave/ Withdrawal Forms processed by the University Registrar's Office will be reviewed for the summer sessions to record the Withdrawal Date and Date of Determination to identify any student receiving federal funding.
3. The Student Financial Aid Office will identify any students that drop courses in the summer sessions.
    - During Summer I this is standard procedure
    - During Summer II this is reviewed after 10th day reporting
    - Any additional dropped courses will be reviewed through the 60% enrollment period
4. Students who are identified as official withdrawals or that officially drop all courses in a session will be reviewed to determine the amount of federal financial aid earned. If a Return of Title IV aid is required, existing institutional procedures will be followed.
5. At the end of the enrollment period the institution will determine if any students are identified as 'unofficial withdrawals.' If a Return of Title IV aid is required, existing institutional procedures will be followed.
6. If a student does not begin courses in all sessions, a Return of Title IV aid may not be required, but other regulatory provisions concerning recalculation may apply.
    - If a student completes both courses in module one, but officially drops courses in module two while attending module one the student is not a withdrawal.

- Since the enrollment is less than half time, the student is no longer eligible for the loan and the funds must be returned.

The following information obtained from the Federal Student Aid Handbook, Chapter 2, Withdrawals and the Return of Title IV Funds, will be used to determine whether a student enrolled in a series of modules is a withdrawal.

How to determine whether a student in a program offered in modules has withdrawn

Schools can determine whether a student enrolled in a series of modules is a withdrawal by asking the following questions.

1. ***After beginning attendance in the payment period or period of enrollment, did the student cease to attend or fail to begin attendance in a course he or she was scheduled to attend?***
   - If the answer is no, this is not a withdrawal.
   - If the answer is yes, go to question 2.

2. ***When the student ceased to attend or failed to begin attendance in a course he or she was scheduled to attend, was the student still attending any other courses?***

   - If the answer is yes, this is not a withdrawal; however other regulatory provisions concerning recalculation may apply.
   - If the answer is no, go to question 3.

3. ***Did the student confirm attendance in a course in a module beginning later in the period (for non-term and nonstandard term programs, this must be no later than 45 calendar days after the end of the module the student ceased attending)?***

   - If the answer is yes, this is not a withdrawal, unless the student does not return.
   - If the answer is no, this is a withdrawal and the Return of Title IV Funds requirements apply.

Contact: Questions regarding this policy or its intent should be directed to the Student Financial Aid Office at 412-268-1353.

Satisfactory Academic Progress Policy and Procedural Statement

To be eligible for federal, state, and institutional financial aid, all students are required to maintain Satisfactory Academic Progress toward the completion of a degree. Each university determines its own policy in accordance with federal regulations set forth by the U. S. Department of Education regarding satisfactory progress standards to ensure student success. To maintain Satisfactory Academic Progress at Carnegie Mellon University, students must meet the following minimum standards for both of the qualitative (QPA) and quantitative (completion rate) measures:

Student Type	QPA (Qualitative)	Completion Rate (Quantitative)*
First Year Undergraduate	1.75	80%
Undergraduate Upper-class	2.00	80%
Heinz Graduate	3.00	80%
Other Graduate (excluding Tepper)	2.00	80%

**To calculate the completion rate, the cumulative number of completed units is divided by the cumulative number of units attempted. Advance Placement credits are excluded from both figures.*

In addition to the above-mentioned Financial Aid Satisfactory Academic Progress standards, federal regulations require a student to complete their degree within a specified amount of time. The maximum timeframe cannot exceed 150 percent of the time published as needed for completion of the program.

Scope:

This policy applies to Federal aid including Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Work-Study, Federal Direct Loans, and Federal Direct PLUS Loan programs; state grant aid; and Carnegie Mellon institutional aid including grants, loans, and scholarships.

Federal regulations can be found at,

Federal Student Aid Handbook, Volume 1
Chapter 1 School Determined Requirements
34 CFR 668.16(e)
34 CFR 668.32(f)
34 CFR 668.34

Evaluation

Carnegie Mellon evaluates all students for Financial Aid Satisfactory Academic Progress annually, at the end of the spring semester. Students that are included in the review are undergraduates, graduates, both full-time and part-time.

Courses that do not count toward a student's degree cannot be used to determine enrollment status for financial aid purposes. Carnegie Mellon will count transfer credit hours that are accepted toward a student's educational program as both attempted hours and completed hours. Advanced Placement Non-Degree and Non-Credit courses are not counted as units passed or attempted. When a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student's QPA. For financial aid eligibility, only one repeat per course is permitted in the determination of enrollment status for courses previously passed.

If the student withdraws and is not assigned a W grade, then it will not be counted in the number of units attempted or completed. If the W grade is assigned, the units will be counted in the number of units attempted and will be counted as zero in the number of units completed.

If the student has incomplete units, the units will be counted as attempted and will be counted as zero in the number of units completed.
The Financial Aid Satisfactory Academic Progress evaluation is a cumulative review of all semesters, regardless of whether or not the student received financial aid during the academic year.

If the minimum requirements are not achieved, the student is ineligible to receive financial aid. In such a case, the student is notified and given an option to appeal their financial aid status. More information about the appeal process can be found at https://www.cmu.edu/sfs/financial-aid/policies/academic-progress.html.

A financial aid package will not be completed unless an appeal is received, approved and processed accordingly. If by chance a financial aid package is processed and released to the student, it is conditional and subjected to financial aid removal until an appeal is received, approved and processed accordingly.

Contact: Accountable Department: Enrollment Services, Student Financial Aid. Questions regarding this policy or its intent should be directed to the Student Financial Aid Office, phone: 412-268-1353.

Student Body Diversity

For Information about the diversity of the university student body, contact the Institutional Research and Analysis Office, https://www.cmu.edu/ira/index.html.

For information about the University's Diversity, Equity and Inclusion initiative, visit the Center for Student Diversity and Inclusion's website at https://www.cmu.edu/student-diversity/.

Written Arrangement Information

A U.S. Department of Education regulation requires disclosure of specific information to prospective and current students regarding written arrangements between Carnegie Mellon University (CMU) and any institution(s) that provides a portion of an educational program to students enrolled at CMU. CMU enters into such arrangements to enrich the educational experiences offered to its students. In accordance with the regulation, CMU provides this information at http://www.cmu.edu/hub/consumer-information/docs/written-arrangement.pdf.

Student Complaints & Consumer Information by State

As required for compliance with U.S. Federal Program Integrity Regulations, state official/agency contact information for each U.S. state/territory that could handle a student's complaint is provided at https://www.cmu.edu/hub/consumer-information/docs/complaints.pdf.

Gainful Employment Disclosures

As required by U.S. Department of Education regulations Gainful Employment Disclosures (Disclosures about CMU certificate programs that prepare students for specific occupations) can be found at https://www.cmu.edu/hub/consumer-information/.

Information about Student Financial Aid:

Meeting the cost of higher education is a significant investment. We are committed to providing a comprehensive financial aid program that makes it possible for admitted students to attend Carnegie Mellon.

Application Process & Timeline:

Graduate Students: **To apply for financial aid for the 2018-2019 academic year, follow the steps below:**

1. Free Application for Federal Student Aid (FAFSA)

The FAFSA is required if applying for federal financial aid programs. There are now two ways to complete the *Free Application for Federal Student Aid (FAFSA)* form: a redesigned https://studentaid.ed.gov/sa/fafsa website or a mobile app (available through Google Play, https://play.google.com/store/apps/details?id=com.fsa.mystudentaid or the Apple App Store, https://itunes.apple.com/us/app/mystudentaid/id1414539145).

We recommend using the IRS Data Retrieval Tool (DRT) (https://studentaid.ed.gov/sa/resources/irs-drt-text) to complete the FAFSA. The DRT transfer process has been improved to include stronger security and privacy protections; therefore, tax information transferred will not display on the form or Student Aid Report. Instead, the phrase "Transferred from the IRS" will appear in the fields.

Those selected for federal verification after FAFSA completion or those unable to use the IRS DRT will need to request an IRS Tax Return Transcript (https://www.irs.gov/individuals/get-transcript).

Additional information:

- Apply as soon as possible after October 1.
- Carnegie Mellon's federal code is 003242.
- Use 2017 tax information to complete the FAFSA.
- A Department of Education Federal Student Aid (FSA) ID is required. View FSA ID

instructions at https://fsaid.ed.gov/npas/index.htm.
- Students must complete the FAFSA's electronic signature requirement.

2. MPN & Entrance Counseling

All first-time Federal Direct Loan borrowers are required to complete entrance counseling. The entrance counseling session provides information about borrower rights and responsibilities. CMU will be notified when a student has completed online entrance counseling. Funds will not be disbursed until the entrance counseling session has been completed. Students who completed a federal entrance counseling session while at CMU, do not have to complete another session.

Additional information:

- View entrance counseling instructions (https://www.cmu.edu/sfs/financial-aid/types/federal-loans/direct/mpn-entrance-counseling.html).
- Complete entrance counseling session at https://studentloans.gov.

3. Grad PLUS Loan

If you plan on borrowing a Federal Direct Graduate PLUS Loan, this is a two-part process and both parts must be completed in order for your loan to be originated. If you borrowed a Grad PLUS Loan last academic year, you are only required to complete the application portion of the process. The application portion of the process cannot be completed before June 1, 2018.

Additional information:

- View detailed Grad PLUS Loan instructions at https://www.cmu.edu/sfs/financial-aid/types/federal-loans/plus/instructions.html.
- The two-part process may be completed at https://studentloans.gov.

Financial Aid Eligibility Notification

Once a student completes all of the steps above, a financial aid package will be determined. The Student Financial Aid Office will notify the student by email that a financial aid award letter has been posted to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home). The letter contains information and further instructions regarding the student's eligibility and awards. If a student's circumstances change, then financial aid eligibility will be re-evaluated and the student will receive notification that a revised award letter is available in SIO.

Missing Documents

If we are unable to process a student's financial aid package due to missing documents, a Financial Aid Alert email will be sent to the student requesting the required documents by a specified date. Until the entire application process is completed and all required documents are submitted, our office may be unable to complete a student's financial aid package. Students may log in to SIO (https://s3.andrew.cmu.edu/sio/index.html#finances-home) to view documents that have been received by our office. View instructions for submitting missing documents at https://www.cmu.edu/sfs/financial-aid/missing-documents/index.html.

Teacher Certification
Teacher certification students at the graduate level should be aware that federal regulations classify them as a grade level 5 undergraduate student for Federal Direct Student Loan purposes. Teacher certification students are, however, considered a graduate student by Carnegie Mellon for academic purposes.

Available Financial Aid

Scholarships & Grants

Graduate students interested in scholarships and grants may contact their program of interest or department. View more information on the Graduate Education Office website, http://www.cmu.edu/graduate/prospective-students/index.html. In addition, the Fellowships & Scholarships Office (http://www.cmu.edu/fso/) provides support to graduate students interesting in pursing certain external scholarships, like Fullbright and UK Awards.

Federal Work-Study

Federal Work-Study (FWS) is a need-based self-help award. If a student has been awarded FWS, the FWS award is the total that can be earned during the academic year as a work-study student.

Federal Loans

For many students and families, educational loans are a necessary part of the process of paying for college. Student Financial Aid certifies loans for students, as well as Federal Direct Parent PLUS Loans for parents of undergraduates and Federal Direct Grad PLUS Loans for graduate students.

Federal Direct Student Loan

The Federal Direct Student Loan is the most widely-used loan for college students and is available to both undergraduate and graduate students. There are two types of Federal Direct Student Loans, subsidized and unsubsidized, and eligibility for both is determined by completing the FAFSA.

Grad PLUS Loan

Eligible graduate students may borrow a Federal Direct Grad PLUS Loan to assist with educational expenses. Students may borrow any amount up to their calculated cost of attendance minus any other aid received.

Private Loans

Private loan programs offer competitive interest rates and borrower benefits. To increase chances of approval and possibly improve the rate you receive, students are strongly recommended to apply with a creditworthy co-signer.

Student Outcomes

Retention and Graduation Rates

Institutional Research and Analysis Office offers up-to-date data on degrees conferred, enrollment reports, freshmen retention rates and race and ethnicity reports for annual degrees. Retention and Graduation rates can be found at https://www.cmu.edu/ira/retentiongradrates.html.

Intercollegiate Athletic Program Participation Rates and Financial Support Data (Equity in Athletics Disclosure Act)

Please visit the U.S. Department of Education's site, The Equity in Athletics Data Analysis (http://ope.ed.gov/athletics/#/) and select the "Get data for one schools" option. Enter "Carnegie Mellon University" in the "Name" field and select the "Continue" button at the bottom of the page.

A printed copy of the report can be requested by calling the Department of Athletics, Physical Education, and Recreation at 412-268-8054 or by sending an email to Josh Centor, Associate Vice President for Student Affairs and Director of Athletics, Physical Education & Recreation, at jcentor@andrew.cmu.edu.

Health and Safety

Drug and Alcohol Abuse Prevention Program

Under the Drug Free Workplace Act of 1988 and the Drug Free Schools and Campuses Act of 1989, the Carnegie Mellon University is required to have an alcohol and other drug policy outlining prevention, education and intervention efforts and consequences for policy violations. The policy can be found at https://www.cmu.edu/policies/administrative-and-governance/alcohol-and-drug-policy.html.

CMU Annual Security and Fire Safety Report

A printed copy of the report can be requested by contacting University Police at 412-268-6232 or campuspd@andrew.cmu.edu.

The annual security and fire safety report (Carnegie Mellon University Police Department Annual Reports) is also available online at http://www.cmu.edu/police/security-fire-

reports/index.html.

Vaccination Policies

CMU Prematriculation Immunization Policy can be found at http://www.cmu.edu/policies/student-and-student-life/immunizations.html.

CMU University Health Services Health Requirements for Incoming Students can be found at https://www.cmu.edu/health-services/new-students/.

Other Information

Voter Registration

Please visit https://www.usa.gov/voter-registration.

Carnegie Mellon Ethics Hotline

The health, safety and well-being of the university community are top priorities at Carnegie Mellon University. CMU provides a hotline that all members of the university community should use to confidentially report suspected unethical activity relating to financial matters, academic and student life, human relations, health and campus safety or research.

Students, faculty and staff can anonymously file a report by calling 877-700-7050 or visiting www.reportit.net (user name: tartans; password: plaid). All submissions will be reported to appropriate university personnel.

The hotline is NOT an emergency service. For emergencies, call University Police at 412-268-2323.

Statement of Assurance

Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex, handicap or disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Furthermore, Carnegie Mellon University does not discriminate and is required not to discriminate in violation of federal, state, or local laws or executive orders.

Inquiries concerning the application of and compliance with this statement should be directed to the vice president for campus affairs, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Obtain general information about Carnegie Mellon University by calling 412-268-2000.

Student Loan Repayment Obligation

If you obtain a loan to pay for INI Pittsburgh-Silicon Valley MSIT-IS or MSIT-MOB/MSMITE programs including any of the Study options (Applied, Advanced, Applied Advanced), you will have the responsibility to repay the full amount of the loan plus interest, less the amount of any refund. If you have received federal student financial aid funds, you are entitled to a refund of moneys not paid from federal student financial aid program funds.

Pending Bankruptcy Disclosure

CMU does not have a pending petition in bankruptcy, is not operating as a debtor in possession, and has not filed a petition in bankruptcy within the preceding 5 years, nor has Carnegie Mellon had a petition in bankruptcy filed against it within the preceding 5 years that resulted in re-organization under Chapter 11 of the United States Bankruptcy Code.

Student Services

Student Affairs

Students on the Silicon Valley campus can meet with Lauren Schachar, Assistant Dean of Student Affairs, for on-site connection to various student services resources. These resources include questions regarding public transportation, health, personal concerns, student organizations, activities and general campus information. Lauren Schachar's office is located in B19 Room 1045, and she can be reached by phone at (650) 335-2844 or email at lauren.schachar@sv.cmu.edu.

Public Transportation

Students are given a VTA clipper card (Smart Pass) during orientation, which provides them with free access to the local VTA bus system and the local light rail. If students live near a Caltrain station or require Caltrain to get to school or work, they can apply for a Caltrain Go Pass at the Student Affairs office, located in Building 19, Room 1045.

Health/Personal Concerns

The Assistant Dean of Student Affairs is the point person for any student who is in distress or experiencing a crisis. Student Affairs consults with CMU's Counseling and Psychological Services (CaPS) in Pittsburgh to support students in these circumstances. The assistant dean also works closely with CaPS to provide training for SV faculty on identifying and supporting students in distress.

To further promote student access to physical and mental health services, the campus contracts with One Medical to provide students with local, timely access to health care. All students, staff, and faculty are able to enroll in a free membership to One Medical, which provides same day and next day appointments at any of their locations. There are three main locations near the SV

campus. The company also provides 24/7 support via their mobile app, including video consultations with a physician. All full-time students are also required to have health insurance. CMU's student health insurance department helps students to enroll, waive (if they have insurance that meets the university requirements), navigate and use insurance. Questions regarding student insurance can be emailed to shinsure@andrew.cmu.edu.

Student Organizations and Activities

Students are encouraged to join student organizations during orientation and welcome week by requesting information (through an online form) and meeting the student organizations on campus. The online form is provided during Action Lab at new student orientation and can also be found on our website at http://sv.cmu.edu/student-services/student-organizations.html.

Student activities are promoted through a weekly CMU-SV Student Newsletter sent by the Assistant Dean of Student Affairs. Students can find out about opportunities, events and activities through the newsletter, the student events calendar (which they can access once they have set up their school Google account) and through the digital displays and posters on campus.

Career Services

The INI Career Services Office strives to bring together the talents of our students with professional opportunities, including:

- Internships
- Full-time jobs
- Practicum projects
- Research sponsorships
- Fellowship and scholarship support

At the INI, the students learn and develop professionally as much beyond the walls of our classrooms as they do in lecture halls and laboratories. They may contribute to real-world research, fulfill valuable internships and complete team-based projects for clients.

To this end, the INI career services office facilitates partnerships with representatives in industry, government and academia. The office also specializes in providing career counseling to students.

The Career and Professional Development Services Center (CPDC) serves to provide students with guidance during their job and internship searches. The services available to students include resume reviews, mock interviewing, salary negotiation, career exploration consultation, internship and job consultation, workshops/events and employer relations. The CPDC is also heavily involved in organizing campus-wide job fairs and bringing employers to campus.

Handshake is Carnegie Mellon's online recruiting system. Through Handshake, employers can request accounts to post jobs, request interviews and information sessions, and review student resumes. Students and alumni can apply to positions, sign up for interviews and find contact information for thousands of recruiters. Handshake can be accessed through the CPDC website.

Students in Silicon Valley can meet with Assistant Director of Career Services, Leigh Mason, or with one of the CMU Silicon Valley Peer Career Consultants. Appointments can be made through Handshake. Career Consultants hold open office hours, which are communicated at the beginning of each semester.

Job Search Guidelines

Departments strive to play a supportive role in the career pursuits of students, but maintains academics as a priority. It is not acceptable for students to skip classes or assignments in order to attend job interviews. Students should conduct their job search in a manner that does not impede the academic progress through their graduate program. It is also important for students to understand how to conduct a job search. When applying for jobs, students are expected to exhibit certain ethical behavior, such as arriving on time for interviews, being truthful about their qualifications, and to honor their agreements with recruiters. Further, students should not continue looking and interviewing for a position after they have accepted an offer. The CPDC reserves the right to limit access for any users that do not follow their ethical job/internship search policy. Students who do not follow such guidelines may forfeit their on campus interviewing and/or resume submission privileges.

Student Grievances

Grievances can be brought directly to the Assistant Dean of Student Affairs. For students who wish to submit a concern online, they can do so at the online Student Suggestions Box at http://goo.gl/forms/BySlZMoB6txYDKz02.

A list of employment positions within the education field for the INI MSIT-IS and MSIT-MOB/MSMITE programs graduates as of 2020 is available at: https://www.cmu.edu/ini/academics/academics_docs/2020MSITEmploymentPositions.pdf.

The INI Career Services disclosure statement is available online at: https://www.cmu.edu/ini/academics/academics_docs/BPPECareerServices_MSIT-2020.pdf

Visa Services

Carnegie Mellon's Office of International Education (OIE) advises international students and scholars regarding immigration/visa and acculturation issues, issues visa documents with which international students and scholars may apply for US visas. Visa documents are issued, per federal regulations, upon request from students who are admitted to full-time programs and who have sufficient, demonstrated financial resources. OIE complies with federal reporting requirements with respect to students/scholars on CMU visa documents and educates students with respect to their own responsibilities for maintaining legal status in the US.

All F and J students/scholars are required to attend a mandatory Orientation and Immigration Check-In upon arrival to their CMU campus or location. The OIE orientation provides legally

required information regarding maintaining status. For those students who participate in Optional Practical Training (OPT) or Curricular Practical Training (CPT), mandatory information/application sessions are provided. These sessions are presented remotely, as needed, by a Carnegie Mellon OIE Designated School Official (DSO). Individual students who have immigration questions or concerns meet with designated OIE advisor during individual, scheduled advising appointments.

For more information, students may view the website or call OIE:
https://www.cmu.edu/oie/foreign-students/index.html
By phone: 1(412) 268-5231

Housing

The CMU campus in Silicon Valley does not offer any on-campus housing or off-campus housing assistance. Students need to find their own housing. There is availability of housing, however, as many apartment complexes and/or room rentals are located within a commutable distance from the campus. Housing costs vary, but the average price for a 2-bedroom apartment is $3300-$3800/month. Most students choose to have roommates. While our student affairs office cannot act as a real estate agency or rental broker for you, we are happy to offer our advice or suggestions on locations that may be of interest to you. For questions, please contact the Assistant Dean of Student Affairs at student-services@sv.cmu.edu

Facilities and Equipment

The Silicon Valley campus is located in the historic Shenandoah Plaza on the NASA Ames Research Park. CMU-SV occupies two buildings, building 23 and building 19.

Building 23 is a 20,111 sq. ft. two-story historic building and is the main administrative and teaching building. It largely houses the academic space: 5 classrooms, 31 faculty and staff offices, 6 conference rooms, 2 kitchen/break rooms, 1 cafe lounge, and 1 multi-function lounge & event space. Located in the annex of Building 23 is the Carnegie Mellon Innovations Lab (CMIL), a 1,247 sq. ft. multi-use lab space.

Building 19 is a multi-tenant building in which CMU occupies 16,225 sq. ft. of space. It houses student-facing staff offices, student study rooms, Ph.D. student space, research space and an assortment of other types of space: 7 staff offices, 18 student study rooms, 6 PhD rooms with individual workstations, and 9 research labs, as well as 8 conference rooms, 1 kitchen/break room, a quiet room, a student organizations room and a large student lounge.

Student Lounges: There are several spaces for students in Silicon Valley to use. The main student lounges can be found in B23, downstairs Room 129 and upstairs Room 227. In B19, students can utilize the Bay Room (B19 Room 1040.)

Masters Suites and PhD Wing: Building 19 has 10 Master's Suites which can accommodate 6-12 students per room. The PhD wing has 8 rooms which hold 8 cubicles. PhD students are assigned a cubicle and given a key to the room and the desk upon arrival.

Labs: There are two labs on campus that are attached to Building 23. The Carnegie Mellon Innovations Lab (CMIL) is the larger general-use lab. Bench space is shared. Lab access is a privilege, not a right. It requires training, respect for access controls, and adherence to/signature on the written lab policies. CMIL contains the following equipment for personal and course projects: Ultimaker 2+ 3D printer, Oscilloscopes (40 MHz and 200 MHz,) regulated DC power supplies, 5MHz Function Generator, Agilent digital multimeter, ESD safe electronics work area, soldering irons, Weller rework station, Various hand tools. The Connected Embedded Systems (CES) lab is the "inner" lab and is for Prof. Iannucci's students only (GA and PhD only- not for classes.) Special access controls and monitoring are in place in this lab. Completed training, signing of written lab policies and approval by Professor Iannucci are required for access to this lab.

Printers: Printers are for use in Building 23 (B23) Room 123, the hallway in B23 outside of 109/110, the Building 19 (B19) kitchen/lounge, and at the end of the 1030 wing in B19. Instructions for adding printers and policies are posted next to each printer.

Keys: The Silicon Valley Facilities department will provide each Master student with a key to the master's study suites in Building 19 at orientation. Each PhD student will be provided with a key to their cubicle and office in the PhD wing. To avoid any financial implications to you, your key must be returned prior to your final departure from CMU. To report a lost key or to request a replacement, please email facilities@sv.cmu.edu.

More information about the rooms and spaces the CMU-SV campus is available at http://sv.cmu.edu/information-center/campus-resources/rooms-and-spaces.html.

The complete CMU-SV Facilities and Campus Policies can be found at http://sv.cmu.edu/information-center/campus-resources/facilities-and-campus-policies.html.

Library and Resources

Library and Resources CMU-SV does not operate a library on campus, but we do have specialized library resources available for students, faculty, and staff. Resources include:

1. Interlibrary Loan
2. e-book developments
3. University Libraries Quick Links

Through the Interlibrary loan, students can request books, articles from journals and conferences, technical reports, or other materials to be sent to you. The materials may be from Carnegie Mellon libraries in the U.S. or other institutions worldwide. Electronic delivery for many articles is available. ILLiad is the system that our students use to request these items. What ILLiad can be used for:

- To request to borrow a book, a tech report, a thesis, copy of an article, etc.
- Check status of requests
- Edit requests

- Cancel requests
- Update your contact information or delivery preferences
- Request to renew an interlibrary loan

The ILLiad link can be found at https://illiad.library.cmu.edu/illiad/illiad.dll.
The first time you use the link you need to provide information about yourself. You only need to do this once. When completing the form, choose these options:

  - For Mailing Address, state: Silicon Valley campus
  - For Delivery Location, state: E&S Library

Ebook developments can be found on our website at http://guides.library.cmu.edu/svc.
See below for an example of ebook developments:

- AccessEngineering
  - This is a "reference tool for professionals, academics, and students that provides seamless access to the world's best-known, most-used collection of authoritative, regularly updated engineering reference information. AccessEngineering also comprises dynamic online features, such as instructional, faculty made videos, calculators, interactive tables and charts, as well as personalization tools allowing users to organize crucial project information as they work." AccessEngineering includes the well-known Schaum's Outline series of books.
- Knovel
  - A digital collection of science and engineering reference books. Carnegie Mellon Users Only (including Silicon Valley Campus). Our access to their new collection on Computer Hardware Engineering is now available! You'll also find the books listed in CAMEO - our online catalog.
- Synthesis Digital Library of Engineering and Computer Science
  - "The basic component of the library is a 50- to 100-page 'Lecture'; a self-contained electronic book that synthesizes an important research or development topic, authored by an expert contributor to the field." You'll also find the books listed in CAMEO - our online catalog.
- Springer e-Books Collection for Computer Science
- Springer e-Book Collection for Engineering
- Springer e-Book Collection for Mathematics & Statistics
- Plus - General e-Book Collecting from Many Different Publishers

University Quick Links can also be found on the website at http://guides.library.cmu.edu/svc.

- Articles & Databases
  - Alphabetical and subject listings of our available databases.
- Cybersecurity
- e-Journals A to Z List
  - Our automated (partially) method of finding e-Journals that we have access to - even if buried in a full-text database.
- ECE Library Guide
  - Library research guide for Electrical & Computer Engineering.

- Off-Campus / Wireless Access
    - EZ Proxy single sign on added as an option!
- University Libraries Home Page
    - Our home page has links to the simple and advanced search functions for CAMEO - our online catalog.

For additional questions regarding library resources, please contact Matt Marsteller, Head, CMU Science Libraries at matthewm@andrew.cmu.edu or by phone: 412-268-7212

Detailed description of the library resources is available at http://sv.cmu.edu/student-services/library-resources.html.

Student Tuition Recovery Fund

The State of California established the Student Tuition Recovery Fund (STRF) to relieve or mitigate economic loss suffered by a student in an educational program at a qualifying institution, who is or was a California resident while enrolled, or was enrolled in a residency program, if the student enrolled in the institution, prepaid tuition, and suffered an economic loss. Unless relieved of the obligation to do so, you must pay the state-imposed assessment for the STRF, or it must be paid on your behalf, if you are a student in an educational program, who is a California resident, or are enrolled in a residency program, and prepay all or part of your tuition.

You are not eligible for protection from the STRF and you are not required to pay the STRF assessment, if you are not a California resident, or are not enrolled in a residency program.

It is important that you keep copies of your enrollment agreement, financial aid documents, receipts, or any other information that documents the amount paid to the school. Questions regarding the STRF may be directed to the Bureau for Private Postsecondary Education, 2535 Capitol Oaks Drive, Suite 400, Sacramento, CA 95833, (916) 431-6959 or (888) 370-7589.

To be eligible for STRF, you must be a California resident or are enrolled in a residency program, prepaid tuition, paid or deemed to have paid the STRF assessment, and suffered an economic loss as a result of any of the following:

1. The institution, a location of the institution, or an educational program offered by the institution was closed or discontinued, and you did not choose to participate in a teach-out plan approved by the Bureau or did not complete a chosen teach-out plan approved by the Bureau.
2. You were enrolled at an institution or a location of the institution within the 120 day period before the closure of the institution or location of the institution, or were enrolled in an educational program within the 120 day period before the program was discontinued.
3. You were enrolled at an institution or a location of the institution more than 120 days before the closure of the institution or location of the institution, in an educational program offered by the institution as to which the Bureau determined there was a

significant decline in the quality or value of the program more than 120 days before closure.
4. The institution has been ordered to pay a refund by the Bureau but has failed to do so.
5. The institution has failed to pay or reimburse loan proceeds under a federal student loan program as required by law or has failed to pay or reimburse proceeds received by the institution in excess of tuition and other costs.
6. You have been awarded restitution, a refund, or other monetary award by an arbitrator or court, based on a violation of this chapter by an institution or representative of an institution, but have been unable to collect the award from the institution.
7. You sought legal counsel that resulted in the cancellation of one or more of your student loans and have an invoice for services rendered and evidence of the cancellation of the student loan or loans.

To qualify for STRF reimbursement, the application must be received within four (4) years from the date of the action or event that made the student eligible for recovery from STRF.

A student whose loan is revived by a loan holder or debt collector after a period of non-collection may, at any time, file a written application for recovery from STRF for the debt that would have otherwise been eligible for recovery. If it has been more than four (4) years since the action or event that made the student eligible, the student must have filed a written application for recovery within the original four (4) year period, unless the period has been extended by another act of law.

However, no claim can be paid to any student without a social security number or a taxpayer identification number.

NOTICE CONCERNING TRANSFERABILITY OF CREDITS AND CREDENTIALS EARNED AT OUR INSTITUTION

The transferability of credits you earn at CMU is at the complete discretion of an institution to which you may seek to transfer. Acceptance of the degree and diploma you earn in the INI Pittsburgh - Silicon Valley MSIT-IS, MSIT-IS Applied, MSIT-IS Advanced, MSIT-IS Applied Advanced, MSIT-MOB/MSMITE, MSMITE-Applied, MSMITE-Advanced, and MSMITE-Applied Advanced programs is also at the complete discretion of the institution to which you may seek to transfer. If the units or degree, or diploma that you earn at this institution are not accepted at the institution to which you seek to transfer, you may be required to repeat some or all of your coursework at that institution. For this reason, you should make certain that your attendance at this institution will meet your educational goals. This may include contacting an institution to which you may seek to transfer after attending CMU to determine if your units, or degree, or diploma will transfer.