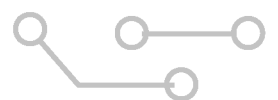# PH.D.IN ELECTRICAL AND COMPUTER ENGINEERING STUDENT HANDBOOK

This document is for the internal use of CMKL University only and may not be distributed or reproduced for external distribution in any form without express written permission of the Carnegie Mellon — CMKL | Thailand Program Director. This handbook is posted to CMKL web page prior to the start of each academic year and is updated as needed.

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1 Soi Chalongkrung 1
Ladkrabang, Bangkok 10520 Thailand
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www.cmkl.ac.th

# Table of Contents

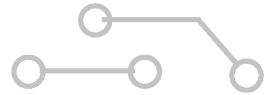# Table of Contents

# Table of Contents

# WELCOME TO ELECTRICAL AND COMPUTER ENGINEERING

Welcome to CMKL University. Our institution was established as a collaboration between Carnegie Mellon University and King Mongkut's Institute of Technology Ladkrabang for the Carnegie Mellon — CMKL | Thailand Electrical and Computer Engineering (ECE) program. Our education and research programs offer a unique experience for our students, who will be able to benefit from the best-in-class Carnegie Mellon education. In addition, you will be well-equipped with industrial experience by participating in real-world engineering research and projects that Carnegie Mellon and CMKL University have been working on with our partners and our communities.

Our program brings about the best of engineering and entrepreneurial minds to tackle challenges that will drive the future development of Thailand and Southeast Asia. Our research and teaching cover a spectrum of technical areas including information, computing, and autonomous technologies. With our hands-on approach, we believe our graduates will have the required technical strength, professional excellence and entrepreneurial mindset that will transform the industries while making an impact on our ever-changing society.

I hope you will browse through this handbook to learn more about our programs.

Sincerely,

Akkarit Sangpetch
Carnegie Mellon – KMITL Program Director
CMKL University
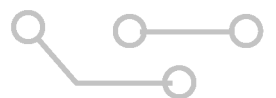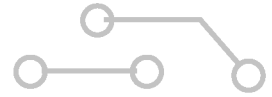
# Mission and Objectives

To inspire, educate, and foster the development of computer engineers capable of tackling fundamental engineering problems and important societal challenges, and to do so with the highest commitment to quality, integrity, and respect for others.

To revolutionize higher education and transform the industry by creating entrepreneurial professionals who will become global leaders through research and knowledge, technology, creativity, and innovation.



To be a creative driving force within the university and worldwide of the

We aim to develop students' breadth of knowledge across the subject areas of electrical and computer engineering, including their ability to apply engineering theory, abstraction, design, and implementation to solve problems and innovate through an interdisciplinary approach.

CMKL University will provide cutting-edge engineering research and education in Southeast Asia. By bridging world-class partnerships with local context, CMKL makes technologies accessible to its society and creates innovations that will benefit Thailand and the Southeast Asia region.
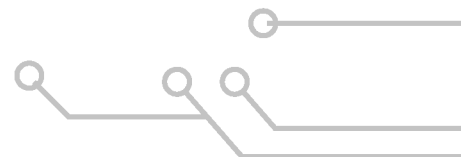
# INTRODUCTION

## Degrees Offered

Graduates of the Ph.D. in ECE program will earn two degrees: one from CMKL University and one from Carnegie Mellon University. Students will be supervised by one faculty advisor from Carnegie Mellon and one faculty advisor from CMKL University who will create and define a research project for each student to complete in pursuit of their degree. The advisors will also assist with course selection and other elements of the Ph.D. program based on the student's background and academic goals.

## Graduate Student Handbook

This handbook is intended to set guidelines and expectations for new and current Doctoral students in Electrical and Computer Engineering at CMKL University. This handbook is not exhaustive and is subject to revision at any time by the program.

It is the responsibility of each student to read and understand the contents of this handbook. This handbook, along with any revisions, will be posted and announced annually on the university website.

# CMKL UNIVERSITY STATEMENT OF ASSURANCE

CMKL University complies with the Constitution of the Kingdom of Thailand on equality and non-discrimination. The same principles apply to the admission, employment and administration of its programs and activities.

Inquiries concerning the application of and compliance with this statement should be directed to the HUB, CMKL University, 1 Soi Chalongkrung 1, Ladkrabang, Bangkok 10520, Thailand. Obtain general information about CMKL University by calling +66 65 878 5000.



# FACULTY  INFORMATION

## University Personnel

Throughout your time in the Ph.D. program, you will encounter a variety of faculty  and  staff members  who  will  help  you  on  your  way  to  completing  your  degree.  You may view a list of faculty and staff members affiliated with ECE online. Below is a list of faculty members whom you are likely to encounter during your time in the Ph.D. program.

**President of CMKL University:**  Dr. Supan Tungjitkusolmun
**Vice President of CMKL University:**  Dr. Orathai Sangpetch
**Program Director of Carnegie Mellon – CMKL at Carnegie Mellon:** Dr. Hyong  Kim
**Program Director of Carnegie Mellon – CMKL at CMKL:**  Dr. Akkarit Sangpetch

# Course Instructors

Our courses are taught by educators and researchers.

### Hyong Kim
Drew D. Perkins Professor, ECE, Carnegie Mellon University Adjunct
Faculty Member, CMKL University
Ph.D., Electrical Engineering, University of Toronto

### José Moura
Phillip L. and Marsha Dowd University Professor, ECE, Carnegie Mellon University Adjunct
Faculty Member, CMKL University
DSc, Electrical Engineering and Computer Science, Massachusetts Institute of Technology

### Sooksan Panichpapiboo
Professor of Information Technology, King Mongkut's Institute of Technology Ladkrabang
Special Faculty Member, CMKL University
Ph.D., Electrical and Computer Engineering, Carnegie Mellon University

### Osman Yağan
Associate Research Professor, ECE, Carnegie Mellon University Adjunct
Faculty Member, CMKL University
Ph.D., Electrical and Computer Engineering, University of Maryland

### Supan Tungjitkusolmun
Associate Professor, King Mongkut's Institute of Technology Ladkrabang
Associate Professor, CMKL University
Ph.D., Electrical Engineering, University of Wisconsin

### Tze Meng Low
Associate Research Professor, ECE, Carnegie Mellon University Adjunct
Faculty Member, CMKL University
Ph.D., Computer Science, University of Texas

### Orathai Sangpetch
Adjunct Faculty Member, ECE, Carnegie Mellon University
Assistant Professor, King Mongkut's Institute of Technology Ladkrabang Assistant
Professor, CMKL University
Ph.D., Electrical and Computer Engineering, Carnegie Mellon University
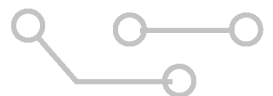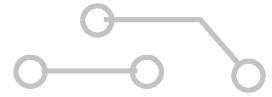
**Akkarit Sangpetch**

Adjunct Faculty Member, ECE, Carnegie Mellon University Assistant
Professor, CMKL University

Ph.D., Electrical and Computer Engineering, Carnegie Mellon University

**Suporn Pongnumkul**

Senior Researcher, National Electronics and Computer Technology Center Special
Faculty Member, CMKL University

Ph.D., Computer Science and Engineering, University of Washington

**Pongsin Poosankam**

Data Innovation, Krungthai Bank

Special Faculty Member, CMKL University

Ph.D., Computer Science, Carnegie Mellon University

**Irving Gomez Mendez**

Assistant Professor, CMKL University

Ph.D., Probability and Statistics, Centro de Investigación en Matemáticas, Mexico

**Sally E. Goldin**

Assistant Professor, CMKL University

Ph.D., Cognitive Psychology, Carnegie Mellon University

**Ekapol Chuangsuwanich**

Faculty of Engineering, Chulalongkorn University Adjunct
Faculty Member, CMKL University

Ph.D., Electrical Engineering and Computer Science, Massachusetts Institute of Technology

**Chaya Hiruncharoenvate**

Senior Officer, Securities and Exchange Commission, Thailand Adjunct
Faculty Member, CMKL University

Ph.D., Computer Science, Georgia Institute of Technology
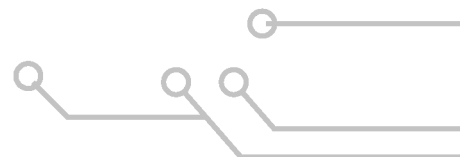
# PRE-MATRICULATION

## Admissions Policies

Admission criteria for the Carnegie Mellon – CMKL | Thailand Ph.D. Program are identical to those for the ECE Ph.D. program at Carnegie Mellon. For information about ECE's admission policies, including application requirements, application deadlines, and a link to apply, please visit these webpages:

- https://www.cmkl.ac.th/ece/overview https://www.ece.cmu.edu/admissions/graduate-application-deadlines.html https://www.ece.cmu.edu/admissions/graduate-faq.html
- 
- 

## English Language Proficiency Test

All international applicants whose native language is not English must take an English Language proficiency exam. Native language is defined as first language, or language spoken from birth. The scores must be received by the application deadline for the semester in which students are applying. An English Language proficiency test is not required if the applicant will have graduated from the U.S.

TOEFL Exam – A minimum overall score of 84 is required, with minimum sub-scores of IBT-R 22, IBT-L 22, IBT-S 18, and IBT-W 22 are required. These requirements must be met from a single test date – we currently do not accept TOEFL My Best scores. Please request ETS to send your scores to Carnegie Mellon institution code 2074. We will accept any Carnegie Mellon department code, as long as the institution code is correct.

IELTS Exam – A minimum overall score of 7 on the IELTS is required, with minimum sub- scores of Reading-6.5, Listening-6.5, Speaking-6, and Writing-6. In order for IELTS to verify that the scores are going to the correct college/department, IELTS requires a physical address. Applicants should use: Carnegie Mellon University College of Engineering, 431 Hamerschlag Drive, ANSYS Hall, Suite 250, Pittsburgh, PA 15213.

Duolingo English Test – The minimum overall score of 105 is required, with minimum sub-scores of Literacy-105, Comprehension-115, Production-70 and Conversation-95. Please send your scores to Carnegie Mellon University, College of Engineering.

## 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 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 CMKL university. 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 CMKL University may prevent the Ph.D. degree from being certified.

# 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 a schedule is developed, it is the student's responsibility to register for courses. 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 THB 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 and drop courses through the CUBE. 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 Academic Calendar.

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

## Degree Requirements Time frame

The Carnegie Mellon — CMKL | Thailand Ph.D. is a five-year program with three years on the Carnegie Mellon campus and two years on the CMKL campus. Students are responsible for completing their enrollment each semester.

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. We will 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, who started the first year in Thailand, will be given Non- immigrant (ED) visa during the academic year which can be extended.

## Full-time Requirements

Full-time students must be enrolled for a minimum of 36 units each semester - fall, spring and summer.

International students must be enrolled in a full-course load (minimum 36 units per semester) to maintain their immigration status. Enrollment for fewer than 36 units 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.
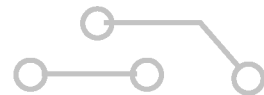
# Statute of Limitations

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 on the University Policies website.

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 (ABD) status for a period commensurate with the duration of that interruption.

Students wishing to obtain an extension due to special circumstances must submit a formal petition at least one semester prior to his/her defense timeline expiring. The time clock will stop for students who have not taken the qualifying exam prior to the leave of absence.

# Degree Timeline and Campus Location

Carnegie Mellon — CMKL | Thailand dual-degree Ph.D. students receive funding for a total of three years on the Pittsburgh Campus. Students will spend at least two years in Thailand. Students and their advisors should work together to determine where the student will be physically located each semester.

# 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.

For a complete list of the course M.S. requirements, see the website: https://www.ece.cmu.edu/academics/ms-ece/
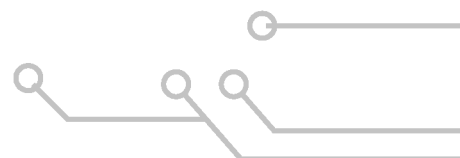
# Ph.D. Course and Breadth Area Requirements

For a complete list of the Ph.D. requirements, see the website:
https://www.ece.cmu.edu/academics/phd-ece/requirements.html

## Double Counting Courses

If a student takes the same course twice, the course with the higher grade will be counted towards the ECE Ph.D. course requirements, provided the student receives a "B-" or above.

## Retaking Courses

Ph.D. students need to receive a "B-" or better grade to pass a course. If students do not pass a course, they should take a different course. If students decide to retake a prerequisite course in which they did not receive the minimum required grade, they should first get approval from their faculty advisors.

All grades are recorded on the transcript and factored into the cumulative QPA; Depending on previous education (entering Ph.D. program with or without an M.S. degree), approved courses will be factored into the 48 or 96 units that fulfill degree requirements and will be 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.

A student who wants to audit a course is required to: Register
- for the course.
- Obtain permission from the instructor and ask the instructor to sign the course audit approval form.
- Submit the form to their academic advisor for approval.
- If approved, the academic advisor will send the form for processing.
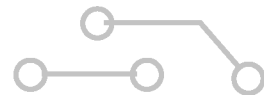
Once a course audit approval form is submitted, a letter grade ('A'-'R') will not be assigned for the course and the declaration cannot be reversed. You can find the deadline for submitting this form on the Academic Calendar. After the deadline, students will not be able to request the option to audit 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, which is 60 units per semester, 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.

# 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 to their academic advisor for approval. If approved, the academic advisor will send the form for processing. Once a Pass/Fail form is submitted, 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.
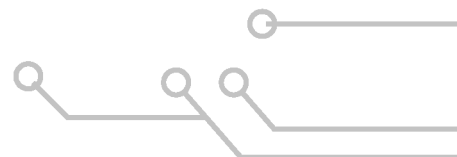
# Petition Process

Petitions for breadth area substitutions, Ph.D. milestone extensions, course substitution and any other changes that are outside the policies stated in this handbook are subject to approval by the ECE Graduate Studies Committee at Carnegie Mellon University.

# REGISTERING FOR COURSES

## Academic Calendar

ECE adheres to the official CMKL Calendar. It provides information on all deadlines including registration dates, class start dates, add/drop deadlines, exam dates, and more.

## 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.

## Adding Courses

Students have the option of adding courses to their schedule starting at their assigned registration time until the add/drop deadline through the HUB. 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 for processing.

## Course Locations

Courses will take place at various buildings and room locations across CMKL University as assigned in 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.
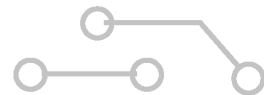
# Dropping Courses

Students have the option of dropping courses from their schedule starting at their assigned registration time until the add/drop deadline through the CUBE. 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 with their academic advisor in order to withdraw from a course. 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.

# Courses with Time Conflicts

Students are not permitted to register for two courses that conflict in time. Registration may be possible with consent from both instructors, 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 university may allow you to register for courses without the published prerequisite, it is the student's responsibility to have an adequate background knowledge to be successful in the subsequent course.

You should consult with the instructors because it is up to their discretion whether or not a prerequisite course can be waived.
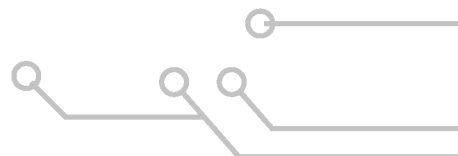
# Final Exams

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.

# Enrollment Verifications

The CUBE 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 program is only able to verify information on ECE courses.

# 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. In extreme cases, a student may request additional leave time via a petition to the CUBE. If they do not return within two academic years, they will be administratively withdrawn from 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.
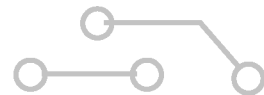
# Returning from a Leave of Absence

A student intending to return from leave of absence must submit the Petition to Return from Leave of Absence form to their academic advisor at least 90 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 attend classes or maintain employment as students at CMKL while their leave is in effect."

# 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 THB 0.00 to receive a diploma. Students will be notified of their degree certification via email once the certification has been completed.

Before graduation, students should update their contact information, such as mailing address and e-mail address, within the HUB system. Also, students should review a proxy of their diploma in HUB 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 Academic Affairs Office.

The title of the degree students receive is Doctor of Philosophy in Electrical and Computer Engineering.
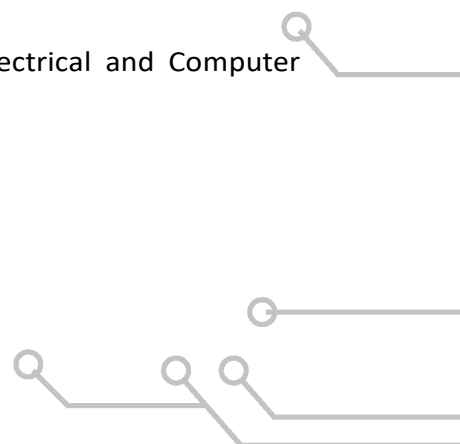
# ACADEMIC STANDARDS

## Grade

Below are the grading structure for students in Electrical and Computer Engineering programs.

## 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 changing grades, grading options, drop/withdrawals and course repeats.

## Grading Policy

ECE follows the following letter grade scale. The letter grade scale is 'A' (highest for students), 'A-', 'B+', 'B', 'B-', 'C+', 'C, 'C-', 'D+', 'D', and 'R' (lowest). Students cannot receive an 'A+' grade on their transcript, even if a course is taken from another college where an 'A+' is given. The passing grade for the M.S. program is "C" while the passing grade for the Ph.D. program is 'B-', except for the Teaching Internship course that requires a 'B' or better. Grades lower than the said passing grades are considered a failure 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: https://www.cmkl.ac.th/hub/registrars-office#v2

## Process for Appealing Final Grades

Final grades will be changed only in exceptional circumstances and only with the approval of the instructor, 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:

- the final grade assigned for a course is based on manifest error (e.g. a clear error such as an arithmetic error in computing a grade or failure to grade one of the answers on an exam), or
- the faculty or staff member who assigned the grade did so in violation of a University policy.
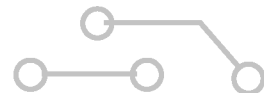
# Withdrawal Grade/Withdrawing from

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 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 units for the Ph.D. program. Coursework or graduate project units with a grade lower than 'B-' 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 program 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.
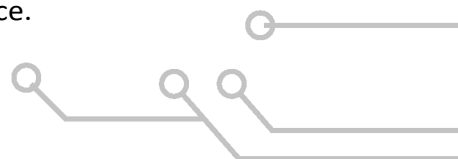
# Academic Integrity

CMKL University is designed to provide a supportive and productive learning environment for our students. It provides the university's ethical expectations of our students and their rights and responsibilities. As members of the CMKL community, students are expected to make choices that reflect integrity and responsible behavior. When using other people's ideas, providing credit to people is required. Failure to provide such acknowledgment is considered plagiarism. Students who violate the code of academic conduct are subject to disciplinary sanctions.

ECE adheres to CMKL and Carnegie Mellon's policy on academic integrity and all students are expected to review the policies prior to their arrival at CMKL.

# Penalties for Violating Academic Integrity

Should an instructor believe that an academic integrity violation has occurred, he or she 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, he/she will be re-enrolled.

If a student is found to have violated the academic integrity policy for a second time, the student will be dropped from the Electrical and Computer Engineering program effective at the end of the semester in which the infraction has occurred. Students have the right to appeal an academic integrity decision.
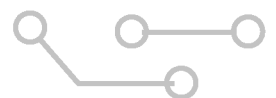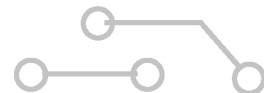
# PH.D. DEGREE REQUIREMENTS

## 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

| Milestone | F1 | S1 | F2 | S2 | F3 | S3 | F4 | S4 | F5 | S5 |
|---|---|---|---|---|---|---|---|---|---|---|
| Research | x | x | x | X | X | X | X | X | X | X |
| Course & Breadth | 1-2 Classes | 1-2 Classes | 1-2 Classes | 1-2 Classes | | | | | | |
| Qualifying exam | | | | X | | | | | | |
| Teaching Internship | | | X | | | X | | | | |
| Prospectus | | | | | | | | X | | |
| Thesis and Defense | | | | | | | | | | X |

Above 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 M.S. degree prior to enrolling, on conversations between the student and his or her advisor, and on which ECE Ph.D. program the student is enrolled in.
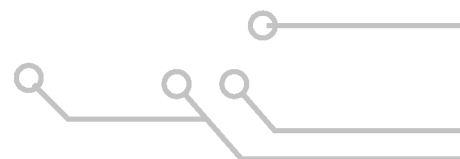
# Coursework

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 an 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 ECE or related courses (totaling 96 units) at Carnegie Mellon. At least six of these eight courses must be approved graduate-level courses.

Students in the Ph.D. program who have earned an M.S. degree elsewhere (outside of Carnegie Mellon's ECE department) must take a total of four ECE or related courses (totaling 48 units) at Carnegie Mellon. At least three of these four courses must be approved graduate-level courses.

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 successfully complete a 1-unit Introduction to Graduate Studies course during their first semester in the Ph.D. program at Carnegie Mellon University.

Students pursuing an M.S. degree on the way to the Ph.D. are required to take 18-900 Research Entrepreneurship and Innovation at CMKL to satisfy the CMKL M.S. program requirements.

# 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.
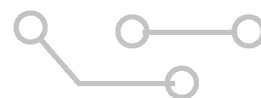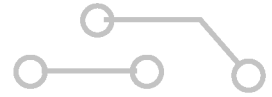
# Breadth Area Requirement

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 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 the ECE's Graduate Studies Committee at Carnegie Mellon, 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.

# Research

All 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 18-990 Reading and Research while they are at Carnegie Mellon or 18- 910 Research and Development while they are at CMKL. Expectations for research and productivity vary greatly throughout the department and should be discussed regularly with the student's faculty advisor.
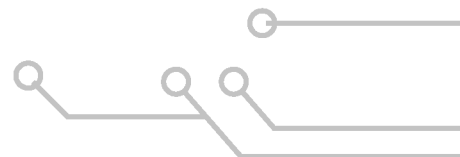
# Teaching Internship Requirement

All ECE Ph.D. students are required to complete two Teaching Internships ("TI") — one at CMKL and one at Carnegie Mellon — 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 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.

# 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 and Thailand, as required by the English Fluency in Higher Education Act of 1990.

# Qualify Exam

The qualifying exam will be held in person at Carnegie Mellon University. It tests the students' ability to think, speak and write. Students must read and understand three technical papers that define the examination's topical area. Students then write a review paper and orally present the review to a faculty examining committee. Details of the qualifying examination can be found at https://www.ece.cmu.edu/academics/phd-ece/qualifying-exam.html.
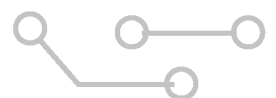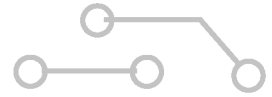
# Prospectus

All Ph.D. students are required to prepare a thesis prospectus (a.k.a. proposal) within four semesters following the successful completion of the Ph.D. Qualifying Examination.

The following prospectus requirements must be completed at least one semester before the final defense:

- an informal written description of the problem to be investigated and the expected accomplishments of that investigation; and
- an oral presentation to the Prospectus Committee for its review and recommendations.

Students should discuss the presentation format of their prospectus with their faculty advisors at CMKL and Carnegie Mellon. More details are available at https://www.ece.cmu.edu/academics/phd-ece/prospectus.html.

# Prospectus Committee

The Prospectus Committee consists of at least four members, including the student's faculty advisor at Carnegie Mellon. At least two members of this committee must be ECE faculty at Carnegie Mellon and at least one member must be from outside the department (e.g. your CMKL faculty advisor). Faculty members from other departments who hold courtesy appointments in ECE at Carnegie Mellon are considered to be "inside" the department. Faculty members who hold an adjunct appointment at Carnegie Mellon 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. For students seeking dual-program, request for teleconferencing will be approved due to the nature of the program.
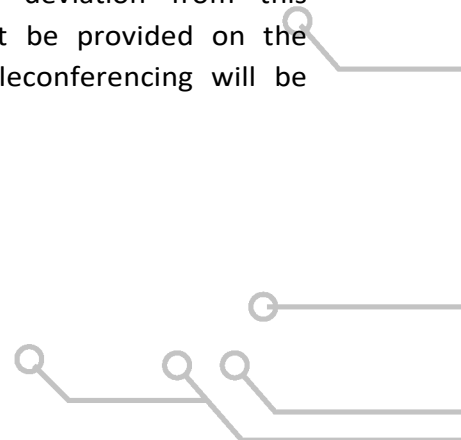
# Milestone Review

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.
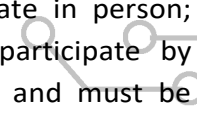
# All But Dissertation Status (ABD)

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.

- ABD in Residence (ABD): students continue enrolling for 36 units each semester and will continue to receive stipend support at the location of their studies (either at CMKL or Carnegie Mellon).
- ABD in Absentia (ABS): students stop enrolling at CMKL or Carnegie Mellon 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 Academic 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 while they are at Carnegie Mellon or 18-910 Research and Development while they are at CMKL as well as all fees. Please note that international students may face additional constraints before going ABS and should consult with the Academic Affairs Office to obtain more information.

# Ph.D. Dissertation

Once the Ph.D. thesis is written, the student must submit the Defense Declaration form to the Graduate Programs 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 need to provide the defense committee with a copy of the thesis at least one and a half months before the defense.

The oral defense is a public examination open to all members of the Carnegie Mellon community. All four of the members of the 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 of four participate by teleconferencing. Any deviation from this teleconferencing policy is exceptional and must be petitioned for approval from the Department via the Final Defense Declaration Form.
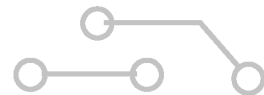
# Departmental Progress Reviews

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 M.S. 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.
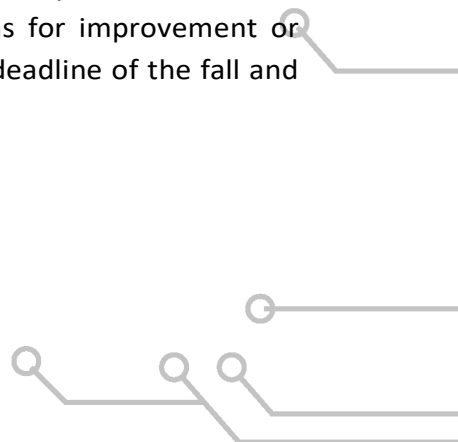
# Internships Course Option

ECE students may wish to participate in paid internships at off-campus organizations during the summer months. 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. ECE will enroll all students who are pursuing an internship for a 3-unit credit-bearing internship course.

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.

# POST-MATRICULATION GUIDELINES
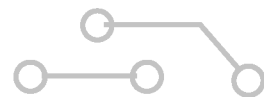
## Return of University Property

ECE students must return all borrowed ECE and university materials — such as software, manuals, library books/materials, or any other CMKL/Carnegie Mellon University property — before they depart from the program.

## Career Services Employment Outcomes

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

## "Grandfather" Policy

New rules will be added to the department policies for improvement when necessary. These changes will be discussed with students before implementation. Students, who matriculated in the program before the new policies, will be governed by the grandfather policies if they are affected by the changes in degree requirements/course offerings.

# TUITION, FEES AND FINANCIAL SUPPORT

Financial support in the form of a Fellowship will cover Ph.D. student's tuition, technology fee and student medical health insurance along with stipend payments both while you are here at CMKL University and when you are at Carnegie Mellon University. You will receive a stipend, paid monthly while at CMKL and paid semi- monthly while at Carnegie Mellon. With satisfactory performance and adherence to university policies, we expect to continue this level of support during your three years of studies at Carnegie Mellon and two years of studies at CMKL University to complete the requirements of your Ph.D. degree. Students are responsible for paying the Student Activities Fee and Transportation fee.

# APPENDIX A: LIST OF PROGRAM COURSES

The following courses are offered at CMKL University in Thailand. Additional courses may be added later.

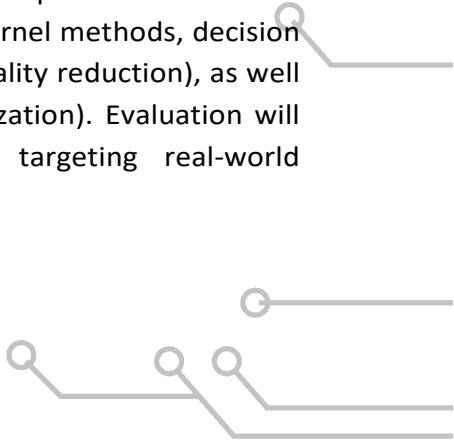## Foundations of Computer Systems (CMKL 18-613) — 12 Units

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.

## Software Requirements and Interaction Design (CMKL 18-658) — 12 Units

This course addresses software design 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.

## Introduction to Machine Learning for Engineers (CMKL 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.

## Introduction to Computer Security (CMKL 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.

## Computer Architecture and Systems (CMKL 18-742) — 12 Units

Historically, the performance and efficiency of computers have 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 data center, 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.
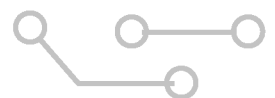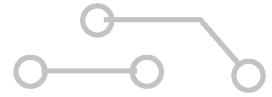
### Packet Switching and Computer Networks (CMKL 18-756) — 12 Units

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 overview; 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.

### Network Management and Control (CMKL 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 (SDN, MPLS, high-speed switching architecture, high-speed net- work control, unified control plane, and optical networks) will be discussed. The course project will explore latest network technologies, design networking systems, and evaluate via simulation techniques.

### Image and Video Processing (CMKL 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 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.
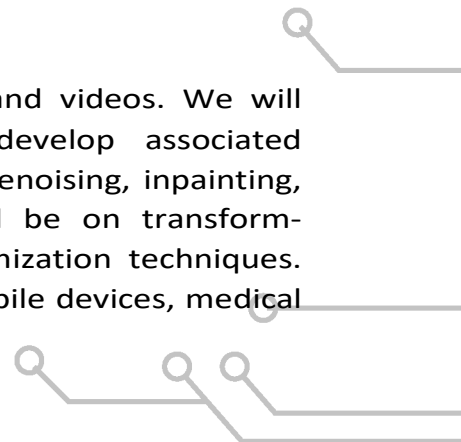
## Graduate Teaching Internship (CMKL 18-999) — 12 Units

Teaching interns will work closely with the course instructors in establishing mutual expectations while providing excellent academic support to students. Depending on the interns' areas of expertise and English proficiency, they may be engaged in various tasks ranging from grading assignments and assisting during the classes to leading recitations.

## Research and Development (CMKL 18-910) – 12 to 36 Units

Students will have the opportunity to participate in real-world supervised research and development projects. Students are encouraged to participate in existing projects with the university partners to gain professional experience in R&D.

Other ECE-approved courses can be found at https://www.cmkl.ac.th/ece/courses

## Industry Internship for Graduate (CMKL 18-995) – Variable

The ECE program considers experiential learning opportunities important educational options for its graduate students. One such option is an internship, which is 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 ECE graduate students wishing to have their internship experience reflected on their official University transcript. International students should also be authorized by the program representatives. Completion of written assignments and requirements will determine the letter grade for the course.

## Research, Entrepreneurship and Innovation (CMKL 18-900) — 12 Units

This course introduces students to explore the connections between research, entrepreneurship and innovation. Students will be introduced to industries and tech communities. Students will participate in exploratory projects which introduce research methodologies while also learning how to apply engineering techniques to solve challenging real-world problems.
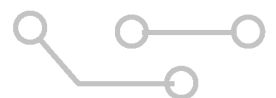
## M.S. in Technology and Creative Innovation (ECE Approved Course for Research and Innovation) — 12 Units

### Building Virtual Realities I (CMKL 56-704) - 12 units

BVR is an introductory but highly intensive and hands-on class in which students are introduced to the development process of mixed reality, augmented reality, and virtual reality experiences. Small teams of students are challenged to create virtual worlds quickly and creatively together using Unity and other industry-standard tools. While this class is highly technical and intensive, it is beginner friendly, and no previous experience is required

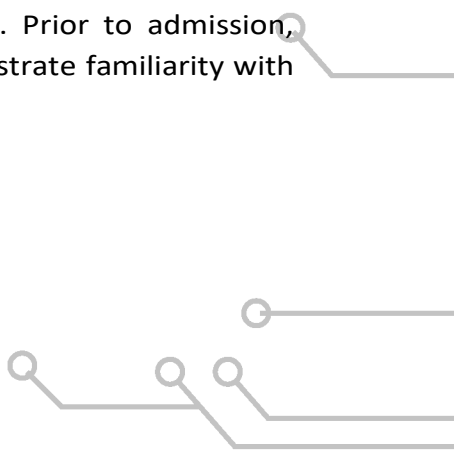### Building Virtual Realities II (CMKL 56-722) - 12 units

In this course, students will design and develop immersive and interactive experiences with Unity's real-time 3D platform, Oculus Head Mounted Display (HMD) and related technologies. This course will build upon the Building Virtual Realities (BVR)

## M.S. in Artificial Intelligence and Computer Engineering (Elective courses at CMKL University. Students can petition for unit transfer.)

### Foundations of Software Engineering (CMKL 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.

Prerequisites: Basic software development experience with proficiency in at least one modern programming language and modern programming concepts. Prior to admission, students successfully complete a programming assignment to demonstrate familiarity with required software technologies.
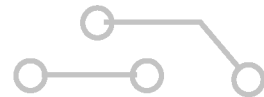
## Bayesian Statistics (CMKL 41-747)- 12 units

One way or another, subjectivity has always been present in scientific activity, starting from the assumptions to analyze a phenomenon. However, it is the informal approaches in which subjectivity is incorporated what yields to basic errors, misrepresentations or overrepresentations that occur in science. Bayesian Statistics take advantage of expert and subjective knowledge, or previous learned knowledge of a phenomenon, incorporating it in mathematical models through an objective rule. The combination of expert information, current data, and the sequential learning framework make of Bayesian models powerful tools to model complex systems which can learn from previous knowledge.

The course starts with a mathematical background of fundamental concepts in Bayesian statistics such as prior, posterior, and predictive distributions. We will introduce such concepts and understand their interrelations through simple models. Then, we will explore theoretical aspects such as conjugate models or non- informative priors. Finally, we will explore more complex models, analyzing the different distributions of the model as powerful tools for prior elicitation, or model evaluation. Due to the mathematical challenges for analyzing in whole formality such models, they have been successfully implemented computationally. Doing the current success of Bayesian analysis also a success of the computational engineer.