

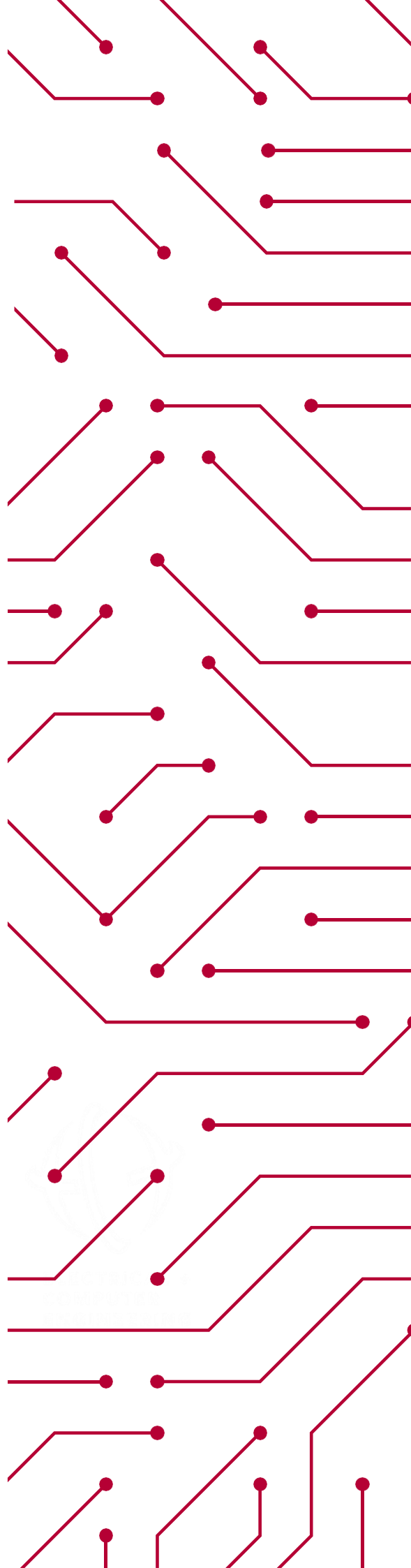
Carnegie  
Mellon  
University  
CMKL |  
Thailand



# M.S. IN ELECTRICAL AND COMPUTER ENGINEERING STUDENT HANDBOOK



Electrical & Computer  
ENGINEERING





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# Contents

<b>INTRODUCTION</b>	<b>1</b>
Degrees Offered	1
Graduate Student Handbook	1
<b>CMKL UNIVERSITY STATEMENT OF ASSURANCE</b>	<b>1</b>
<b>FACULTY INFORMATION</b>	<b>2</b>
University Personnel	2
Course Instructors	2
<b>PRE-MATRICULATION</b>	<b>5</b>
Admissions Policies	5
English Language Proficiency Test	5
Deferral	5
Final Transcripts	5
<b>ENROLLMENT AND REGISTRATION</b>	<b>6</b>
Degree Progress and Planning Overview	6
Student Responsibility	6
Degree Requirements Time frame	6
Full-time Requirements	6
Degree Timeline and Campus Location	7
Course Requirements	7
Double Counting Courses	7
Maximum Units Allowed	7
Retaking Courses	7
Auditing Courses	7
Pass/No Pass Courses	8
Research for Credit	8
Leave of Absence	8
Returning from a Leave of Absence	9
Enrollment Verifications	9
Degree Certification Process & Commencement	9
<b>REGISTERING FOR COURSES</b>	<b>10</b>
Academic Calendar	10
Course Load	10
Adding Courses	10
Dropping Courses	10

Withdrawing from Courses	10
Courses with Time Conflicts	10
Prerequisites	11
Final Exams	11
<b>RESEARCH ASSISTANT AND TEACHING ASSISTANT POSITIONS</b>	<b>11</b>
Research Assistant for Credit	11
Research Assistant for Pay	11
Teaching Assistant Positions	11
<b>ACADEMIC STANDARDS</b>	<b>12</b>
Grade	12
University Policy on Grades	12
Grading Policy	12
Incomplete Grade	12
Withdrawal Grade/Withdrawing from Courses	12
<b>ACADEMIC PERFORMANCE</b>	<b>12</b>
Quality Point Average	12
Academic Probation	12
Academic Integrity	13
Penalties for Violating Academic Integrity	13
<b>M.S. DEGREE REQUIREMENTS</b>	<b>14</b>
M.S. in Electrical and Computer Engineering	14
Internship Course Option (Thailand)	14
<b>POST-MATRICULATION GUIDELINES</b>	<b>15</b>
Return of University Property	15
Career Services Employment Outcomes	15
“Grandfather” Policy	15
<b>TUITION AND FEES</b>	<b>15</b>
Tuition Billing & Payments	15
<b>APPENDIX A: LIST OF PRE-APPROVED PROGRAM COURSES</b>	<b>16</b>



## 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,

A handwritten signature in black ink that reads "Akkarit Sangpetch". The signature is fluid and cursive, written in a professional style.

Akkarit Sangpetch  
Carnegie Mellon – CMKL 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 highest scholarly and entrepreneurial quality.



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 M.S. in ECE program will earn two degrees: one from Carnegie Mellon University and one from CMKL University. Students in the M.S. 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 program, students are given the opportunity, with the help of an academic advisor and faculty member, to choose an educational program that is consistent with their background and is best suited to their own academic goals.

## Graduate Student Handbook

This handbook is intended to set guidelines and expectations for new and current Master's 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 revision 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 CUBE, 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 M.S. 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 on the university's website.

## Course Instructors

Our courses are taught by educators and researchers.

### Hyong Kim

Drew D. Perkins Professor, Electrical and Computer Engineering, Carnegie Mellon University  
Adjunct Faculty, CMKL University  
B.Eng., Electrical Engineering, McGill University, Canada  
M.A.SC., Electrical Engineering, University of Toronto, Canada  
Ph.D., Electrical Engineering, University of Toronto, Canada

### Akkarit Sangpetch

Adjunct Faculty Member, Electrical and Computer Engineering, Carnegie Mellon University  
Assistant Professor, King Mongkut's Institute of Technology Ladkrabang  
Assistant Professor, CMKL University  
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B.S., Electrical and Computer Engineering, Carnegie Mellon University, USA  
Ph.D., Electrical and Computer Engineering, Carnegie Mellon University, USA

### Supan Tungjitkusolmun

Associate Professor, King Mongkut's Institute of Technology Ladkrabang  
Associate Professor, CMKL University  
B.S., Electrical and Electronics Engineering, University of Pennsylvania, USA  
M.S., Electrical Engineering, University of Wisconsin, USA  
Ph.D., Electrical Engineering, University of Wisconsin, USA

### Orathai Sangpetch

Adjunct Faculty Member, Electrical and Computer Engineering, Carnegie Mellon University  
Assistant Professor, King Mongkut's Institute of Technology Ladkrabang  
Assistant Professor, CMKL University  
B.S., Electrical and Computer Engineering, Carnegie Mellon University, USA  
M.S., Electrical and Computer Engineering, Carnegie Mellon University, USA  
Ph.D., Electrical and Computer Engineering, Carnegie Mellon University, USA

### Sally Goldin

Assistant Professor, CMKL University  
Associate Director of Learning Innovation, CMKL University  
B.A., Cognitive Psychology, Brown University, USA

M.A., Cognitive Psychology, Brown University, USA  
M.S., Cognitive Psychology, Carnegie Mellon University, USA  
Ph.D., Cognitive Psychology, Carnegie Mellon University, USA

### **Irving Gómez Méndez**

Assistant Professor, CMKL University  
B.Sc., Mathematical Engineering, Instituto Politecnico Nacional, Mexico  
M.Sc., Probability and Statistics, Centro de Investigacion en Matematicas, Mexico  
Ph.D., Probability and Statistics, Centro de Investigación en Matemáticas, Mexico

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Assistant Director of IT, CMKL University  
Instructor, CMKL University  
B.S., Computer Engineering (International Program), King Mongkut's University of Technology Thonburi, Thailand  
M.S., Software Engineering, Chulalongkorn University, Thailand  
Ph.D., Japan Advanced Institute of Science and Technology (JAIST), Japan

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Assistant Professor, CMKL University  
B.A., Physics and Mathematics, Cornell University, USA  
M.F.A., Digital Production Arts, Clemson University, USA  
Ph.D., Computer Science, Trinity College Dublin, Ireland

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Assistant Professor, CMKL University  
M.Sc., Computer Science, Quaid-i-Azam University, Pakistan  
M.Phil., Information System, University of Paris, France  
Ph.D., Information Security, University of Nantes, France

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M.S., Computer Science, University of Texas, USA  
Ph.D., Computer Science, University of Texas, USA

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Adjunct Faculty, CMKL University  
B.S., Electrical and Computer Engineering, Carnegie Mellon University, USA  
M.S., Electrical and Computer Engineering, Carnegie Mellon University, USA  
Ph.D., Electrical Engineering and Computer Science, Massachusetts Institute of Technology, USA

### **Panarat Cherntanomwong**

Assistant Professor, Department of Computer Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang

Associate Dean of Global Partnerships, CMKL University

Associate Director of Partnerships, AI Engineering

Adjunct Faculty, CMKL University

B.Eng., Telecommunication Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand

M. Eng., Electrical Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand

D.Eng., in International Development Engineering, Tokyo Institute of Technology, Japan

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Adjunct Faculty, CMKL University

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

### **Suporn Pongnumkul**

Senior Researcher, National Electronics and Computer Technology Center

Adjunct Faculty, CMKL University

B.S., Computer Science, Carnegie Mellon University, USA

B.S., Mathematics, Carnegie Mellon University, USA

M.S., Computer Science and Engineering, University of Washington, USA

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

# PRE-MATRICULATION

## Admissions Policies

Admission criteria for the Carnegie Mellon – CMKL | Thailand M.S. Program are identical to those for the ECE M.S. program at Carnegie Mellon University. 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 a 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 TS to send your scores to Carnegie Mellon institution code 2071. 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 – A 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 M.S. degree from being certified.

# **ENROLLMENT AND REGISTRATION**

## **Degree Progress and Planning 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.

## **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 duration of the ECE program is four full-time semesters (two semesters at CMKL and two semesters at Carnegie Mellon). Students are required to enroll in at least 36 units per semester in order to maintain their full-time status as a student at CMKL. The maximum number of units allowed in a semester is 48 units. 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.

## **Full-time Requirements**

The M.S. degree program is a full-time program in which students complete four full-time (36 units/semester) semesters. In addition to the regular courses, the student must also enroll in an M.S. graduate project or research course and participate in an ongoing university-partner project during their time in Thailand.

## **Degree Timeline and Campus Location**

The Carnegie Mellon – CMKL M.S. program is a two-year program with the first year on the CMKL campus in Bangkok, Thailand, and the second year on the Carnegie Mellon campus in Pittsburgh, PA, U.S.A.

## **Course Requirements**

For a complete list of course requirements, see the ECE website at [www.ece.cmu.edu/academics/ms-ece/standard-program.html](http://www.ece.cmu.edu/academics/ms-ece/standard-program.html) and the "M.S. degree requirements" section in this handbook.

## **Double Counting Courses**

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**

No more than 96 units should be taken while pursuing your degree at CMKL. These units include courses taken for audit, pass/no pass, and withdrawal.

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 program.

## **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 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 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. Students who would like to be present in class, but not receive academic credits or a letter grade must audit the class to continue to attend regularly. 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.

### **Research for Credit**

This option is only applicable when students are spending their semester at Carnegie Mellon in the United States.

Students can apply up to 27 units of research credit towards their M.S. degree requirements by registering for 18-980 M.S. Graduate Project. The number of units registered should equal the number of hours you complete each week. For example, a 12-unit research project means the student should complete 12 hours of research each week.

### **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 academic years throughout the program. In extreme cases, students may request additional leave time via a petition to CUBE. If they do not return within two academic years, they will be administratively withdrawn from the program. Questions can be directed to the 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."

## Enrollment Verifications

CMKL CUBE is the primary contact for students or alumni who would like to request a transcript, enrollment verification, billing, and payment services or other information related to their time in ECE at CMKL University.

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.

## Degree Certification Process & Commencement

A student must satisfy all degree requirements and achieve a minimum of 3.0 QPA in the courses being applied towards the required 96 units from CMKL and 97 units from Carnegie Mellon 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 THB 0.00 to receive a diploma.

CMKL Commencement only occurs once a year. ECE holds a diploma ceremony at the same time as the university. Students who are certified after the annual ceremony will be invited to attend the next commencement ceremony.

Before graduation, students should update their contact information, such as mailing address and e-mail address, with the university. Also, students should review a proxy of their diploma 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*.



# 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. Students can find CMKL academic calendar on [www.cmkl.ac.th/cube/student-experience/academic-calendar](http://www.cmkl.ac.th/cube/student-experience/academic-calendar)

## Course Load

Due to the rigor of this program, students are advised to take 36 units of courses in their first semester and 36 units of courses each semester thereafter. However, we recognize that our students body is diverse, and that includes how each student handles their course load. While students may register for maximum number of units each semester, we strongly recommend students to take no more than 36 units each semester. Students unsure of whether they should take 48 units 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. If students wish 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 students must submit the form to their academic advisor for approval.

## Dropping Courses

Students have the option of dropping courses from their schedule starting at their assigned registration time until the add/drop deadline. 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 students choose 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 advisors 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. This background knowledge may come in the form of an introductory course taken at your undergraduate institution, or other work/research experience. 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 students believe that a final exam presents a scheduling conflict, they 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.

# **RESEARCH ASSISTANT AND TEACHING ASSISTANT POSITIONS**

## **Research Assistant for Credit**

This option is only applicable when students are spending their semester at Carnegie Mellon in the United States.

Students can apply up to 27 units of research credit towards their M.S. degree requirements by registering for 18-980 M.S. Graduate Project. The number of units registered should equal the number of hours you complete each week. For example, a 12-unit research project means the student should complete 12 hours of research each week.

## **Research Assistant for Pay**

Students are permitted to pursue research opportunities for pay in any department/program. 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 seek advice and counsel from the academic advisor.

# ACADEMIC STANDARDS

## Grade

Below are the grading structures for students in Electrical and Computer Engineering program.

## 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.

## 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. Grades lower than 'C', meaning C- or below, are considered failures and will not count toward degree requirements. For pre-approved CMKL courses to be transferred from CMKL to Carnegie Mellon, students need a grade of 'B' or above to meet the course transfer requirement.

## 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 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 96 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

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 University'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.



## **M.S. DEGREE REQUIREMENTS**

This section outlines the degree requirements for the Master of Science in Electrical and Computer Engineering at CMKL University. ECE course list and course descriptions are available on the ECE website.

### **M.S. in Electrical and Computer Engineering**

The M.S. in ECE is a four-semester program. Students will take between 72 and 96 units at CMKL and take 73 to 97 units at Carnegie Mellon.

Students need to have 97 units that can be counted towards the M.S. in ECE requirements at Carnegie Mellon, which are broken down as follows:

- 60 units of ECE Core Courses (taken at CMKL and Carnegie Mellon; up to 3 pre-approved courses at CMKL can be transferred to ECE at Carnegie Mellon)
- 24 units of CIT Elective Courses (taken at Carnegie Mellon)
- 12 units of General Technical Elective Courses (taken at Carnegie Mellon)
- 1 unit of Introduction to Graduate Studies (taken at Carnegie Mellon during the first semester)

In addition to the M.S. requirements at Carnegie Mellon, students must take the following research units at CMKL:

- 12 units of Research, Entrepreneurship and Innovation (CMKL 18-900)
- 36 units of Research and Development (CMKL 18-910 or ECE approved TCI courses)

#### **Options for Research and Development:**

Student can complete the required Research and Development units via one of the following options:

- 36 units at CMKL
- 24 units at CMKL and 12 units of 18-980 M.S. Graduate Project at Carnegie Mellon
- 12 units at CMKL and 24 units of 18-980 M.S. Graduate Project at Carnegie Mellon

#### **Course Restrictions:**

Courses in which more than 50% of the course grade is based on a group project or more than 20% is based on attendance cannot be counted towards the M.S. in ECE requirements.

#### **Internship Course Option (Thailand)**

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

ECE will enroll all students who are pursuing an internship for a 3-unit credit-bearing internship course (CMKL 18-995 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 CMKL transcript and tuition will be charged for 3 units. The work for the internship must be appropriate to the goals of the academic program.

# 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 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 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 an estimated schedule of total charges for the entire educational program can be found at the following website: <https://www.cmkl.ac.th/ece/tuition-and-fees>.

## Tuition Billing & Payments

The tuition rate for students entering ECE programs is set in the spring for the class entering 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 by approximately 3% per year.

Students will be charged tuition per semester for each semester in which they are enrolled. The tuition billing and payment process for all ECE students is handled centrally by CMKL University.



# APPENDIX A: LIST OF PRE-APPROVED 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.

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

Nowadays, information system is important for daily life activities, ranging from remote communications to financial exchanges, has made information security a central issue of our critical infrastructure. The course provides the foundation of information security in details of some important technical and policy. The significant goal of the course is to encourage students to understand a security engineering perspective about information systems and consider technical, economic, and policy factors. Topics covered in the course consist of 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; economic security; and special topics in information security. Prerequisites: The course required basic working knowledge of computers, networks, C, and UNIX programming, including an elementary mathematics background, but does not require any prior exposure to topics in computer or communications security. Students who do not have a technical background (e.g., students without any programming experience) are expected to accelerate through self-learning.

## **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 broadband networks, and expose the research problems in next-generation networks. Many concepts (SDN, MPLS, high-speed switching architecture, high-speed network control, unified control plane, and optical networks) will be discussed. The course project will explore the 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.

### **Research, Entrepreneurship, and Innovation Requirements**

The following courses satisfy the M.S. research requirements for the Carnegie Mellon – CMKL | Thailand Program. Students must take 12 units of CMKL 18-900 and at least 12 units of CMKL 18-910 during their time in Thailand.

### **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.

### **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.

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

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.

### **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.

### **M.S. in Technology and Creative Innovation at CMKL (ECE Approved Course for Research and Innovation) – 12 Units**

#### **Building Virtual Realities I (CMKL 56-604) – 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 56-622) – 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 I (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.

### **Computer Graphics (CMKL 41-462) – 12 units**

Introduction to the principles of computer graphics in three dimensions. Topics include 3D geometry and affine transform, ray tracing, perspective and 3D viewing, the graphics pipeline, curves and surfaces, and human visual perception, This course emphasizes fundamental techniques in graphics, with practical assignments.

### **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.

