BULLETIN 2016

Faculty of Engineering
Chulalongkorn University
FOR USE BY
ENGINEERING STUDENTS
HAVING ID.NO.59X XXXXX XX
UNTIL THEIR GRADUATION
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIVERSITY CALENDAR</td>
<td>1</td>
</tr>
<tr>
<td>FACULTY BOARD</td>
<td>2</td>
</tr>
<tr>
<td>OBJECTIVE</td>
<td>2</td>
</tr>
<tr>
<td>ACTIVITIES</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
</tr>
<tr>
<td>Research</td>
<td>3</td>
</tr>
<tr>
<td>Services</td>
<td>3</td>
</tr>
<tr>
<td>SERVICES AND FACILITIES</td>
<td></td>
</tr>
<tr>
<td>Campus</td>
<td>3</td>
</tr>
<tr>
<td>Laboratories</td>
<td>3</td>
</tr>
<tr>
<td>The Engineering Library</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Computer Center</td>
<td>4</td>
</tr>
<tr>
<td>Accommodations</td>
<td>4</td>
</tr>
<tr>
<td>Scholarships and Financial Aids</td>
<td>4</td>
</tr>
<tr>
<td>University Health care</td>
<td>4</td>
</tr>
<tr>
<td>Reserve Officer Training Corp (ROTC) Program</td>
<td>4</td>
</tr>
<tr>
<td>ADMISSION REQUIREMENTS</td>
<td>4</td>
</tr>
<tr>
<td>GENERAL REGULATIONS</td>
<td></td>
</tr>
<tr>
<td>Registration</td>
<td>4</td>
</tr>
<tr>
<td>Student Advisors</td>
<td>4</td>
</tr>
<tr>
<td>Grading System</td>
<td>4-5</td>
</tr>
<tr>
<td>Academic Performance Evaluation and Disqualification</td>
<td>5</td>
</tr>
<tr>
<td>Adding or Dropping Courses</td>
<td>5</td>
</tr>
<tr>
<td>Class Attendance</td>
<td>5</td>
</tr>
<tr>
<td>Graduation Honors</td>
<td>5</td>
</tr>
<tr>
<td>TUITION AND FEES</td>
<td>5</td>
</tr>
<tr>
<td>LIST OF DEPARTMENTS</td>
<td>5-6</td>
</tr>
<tr>
<td>CURRICULUM INFORMATION</td>
<td></td>
</tr>
<tr>
<td>Common Fundamental Subjects</td>
<td>6</td>
</tr>
<tr>
<td>Program Core Courses</td>
<td>6</td>
</tr>
<tr>
<td>Approved Electives</td>
<td>6</td>
</tr>
<tr>
<td>Free Electives</td>
<td>6</td>
</tr>
<tr>
<td>First Year Curriculum</td>
<td>7</td>
</tr>
<tr>
<td>DEPARTMENT, CURRICULUM AND DESCRIPTION OF COURSES</td>
<td></td>
</tr>
<tr>
<td>Department of Civil Engineering</td>
<td>8 - 22</td>
</tr>
<tr>
<td>Department of Electrical Engineering</td>
<td>23 - 42</td>
</tr>
<tr>
<td>Department of Mechanical Engineering</td>
<td>43 - 58</td>
</tr>
<tr>
<td>Department of Industrial Engineering</td>
<td>59 - 70</td>
</tr>
<tr>
<td>Department of Chemical Engineering</td>
<td>71 - 84</td>
</tr>
<tr>
<td>Department of Mining and Petroleum Engineering</td>
<td>85 - 97</td>
</tr>
<tr>
<td>Department of Environmental Engineering</td>
<td>98 - 108</td>
</tr>
<tr>
<td>Department of Survey Engineering</td>
<td>109 - 120</td>
</tr>
<tr>
<td>Department of Metallurgical Engineering</td>
<td>121 - 130</td>
</tr>
<tr>
<td>Department of Computer Engineering</td>
<td>131 - 149</td>
</tr>
<tr>
<td>Department of Nuclear Engineering</td>
<td>150 - 155</td>
</tr>
<tr>
<td>Department of Water Resources Engineering</td>
<td>156 - 160</td>
</tr>
<tr>
<td>International School of Engineering (ISE)</td>
<td>161 - 162</td>
</tr>
<tr>
<td>Nano Engineering (International Program)</td>
<td>163 - 170</td>
</tr>
<tr>
<td>Automotive Design and Manufacturing Engineering (International Program)</td>
<td>171 - 178</td>
</tr>
<tr>
<td>Information and Communication Engineering (International Program)</td>
<td>179 - 187</td>
</tr>
<tr>
<td>Aerospace Engineering (International Program)</td>
<td>188 - 194</td>
</tr>
<tr>
<td>Courses Descriptions in Basic Sciences and English</td>
<td>195 - 195</td>
</tr>
<tr>
<td>The Regional Centre for Manufacturing Systems Engineering</td>
<td>196 - 199</td>
</tr>
<tr>
<td>Biomedical Engineering Program (Interdisciplines)</td>
<td>200 - 206</td>
</tr>
<tr>
<td>Defense Engineering and Technology</td>
<td>207 - 216</td>
</tr>
</tbody>
</table>
## Appendix

<table>
<thead>
<tr>
<th>Course</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation English Courses</td>
<td>217</td>
</tr>
<tr>
<td>Basic Sciences and Mathematics Courses</td>
<td>217-218</td>
</tr>
<tr>
<td>Basic Engineering Practice</td>
<td>218</td>
</tr>
<tr>
<td>General Education, Special</td>
<td>218</td>
</tr>
<tr>
<td>Description of General Education Courses</td>
<td>219-223</td>
</tr>
<tr>
<td>Chulalongkorn University Map</td>
<td>224-225</td>
</tr>
</tbody>
</table>
# UNIVERSITY CALENDAR
## ACADEMIC YEAR 2016

### First Semester
- **First day of classes**: Monday, August 8, 2016
- **Midterm Examinations (if any)**: Monday, September 26 - Friday, September 30, 2016
- **Close of first semester activities**: Sunday, October 30, 2016
- **Last day of classes**: Saturday, November 26, 2016
- **Final Examinations**: Monday, November 28 - Tuesday, December 1, 2016
- **Close of first semester**: Wednesday, December 14, 2016

### Second Semester
- **First day of classes**: Tuesday, January 3, 2017
- **Midterm Examinations (if any)**: Monday, February 27 - Friday, March 3, 2017
- **Close of second semester activities**: Sunday, April 9, 2017
- **Last day of classes**: Saturday, May 6, 2017
- **Final Examinations**: Monday, May 8 - Tuesday, May 23, 2017
- **Close of second semester**: Wednesday, May 24, 2017

### Summer Session
- **First day of classes**: Monday, June 5, 2017
- **Last day of classes and Examinations**: Friday, July 21, 2017
- **Close of summer session**: Saturday, July 22, 2017
- **Last day of Academic Year**: Friday, August 11, 2017
ADMINISTRATION  
FACULTY BOARD

Dean of the Faculty:
Assoc. Prof. Dr. Supot Techavorasinskun

Associate Dean
Assoc. Prof. Dr. Kasem Choocharuk
Assoc. Prof. Dr. Jrawat Chawrangroaj
Assoc. Prof. Dr. Tawatchai Charinpanitkul
Assoc. Prof. Dr. Anongnat Somwangthananaraj
Assoc. Prof. Dr. Manop Wongpaisan
Assoc. Prof. Dr. Sanphet Chumthipaipan
Assoc. Prof. Dr. Atiwong Suchato
Assoc. Prof. Dr. Manop Lohatepanont
Assoc. Prof. Dr. Pirapat Painmanakul

Assistant Dean
Assoc. Prof. Dr. Thanyarat Singhanart
Assoc. Prof. Dr. Charmaei Pluemptiwiriyaweja
Assoc. Prof. Dr. Chalayachat Saiwichit
Assoc. Prof. Dr. Niphon Wansophark
Assoc. Prof. Dr. Sukree Sinthupinyo
Dr. Falan Sirisaryachai
Dr. Phannee Saengkaew
Dr. Sinkanya Singcuna

Head of Department of Civil Engineering
Prof. Dr. Teerapong Senjuntichai

Head of Department of Electrical Engineering
Assist. Dr. Komson Petcharaks

Head of Department of Mechanical Engineering
Assist. Prof. Dr. Witaya Wannasuphprasisit

Head of Department of Industrial Engineering
Assist. Prof. Dr. Paveena Chaowalithwongse

Head of Department of Chemical Engineering
Prof. Dr. Paisan Kittisupakorn

Head of Department of Mining and Petroleum Engineering
Dr. Thitsak Boonpromote

Head of Department of Environmental Engineering
Assist. Prof. Dr. Khemarat Osathaphan

Head of Department of Survey Engineering
Prof. Dr. Chalermsomboon Satriapod

Head of Department of Metallurgical Engineering
Assoc. Prof. Dr. Gobboon Lothongkum

Head of Department of Computer Engineering
Assist. Prof. Dr. Natawut Nupairoj

Head of Department of Nuclear Engineering
Assoc. Prof. Dr. Suporn Nilsuwankosit

Head of Department of Water Resources Engineering
Assist. Prof. Dr. Anurak Sriayawat

Elected Members of the Board:
Assoc. Prof. Dr. Sirima Panyametheekul
Assoc. Prof. Dr. Jaroon Rungamomrat
Assoc. Prof. Dr. Wanchaleem Pora
Assoc. Prof. Dr. Napasavong Osotssilp
Assoc. Prof. Dr. Thanyarat Mekumpompong
Assoc. Prof. Dr. Somchai Kiengkraisrin
Dr. Phannee Saengkaew
Dr. Somboon Rassamee
Dr. Phintada Ruangkraissamee
Mr. Chatay Patanaothai

Program Director of International School of Engineering
Mrs. Kaewja Nacaskul

Program Director of The Regional Centre for Manufacturing Systems Engineering
Prof. Dr. Parames Chutima

Acting Director of Biomedical Engineering Program
Assoc. Prof. Dr. Siriporn Damronsgakul

Acting Director of Defense Engineering and Technology
Assoc. Prof. Dr. Withit Pansuk
Col. Assist. Prof. Dr. Chuan Chuntavan

Director of Center for Engineering Research and Technical Services
Assoc. Prof. Dr. Thanawat Pothisiri

Registrar:
Assist. Prof. Dr. Charmaei Pluemptiwiriyaweja

FACULTY OF ENGINEERING

OBJECTIVE

It is the objective of the Faculty to educate engineering students both in the fundamental and professional knowledge, and to train the students in the analysis and synthesis of engineering systems. It is expected that our graduates should possess the ability to function effectively both as individual and in a team. Initiative, self-confidence and perseverance are the desired quality in our graduates. It is also our objective to instill the sense of professional and social responsibility and integrity in the students during the course of instruction.
ACTIVITIES

Education:

The Faculty of Engineering prepares men and women for professional careers in engineering and for responsible positions of a technical and semitechnical character in industry, commerce, education, and government.

At present, the Faculty of Engineering offers courses leading to Bachelor, Master, and Doctoral degrees in Engineering, Master degree in Science as well as Graduate Diploma. The curricula are administered by the departments shown below.

<table>
<thead>
<tr>
<th>Department</th>
<th>B.Eng</th>
<th>G.Dip</th>
<th>M.Eng</th>
<th>M.Sc</th>
<th>D.Eng</th>
<th>JPh.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining and Petroleum Engineering</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey Engineering</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metallurgical Engineering</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Nuclear Engineering</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Resources Engineering</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Centre For Manufacturing Systems</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automotive Design and Manufacturing Engineering (International Program)</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nanotechnology Engineering (International Program)</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerospace Engineering (International Program)</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information and Communication Engineering (International Program)</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomedical Engineering</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defense Engineering and Technology</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Details of the graduate degrees in Engineering can be found in the handbook on Graduate Studies.

Research

The Current development in Engineering, Science and Technology is a result of extensive research endeavors worldwide. Recognizing the vast impact of research on engineering education and on the industrial development as a whole, the Faculty of Engineering is determined to drive itself to be a research-oriented one. Faculties are encouraged to engage actively in research activities. Inevitably, engineering students, at one stage of their education at the Faculty, can learn from the research projects in which they participate. A strong emphasis is placed in research because the key element to a better understanding of engineering necessitates that practical work and research be conducted in order to compliment theoretical studies. Students also gain ‘hands-on experience’. Research is a source of learning and transferring of knowledge by the principles of academic freedom.

Services

The Faculty provides academic services to the public in the form of seminars, training courses, technical conferences, continual education and technical consultancy in all engineering disciplines. The array of equipment at the Faculty of Engineering are also utilized to service small, medium and multi-national industries in Thailand as well as other governmental agencies in the form of material and product testing.

SERVICES AND FACILITIES

Campus

The University compound is located between Phya Thai and Henry Dunant Road in Bangkok, a city of more than eight million people. The Faculty of Engineering occupies a large section on the south of the campus. These include four main office and classroom buildings which house a large library and an auditorium of 600 seats. Other buildings are Department of Civil, Electrical, Mechanical, Industrial, Chemical, Mining and Petroleum, Environmental, Survey, Computer, Nuclear Technology, Water Resources, The Regional centre for Manufacturing Systems Engineering and International office.

Laboratories

The Faculty has well-equipped laboratory facilities for conducting experiment associated with classroom courses in various departments. Facilities of testing according to industrial standards and facilities of testing for student thesis, dissertation, and for faculty research are also provided.
The Engineering Library

The Library, located on the third floor and the fourth floor of the Engineering Building No.3, contains a collection of more than 60,000 volumes of technical literatures, text-books, standard books as well as audio visual tape, CD-ROM multimedia and 95 periodicals which cover practically all branches of engineering. Computer online searching service and internet are available.

Engineering Computer Center

Engineering Computer Center (ECC) was established in 1984 to provide and support computer services and related facilities which concentrate on engineering applications. The ECC provides not only computing facilities for training of engineering students and for research and development in various engineering disciplines, but also some specific engineering applications and professional services to industrial sectors such as Database applications, Computer Aided Design, Finite Element Analysis, Mathematics related applications, System Simulations, etc.

The ECC is one of the largest faculty-level computer center in Thailand. The facilities include various models and sizes of Computer Servers, Engineering Workstations both UNIX and Windows-based, network printing, and Web-based learning facilities. All of these facilities are connected to the Engineering Network (ENGINET), which is linked to the Chulalongkorn University Network (CHULANET). The networking enables users to access to the facilities from anywhere at any time and to link to many other networks around the world.

Accommodations

Chulalongkorn University provides five dormitories for unmarried students. Two for Thai male, two for Thai female, and one for international students. Private accommodation may also be found in the nearby area.

Scholarships and Financial Aids

A number of scholarships are available for needy students with good academic and behavior records or outstanding in his/her field of study. Financial aids are also provided for students with urgent financial problems.

University Health Care

The University maintains a clinic where medical care for minor illness and injuries is provided for students free of charge. The Health Center is located at Jamjuree 9 Building. The center is open every weekday from 8.00 a.m. to 4.00 p.m.

Reserve Officer Training Corp (ROTC) Program

Students of Chulalongkorn University are eligible to apply for training in the Reserve Officer Training Corp Program. Male students who do not participate in the program, or have not completed the third year of the program, may apply for deferment of conscription for military service.

ADMISSION REQUIREMENTS

To be eligible for admission to Faculty of Engineering an applicant must meet the following requirements:

1. He/she must hold a Mathayom Suksa 6 (Grade 12) certificate from a High-School or other equivalent which the University recognizes as being acceptable,
2. He/she must have passed the competitive entrance examination held annually by the Commission On Higher Education.

GENERAL REGULATIONS

Registration

Students must register at the time appointed to enroll according to academic calendar in each year. Late registration will be penalized by additional fees.

Student Advisors

Each student will be assigned to a faculty advisor after notification of his/her admission, throughout his/her academic program. The student must consult and seek approval from his/her advisor in all matters of program planning for his/her study before registration.

Grading System

The quality of the student's work will be evaluated as follows:

<table>
<thead>
<tr>
<th>GRADE</th>
<th>DEFINITION</th>
<th>GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Excellent</td>
<td>4.0</td>
</tr>
<tr>
<td>B+</td>
<td>Very Good</td>
<td>3.5</td>
</tr>
<tr>
<td>B</td>
<td>Good</td>
<td>3.0</td>
</tr>
<tr>
<td>C+</td>
<td>Fairly Good</td>
<td>2.5</td>
</tr>
<tr>
<td>C</td>
<td>Fair</td>
<td>2.0</td>
</tr>
<tr>
<td>D+</td>
<td>Poor</td>
<td>1.5</td>
</tr>
<tr>
<td>D</td>
<td>Very Poor</td>
<td>1.0</td>
</tr>
<tr>
<td>F</td>
<td>Fail</td>
<td>0.0</td>
</tr>
</tbody>
</table>

In addition, the following letter symbols may also given:

I (Incomplete)
P (In progress)
Academic Performance Evaluation and Disqualification

One lecture or discussion-hour per week in a semester is equal to one Unit of Credit. Three hours of Laboratory work per week in a semester are also equivalent to one Unit of Credit.

The overall scholastic performance of a student is average and expressed in a semester as a Grade-Point Average (GPA) and annually as a Cumulative Grade-Point Average (GPAX). The GPA is obtained by the sum of the products of grade points and units of credit divided by the total units of credit for which grades A, B+, B, C+, C, D+, D and F in each semester are received. Grades P, S, U, V, W, M and X are disregarded in the computation for GPA.

The grade I (Incomplete) may be replaced if the student completes his/her work of that course with the approval of the instructor within the second week of the subsequent semester. If the work is not done or un-approved within this limit of time, the grade I will be automatically converted to grade F.

A student may repeat his/her course only for the course which he/she has received a grade D+, D, F, or U. When a course is repeated, the units of credit shall be counted toward a degree only once, but the student's Grade-Point Average will be computed on the total number of credits attempted. To be qualified for graduation, a student must pass all the required courses with the Cumulative Grade-Point Average of at least 2.00. An undergraduate student who receives his/her Cumulative Grade-Point Average less than 2.00 will be classified as on academic probation. This probation can be removed when that student can increase his/her GPAX greater than or equal to 2.00.

An undergraduate student will be disqualified for further registration in the Faculty when
(a) his/her GPAX falls less than 1.50 at the end of any semester except for the first semester, or
(b) his/her GPAX is less than 1.80 for two consecutive semesters during his/her academic probation, or
(c) his/her GPAX is less than 2.00 for four consecutive semesters during his/her academic probation.
(d) his/her GPAX is less than 2.00 or the number of total credits is less than the course's requirement within 16 semesters for four-academic years

Adding or Dropping Courses

A request for adding or dropping courses after registration must be approved by the student's advisor. For the withdraw, the request must be approved by the dean of Faculty as well.

Adding courses can be made within the first two weeks of a regular semester or within the first week of a summer semester.

Dropping courses can be made within the first six weeks of a regular semester or within the first two weeks of summer semester. Any attempt to drop courses after these periods shall be considered as withdraw which these courses will be shown in the student's transcript of record with the letter symbol "W".

Class Attendance

A minimum attendance for class participation of students is 80 percent, otherwise he/she will not be allowed to attend an examination.

Graduation Honors

There are two classes of honors. The first class honors is awarded to graduates who received a Bachelor of Engineering with cumulative grade-point average is equal to or higher than 3.60 in four academic years and never received grade F and U in any subject. Similarly requirements apply to those who received the second class honors, except the cumulative grade-point average is equal to or higher than 3.25.

Gold medal will be awarded to the outstanding student who has completed all the curriculum requirements with the highest ranking among the students of the same professional for the same academic year in addition to his/her first class honors.

TUITION AND FEES

Tuition fees:

Regular Undergraduate Programs

<table>
<thead>
<tr>
<th>Session</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular semester</td>
<td>21,000 baht per semester</td>
</tr>
<tr>
<td>Summer session</td>
<td>5,250 baht per session</td>
</tr>
</tbody>
</table>

Regular Graduate Programs

<table>
<thead>
<tr>
<th>Session</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular semester</td>
<td>31,000 baht per semester</td>
</tr>
<tr>
<td>Summer session</td>
<td>7,750 baht per session</td>
</tr>
</tbody>
</table>

Notes: The rates for special programs are set separately. Details may be requested directly from each program.

LIST OF DEPARTMENTS

Code No.  Name
2101  Department of Civil Engineering
2102  Department of Electrical Engineering
2103  Department of Mechanical Engineering
2104  Department of Industrial Engineering
2105  Department of Chemical Engineering
2106  Department of Mining and Petroleum Engineering
2107  Department of Environmental Engineering
2108  Department of Survey Engineering
2109  Department of Metallurgical Engineering
2110  Department of Computer Engineering
2111  Department of Nuclear Engineering
2112  Department of Water Resources Engineering
2163  The Regional Centre for Manufacturing Systems Engineering
2141  Nano Engineering (International Program)
Faculty of Engineering offers the programs leading to Bachelor degrees in Civil Engineering, Electrical Engineering, Mechanical Engineering, Naval Architecture and Marine Engineering, Automotive Engineering, Industrial Engineering, Chemical Engineering, Mining and Petroleum Engineering, Environmental Engineering, Survey Engineering, Metallurgical Engineering, Computer Engineering, and Nuclear Engineering. Nowadays, we provide the international programs in Nano Engineering, Automotive Design and Manufacturing Engineering, Information and Communication Engineering, and Aerospace Engineering. The student is required to select a program of study after he/she has completed his/her second semester, except for international program, and some specific programs.

Common Fundamental Subject (55 - 61 Credits)

<table>
<thead>
<tr>
<th>General Education</th>
<th>(30 Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Science*</td>
<td>3 credits</td>
</tr>
<tr>
<td>Humanities*</td>
<td>3 credits</td>
</tr>
<tr>
<td>Science and Mathematics*</td>
<td>3 credits</td>
</tr>
<tr>
<td>Interdisciplinary*</td>
<td>3 credits</td>
</tr>
<tr>
<td>English</td>
<td>12 credits</td>
</tr>
<tr>
<td>General Education, Special</td>
<td>6 credits</td>
</tr>
<tr>
<td>2100111 Exploring Engineering, World (compulsory)</td>
<td>3 credits</td>
</tr>
<tr>
<td>2100311 Engineering Essentials (optional)</td>
<td>3 credits</td>
</tr>
</tbody>
</table>

*The subject should be chosen from the list approved by General Education Office except English.

Basic Science and Mathematics (21 - 24 Credits)

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>(2301107 -108, and/or 2301207, and/or 2603284)</th>
<th>6-12 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>2302127,2302163</td>
<td>4 credits</td>
</tr>
</tbody>
</table>

Physics (2304103 - 104,2304183 - 184 | 8 credits

Basic Engineering (14 -26 Credits)

| 2100301 Eng Practice | 2 credits |
| 2103106 Eng Drawing  | 3 credits |
| 2103213 Eng Mechanics I** | 3 credits |
| 2109101 Eng Materials | 3 credits |
| 2110101 Comp Prog    | 3 credits |
| 2102391 Elec Eng I   | 3 credits |

Program Core Courses

Each Program has its area of concentration which is composed of compulsory courses and approved electives. The total number of core course credit of each program is about 74 - 84 credits.

Approved Electives

Each engineering curriculum offers some approved electives. All elective courses must be chosen from departmentally approved list.

Free Electives

A student has a free selection of courses of 3-6 credits which are offered by any faculty in the University. The total number of credits for graduation from The Faculty of Engineering must not be less than the amount of the credits which are specified by each curriculum. Each undergraduate is required to undertake a minimum of six weeks practical training in industry as the part of the course 2100301 Engineering Practice, which is offered for the third year student in the summer session, before graduation. Work in the laboratory is also brought into sharper focus by the fourth year senior project. The engineering project work, which is aimed at providing the student with experience similar to those of practicing engineers, is a compulsory course of all departments.
# FIRST YEAR CURRICULUM
## COMMON TO ALL ENGINEERING STUDENTS

### FIRST SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103106</td>
<td>ENG DRAW</td>
<td>3</td>
<td>2109101</td>
<td>ENG MATERIALS</td>
<td>3</td>
</tr>
<tr>
<td>2301107</td>
<td>CALCULUS I</td>
<td>3</td>
<td>2110101</td>
<td>COMP PROG</td>
<td>3</td>
</tr>
<tr>
<td>2302127</td>
<td>GEN CHEM</td>
<td>3</td>
<td>2301107</td>
<td>CALCULUS I</td>
<td>3</td>
</tr>
<tr>
<td>2302163</td>
<td>GEN CHEM LAB</td>
<td>1</td>
<td>2304103</td>
<td>GEN PHYS I</td>
<td>3</td>
</tr>
<tr>
<td>2304103</td>
<td>GEN PHYS I</td>
<td>3</td>
<td>2304183</td>
<td>GEN PHYS LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2304183</td>
<td>GEN PHYS LAB I</td>
<td>1</td>
<td>5500111</td>
<td>EXP ENG I</td>
<td>3</td>
</tr>
<tr>
<td>5500111</td>
<td>EXP ENG I</td>
<td>3</td>
<td>2100111</td>
<td>EXPL ENG WORLD</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>17</strong></td>
<td></td>
<td></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

### SECOND SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100111</td>
<td>EXPL ENG WORLD</td>
<td>3</td>
<td>2103106</td>
<td>ENG DRAW</td>
<td>3</td>
</tr>
<tr>
<td>2109101</td>
<td>ENG MATERIALS</td>
<td>3</td>
<td>2301108</td>
<td>CALCULUS II</td>
<td>3</td>
</tr>
<tr>
<td>2110101</td>
<td>COMP PROG</td>
<td>3</td>
<td>2302127</td>
<td>GEN CHEM</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>CALCULUS II</td>
<td>3</td>
<td>2302163</td>
<td>GEN CHEM LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2304104</td>
<td>GEN PHYS II</td>
<td>3</td>
<td>2304183</td>
<td>GEN PHYS II</td>
<td>3</td>
</tr>
<tr>
<td>2304184</td>
<td>GEN PHYS LAB II</td>
<td>1</td>
<td>5500112</td>
<td>EXP ENG II</td>
<td>3</td>
</tr>
<tr>
<td>5500112</td>
<td>EXP ENG II</td>
<td>3</td>
<td></td>
<td></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

TOTAL CREDITS FOR COMMON TO ALL ENGINEERING STUDENTS = 35
(Except international program)
DEPARTMENT OF CIVIL ENGINEERING

The Department's curriculum is designed to provide the students with broad educational and professional perception as well as to enhance their effectiveness as practitioners and researchers in the field of modern civil engineering, which includes planning, analysis, design and construction of buildings, bridges, foundations, dams, hydraulic structures and transportation facilities. It contains courses in mathematics, related basic sciences, fundamentals of general engineering and specific civil engineering subjects. Besides, the students are required to fulfill selected courses in English, humanities and social sciences so as to broaden their outlooks in their future careers.

Laboratories in various divisions and research units of the Department are set up to supplement classroom works and to facilitate the study of advanced topics.

The Department offers a 4-year undergraduate program leading to the Bachelor of Engineering degree as well as graduate programs for Master and Doctor of Engineering degrees.

HEAD:

Teerapong Senjuntichai, Ph.D. (Manitoba)

PROFESSORS:

Teerapong Senjuntichai, Ph.D. (Manitoba)
Suched Likitlersuang, D.Phil. (Oxford)

ASSOCIATE PROFESSORS:

Akhrarat Lenwari, Ph.D. (Chula)
Anat Ruangrassamee, Ph.D. (Tokyo Tech)
Boonchai Sitthimaithum, D.Eng. (Tokyo)
Boonchai Ukritchon, Sc.D. (MIT)
Jaraton Rungamonrat, Ph.D. (UT Austin)
Jittichai Rudjanakanoknud, Ph.D. (UC Berkeley)
Kasem Choocharukul, Ph.D. (Purdue)
Phoonsak Phenisusom, D.Eng. (Tokyo)
Saksith Chalermpong, Ph.D. (UC Irvine)
Sorawit Narupiti, Ph.D. (Michigan State)
Supot Techavorasinsun, D.Eng. (Tokyo)
Tanit Tongthong, Ph.D. (Maryland)
Thanyawat Pothisiri, Ph.D. (UI Urbana-Champaign)
Tospol Pinkaew, D.Eng. (Tokyo)
Tirawat Boonyatee, D.Eng. (Kyoto)
Visuth Chovichien, Ph.D. (UI Urbana-Champaign)
Veerasak Likhitruangsilp, Ph.D. (Michigan)
Wanchai Teparaksa, D.Eng. (Kyoto)
Wisun Suksampon, Ph.D. (Carnegie Mellon)
Withit Pansuk, Ph.D. (Hokkaido)

ASSISTANT PROFESSORS:

Boonchai Sangpetngam, Ph.D. (Florida)
Chatpan Chintanapakdee, Ph.D. (UC Berkeley)
Manoj Lohatepanont, Sc.D. (MIT)
Noppadon Jokkaw, Ph.D. (Chula)
Tanate Srisrirajanakorn, Ph.D. (UI Urbana-Champaign)
Vachara Peansupap, Ph.D. (RMIT)
Watanachai Smittakorn, Ph.D. (Colorado State)
# CIVIL ENGINEERING CURRICULUM

## FIRST YEAR CURRICULUM
**COMMON TO ALL ENGINEERING STUDENTS**

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>THIRD SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>SIXTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2101252</td>
<td>STAT CE</td>
<td>3</td>
<td>2101307</td>
<td>RC DESIGN</td>
<td>4</td>
</tr>
<tr>
<td>2101256</td>
<td>CE PROFESSION</td>
<td>3</td>
<td>2101312</td>
<td>STRUCT ANAL II</td>
<td>3</td>
</tr>
<tr>
<td>2103213</td>
<td>ENG MECH I</td>
<td>3</td>
<td>2101335</td>
<td>CONS SUPVN</td>
<td>2</td>
</tr>
<tr>
<td>2301207</td>
<td>CALCULUS III</td>
<td>3</td>
<td>2101338</td>
<td>HIGHWAY ENG</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKLL</td>
<td>3*</td>
<td>2101421</td>
<td>GEO ENG DES CONS</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>18</td>
<td>2108306</td>
<td>FLD PRAC TOPO SURV</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>FOURTH SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>SUMMER SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2101202</td>
<td>MECH MAT I</td>
<td>3</td>
<td>2100301</td>
<td>ENG PRACTICE</td>
<td>2</td>
</tr>
<tr>
<td>2101253</td>
<td>APP MATH CE</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2101254</td>
<td>GEOL CE</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2101302</td>
<td>MAT TESTING LAB</td>
<td>1</td>
<td>2101490</td>
<td>PRE-PROJECT</td>
<td>1</td>
</tr>
<tr>
<td>2108298</td>
<td>SURVEYING</td>
<td>3</td>
<td>xxxxxxx</td>
<td>FOREIGN LANGUAGE</td>
<td>3</td>
</tr>
<tr>
<td>2112346</td>
<td>HYDRAULICS I</td>
<td>3</td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>18</td>
<td>xxxxxxx</td>
<td>ELECTIVE COURSES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>FIFTH SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>SEVENTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2101310</td>
<td>STRUCT ANAL I</td>
<td>3</td>
<td>2101406</td>
<td>STL/TIMBER DSGN</td>
<td>4</td>
</tr>
<tr>
<td>2101311</td>
<td>CIV ENG MAT</td>
<td>4</td>
<td>2101455</td>
<td>CONS ENG COST EST</td>
<td>3</td>
</tr>
<tr>
<td>2101321</td>
<td>SOIL MECHS</td>
<td>3</td>
<td>2101490</td>
<td>PRE-PROJECT</td>
<td>1</td>
</tr>
<tr>
<td>2101322</td>
<td>SOIL MECHS LAB</td>
<td>1</td>
<td>xxxxxxx</td>
<td>FOREIGN LANGUAGE</td>
<td>3</td>
</tr>
<tr>
<td>2101337</td>
<td>TRANS ENG</td>
<td>3</td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>2112342</td>
<td>PRIN OF HYDROLOGY</td>
<td>3</td>
<td>xxxxxxx</td>
<td>ELECTIVE COURSES</td>
<td>3</td>
</tr>
<tr>
<td>2112344</td>
<td>HYDRAULIC LAB I</td>
<td>1</td>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>EIGHTH SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>2101454</td>
<td>CONST MANAGEMENT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2101499</td>
<td>CIVIL ENG PROJECT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL CREDITS FOR GRADUATION = 146
CIVIL ENGINEERING

NAME OF THE MASTER'S DEGREE
: Master of Engineering
: M. Eng.

NAME OF THE DOCTORAL DEGREE
: Doctor of Philosophy
: Ph.D.

ADMISSION
To be eligible for admission to the M. Eng. program, an applicant must meet two basic requirements:
1. Hold a Bachelor's degree in Civil Engineering or equivalent.
2. Have other qualifications as prescribed by the regulations of the Graduate School or the committee of the program considers acceptable for admission.

To be eligible for admission to the Ph.D. program, an applicant must meet two basic requirements:
1. Hold a Bachelor's Degree in Civil Engineering or equivalent with a minimum of second-class honor (GPA >3.25/4.00) for Option 3; or hold a Master's Degree in Civil Engineering or equivalent with good academic records for Option 2 and excellent academic records for Option 1.
2. Have other qualifications as prescribed by the regulations of the Graduate School or the committee of the program considers acceptable for admission.

DEGREE REQUIREMENTS
An acceptable thesis of not less than 12 credits, together with 9 credits of core courses plus 15 credits of elective courses are required for the Master's degree.
A student who has fulfilled the requirements of the Master's program with a passing grade point average of not less than 3.00, passing English examination and a minimum of one published technical paper. A period of study of not more than 8 regular semesters will be awarded the degree of Master of Engineering.

An acceptable dissertation of not less than 60 credits for Option 1 and 48 credits of Option 2 and Option 3 together with 12 credits of elective courses for Option 2 for or 9 credits of core courses plus 15 credits of elective courses for Option 3 are required for the Ph.D. Degree. A student must fulfill the requirements of the Graduate school by passing the English examination and publishing technical papers in international peer-reviewed journals. The maximum period of study is 5 academic years for Option 1 and Option 2 and 8 academic years for Option 3.

COURSE REQUIREMENTS
A student must choose his major area of study from one of the following:

1) Core Courses 9 credits

A. Structural Engineering
2101601 Advanced Structural Theory 3(3-0-9)
2101607 Advanced Mechanics of Materials 3(3-0-9)
2101680 Applied Mathematics I 3(3-0-9)

B. Geotechnical Engineering
2101621 Foundation Engineering 3(3-0-9)
2101637 Advanced Soil Mechanics 3(3-0-9)
2101835 Earth and Retaining Structures 3(3-0-9)

C. Transportation Engineering
2101660 Transportation Systems 3(3-0-9)
2101661 Transportation Planning and Policy 3(3-0-9)
2101662 Methods for Transportation Analysis 3(3-0-9)

D. Construction Engineering and Management
2101690 Construction Methods and Equipment 3(3-0-9)
2101692 Analytical Methods in Construction Management 3(3-0-9)
2101870 Construction Project Management 3(3-0-9)

2) Elective Courses 15 credits

A. Structural Engineering
2101510 Computer Methods for Civil Engineering 3(3-0-9)
2101512 Advanced Concrete Technology 3(3-0-9)
2101603 Theory of Elasticity 3(3-0-9)
2101604 Shell Structures 3(3-0-9)
2101605 Stability of Structures 3(3-0-9)
2101606 Dynamics and Vibrations 3(3-0-9)
2101608 Plate Structures 3(3-0-9)
2101609 Plastic Design of Steel Structures 3(3-0-9)
2101611 Matrix Analysis of Structures 3(3-0-9)
2101614 Behavior of Steel Structures 3(3-0-9)
2101615 Advanced Prestressed Concrete Structures 3(3-0-9)
2101616 Long Span Structural Systems 3(3-0-9)
2101617 Structural Building Components 3(3-0-9)
2101618 Finite Element Method for Civil Engineers 3(3-0-9)
2101619 Seismic Design of Structures 3(3-0-9)
2101654 Engineering for Disaster Mitigation 3(3-0-9)
2101656 Disaster Damage Mitigation and Recovery Management 3(3-0-9)
2101681 Applied Mathematics II 3(3-0-9)
2101794 Graduate Seminar in Civil Engineering 3(3-0-9)
2101800 Advanced Solid Mechanics 3(3-0-9)
2101801 Fracture Mechanics 3(3-0-9)
2101802 Inelastic Behavior of Materials 3(3-0-9)
2101803 Nonlinear Analysis in Structural Mechanics 3(3-0-9)
2101804 Behavior of Reinforced Concrete Structure 3(3-0-9)
2101805 Limit State Design of Concrete Structures 3(3-0-9)
2101806 Numerical and Approximate Methods for Structural Engineering 3(3-0-9)
2101810 Fire Safety Design of Structures 3(3-0-9)
2101817 Structural Testing and Evaluation 3(2-3-7)
2101818 Life Cycle of Concrete Structures 3(3-0-9)

B. Geotechnical Engineering
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101524</td>
<td>Computer Programming and Computer Tools for Graduate Research</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101534</td>
<td>Computer Application for Geotechnical Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101535</td>
<td>Tunnel Engineering</td>
<td>2(0-0-6)</td>
</tr>
<tr>
<td>2101624</td>
<td>Elasticity in Soil Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101632</td>
<td>Rock Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101634</td>
<td>Plasticity in Soil Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101636</td>
<td>Interpretation of Field Exploration and Soil Testing</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2101639</td>
<td>Special Study in Soil Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101793</td>
<td>Graduate Seminar in Civil Engineering</td>
<td>S/U</td>
</tr>
<tr>
<td>2101820</td>
<td>Geo-environment Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101821</td>
<td>Deep Foundation Design</td>
<td>3(2-0-6)</td>
</tr>
<tr>
<td>2101824</td>
<td>Finite Element Method in Geotechnical Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101831</td>
<td>Engineering Ground Modification</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101832</td>
<td>Engineering Geophysics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101833</td>
<td>Soil Dynamics and Earthquake Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101834</td>
<td>Earth and Retaining structures</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

**C. Transportation Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101551</td>
<td>Pavement Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101553</td>
<td>Public Transit Systems Planning and Operations</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101554</td>
<td>Traffic and Parking Studies for Site Development</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101555</td>
<td>Travel Behavior Survey and Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101556</td>
<td>Air Transportation System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101557</td>
<td>Planning and Management of Airport System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101558</td>
<td>Transportation and Logistics System Optimization</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101559</td>
<td>Traffic Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101560</td>
<td>Sustainable Transportation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101562</td>
<td>Train Control and Operation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101567</td>
<td>Rail Transport System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101644</td>
<td>Urban Transportation Planning</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101649</td>
<td>Probability Statistics and Decision for Civil Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101653</td>
<td>Computer Model in Transportation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101664</td>
<td>Transportation Operations</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101665</td>
<td>Highway Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101666</td>
<td>Intelligent Transportation Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101667</td>
<td>Logistics System Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101668</td>
<td>Evaluation of Transportation Project and Policy</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101669</td>
<td>Transport Policy</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101793</td>
<td>Graduate Seminar in Civil Engineering</td>
<td>S/U</td>
</tr>
<tr>
<td>2101811</td>
<td>Thesis</td>
<td>12 credits</td>
</tr>
<tr>
<td>2101828</td>
<td>Dissertation</td>
<td>48 credits</td>
</tr>
<tr>
<td>2101894</td>
<td>Doctoral Dissertation Seminar</td>
<td>0(0-0-0)</td>
</tr>
<tr>
<td>2101897</td>
<td>Qualifying Examination</td>
<td>0(0-0-0)</td>
</tr>
</tbody>
</table>

**3) Thesis**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101535</td>
<td>Tunnel Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101550</td>
<td>Civil Engineering Project Planning</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101618</td>
<td>Finite Element Method for Civil Engineers</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2101621</td>
<td>Foundation Engineering</td>
<td>2(0-0-6)</td>
</tr>
<tr>
<td>2101635</td>
<td>Earth and Retaining Structures</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101649</td>
<td>Probability Statistics and Decision for Civil Engineering</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101691</td>
<td>Special Studies</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101694</td>
<td>Contracting in Construction Business</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101695</td>
<td>Computer Applications in Construction</td>
<td>S/U</td>
</tr>
<tr>
<td>2101697</td>
<td>Infrastructure Planning and Management</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101698</td>
<td>Construction Business Management</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101793</td>
<td>Graduate Seminar in Civil Engineering</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101831</td>
<td>Engineering Ground Modification</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101871</td>
<td>Risk Management in Civil and Environmental Engineering Systems</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2101873</td>
<td>Special Topics in Construction Engineering and Management</td>
<td>3(0-0-9)</td>
</tr>
<tr>
<td>2604501</td>
<td>Financial Management</td>
<td>3(0-0-9)</td>
</tr>
</tbody>
</table>

**D. Construction Engineering and Management**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101811</td>
<td>Thesis</td>
<td>12 credits</td>
</tr>
<tr>
<td>2101828</td>
<td>Dissertation</td>
<td>48 credits</td>
</tr>
<tr>
<td>2101894</td>
<td>Doctoral Dissertation Seminar</td>
<td>0(0-0-0)</td>
</tr>
<tr>
<td>2101897</td>
<td>Qualifying Examination</td>
<td>0(0-0-0)</td>
</tr>
</tbody>
</table>
### PROGRAM OF STUDY (CIVIL ENGINEERING)

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>M.Eng.</th>
<th>Ph.D. (Option 1)</th>
<th>Ph.D. (Option 2)</th>
<th>Ph.D. (Option 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Core Courses 9 credits&lt;br&gt;Elective Courses 3 credits</td>
<td>Dissertation 12 credits</td>
<td>Elective Courses 12 credits</td>
<td>- Core Courses 9 credits&lt;br&gt;- Elective Courses 3 credits</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Elective Courses 12 credits</td>
<td>Dissertation 12 credits</td>
<td></td>
<td>Elective Courses 12 credits</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Thesis 12 credits</td>
<td>Dissertation 12 credits</td>
<td>Dissertation 12 credits</td>
<td>Dissertation 12 credits</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>Dissertation 12 credits</td>
<td></td>
<td>Dissertation 12 credits</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td></td>
<td>Dissertation 12 credits</td>
<td></td>
<td>Dissertation 12 credits</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>Dissertation 12 credits</td>
<td></td>
<td>Dissertation 12 credits</td>
</tr>
</tbody>
</table>
2101202 Mechanics of Materials I 3(3-0-6)
Condition: Prerequisite 2103213 or 2103211
Fundamental concepts of stress and strain; axially loaded members; torsion; shear force and bending moment in beams; deflection of beams; stresses in beams; composite beams; unsymmetrical bending; combined stresses; buckling of column.

2101251 Civil Engineering Professional Conduct 3(3-0-6)
Development of concepts, methodology and processes of civil works since the ancient times; relationship between civil engineering and other engineering professions, and society; roles and contributions of civil engineering to world civilization; process of engineering design; fundamental of construction techniques; professional ethics; safety; sustainable development.

2101252 Statistics for Civil Engineering 3(3-0-6)
Necessity of statistical methods in civil engineering; probability theory; random variables; probability distribution models in civil engineering; statistical estimation and hypothesis testing in civil engineering; applications of regression analysis in civil engineering.

2101253 Applied Mathematics for Civil Engineers 3(3-0-6)
Introduction to linear algebra, matrices and matrix operations, linear equations, linear operators, eigen value problems; introduction to vector analysis, vector fields and operations, line integrals, surface integrals, volume integrals, integral theorems; Fourier and Laplace transforms, series representation of functions; basic concept of optimization; Ordinary Differential Equation (ODE), Initial Value Problem (IVP), Boundary Value Problem (BVP), introduction to Partial Differential Equation (PDE); Introduction to numerical techniques, some interesting topics of numerical methods for civil engineering.

2101254 Geology for Civil Engineers 2(2-0-4)
A general survey of geology with particular reference to civil engineering; common rock forming minerals; general characteristics and origins of rocks; features of the earth and geological process; structural features of the earth’s crust; geology of water supply, reservoirs and dam sites, erosion and flood control; river and harbor improvement; geological factors affecting quarrying, tunneling, landslide, land subsidence, foundations and building materials.

2101255 Introduction to Electrical, Mechanical and Environmental Engineering 2(2-0-4)
Basic concepts of electrical, mechanical and environmental engineering; fundamentals of structures, components and processes of each discipline; interrelationship between these engineering systems; practical application in buildings and civil works.

2101302 Materials Testing Laboratory 1(0-3-0)
Condition: Co-requisite 2101202
Behavior and testing of most construction materials such as metals, timber, brick, glass and synthetics.

2101307 Reinforced Concrete Design 4(3-3-6)
Structural behavior in thrust, flexure, torsion, shear, bond and interaction among these forces; analysis and design of reinforced concrete structural components by working stress and strength design methods; design calculations and construction drawings; application of graphs, tables, and computer software in design of reinforced concrete structures.

2101308 Mechanics of Materials II 3(3-0-6)
Condition: Prerequisite 2101202
Analysis flexural and shearing stresses in beams; composite beams; unsymmetrical bending; combined stresses and strains; buckling of columns; introduction to structural dynamics.

2101310 Structural Analysis I 3(3-0-6)
Condition: Prerequisite 2101202
Introduction to structural analysis; degree of statical indeterminacy and stability of structures; reactions, shears and bending moments in beams and rigid frames including deflected shapes; analysis of determinate plane trusses; responses of plane structures under moving loads by using influence lines; deflection analysis by method of moment-area and conjugate structures; deformation analysis of structures by virtual work and related energy methods; analysis of indeterminate structures by force method or flexibility method.

2101311 Civil Engineering Materials 4(3-3-6)
Condition: Prerequisite 2101202
Properties, behavior, and testing of civil engineering materials such as materials for concrete, materials for highway, steel, metal, wood, brick, tile, glass, plastic, rubber, composite materials, and other synthetic materials.

2101312 Structural Analysis II 3(3-0-6)
Condition: Prerequisite 2101310
Methods of structural analysis; slope-deflection method; moment distribution method; introductory plastic structural analysis; matrix structural analysis; introduction to finite element method in structural analysis.

2101321 Soil Mechanics 3(3-0-6)
Condition: Prerequisite 2101254 or 2106296
Formation of soils; soil classification; soil exploration; flow through porous media; stresses in a soil mass; stress-strain and strength properties of cohesionless soils; stress-strain and strength properties of cohesive soils; Terzaghi’s bearing capacity formula settlement; consolidation theory.

2101322 Soil Mechanics Laboratory 1(0-3-0)
Condition: Concurrent 2101321
Soil exploration; index properties of soils; permeability; compaction; CBR; stress-strain behavior of soils; shear strength and one dimensional consolidation.

2101335 Construction Supervision 2(2-0-4)
Construction methods; construction standards; components, methods, and procedures of construction supervision and inspection check list in foundation construction, structural and architectural works as well as infrastructure construction.
2101336 Reinforced Concrete Design 3(2-3-4)
Condition: Prerequisite 2101310
Structural behavior in thrust, flexure, torsion, shear, bond and interaction among these forces; analysis and design of reinforced concrete structural components by working stress and strength design methods; design calculations and construction drawings.

2101337 Transportation Engineering 3(3-0-6)
Introduction to transportation engineering; principles and concepts of transportation including transportation demand and supply; fundamental traffic operations and transportation system analysis; transportation economics, and transportation planning concepts.

2101338 Highway Engineering 3(2-3-4)
Condition: Prerequisite 2101337
Road and traffic systems; highway planning and development; traffic consideration; roadway design; road materials; highway construction and maintenance; highway safety management.

2101403 Timber and Steel Design 3(2-3-4)
Condition: Prerequisite 2101310
Design of timber and steel structures; tension and compression members; beam-columns; built-up members; plate girders; connections.

2101421 Geotechnical Engineering Design and Construction 3(3-0-6)
Condition: Prerequisite 2101321
Criteria in geotechnical engineering design; Terzaghi's bearing capacity formula design and construction of pile foundation and construction control; design and construction of retaining structures, sheet piles and diaphragm walls for excavation and filling; design of caisson and construction method; slope stability.

2101454 Construction Management 3(3-0-6)
Condition: Consent of Faculty
Construction industry; principles of management; construction organization; contracts and tendering; planning and control tools; feasibility study; cash-flow analysis; construction laws and regulations; safety in construction; construction finance and accounting; construction claims and disputes; arbitration.

2101455 Construction Engineering and cost Estimating 3(3-0-6)
Condition: Consent of Faculty
Principle of construction engineering, construction materials and methods, construction productivity; principle of cost estimating; approximate and detailed estimating; quantity takeoff; methods of measurement, labor and equipment costing.

2101460 Structural Steel Design 3(2-3-4)
Condition: Prerequisite 2101310
Design of steel structures; tension and compression members; beams and beam-columns; plate girders; bolted and welded connections and composite members.

2101461 Building Design 3(2-3-4)
Condition: Prerequisite 2101307 or 2101336
Design of reinforced concrete buildings of various types; structural systems; slab systems; frame analysis; interaction of frames and walls; walls; footings.

2101462 Prestressed Concrete Design 3(2-3-4)
Condition: Co-requisite 2101307 or 2101336
Concept and principles of prestressing; properties of relevant materials; prestressing systems; loss of prestress; analysis and design of statically determinate members; flexure, shear, bond, anchorage and bearing; moment-curvature analysis; deflections and camber; design for anchorage zone reinforcement prestressed concrete piles; introduction to post-tensioned concrete floor systems; construction site visit.

2101464 Bridge Design 3(2-3-4)
Condition: Prerequisite 2101307 and 2101336
Theories of load distribution and application; simply supported bridges in reinforced concrete, steel and prestressed concrete; statically indeterminate bridges; ultimate load method; bridge economy.

2101468 Reinforced Concrete Design Problems 1(1-0-3)
Condition: Co-requisite 2101336
Problems in design of reinforced concrete structures; application of graphs, tables and computer software in design of reinforced concrete structures.

2101495 Advanced Topics in Civil Engineering I 3(3-0-6)
Topics of current interest or new developments in various fields of civil engineering; A complete written report is required by the Department. A final oral examination is optional.

2101499 Civil Engineering Project 3(0-6-3)
Student shall carry out a practical project of interest on problems in various fields of civil engineering. The project is to be proposed by the student group and approved by the instructor and the Department. The work must be completed within one semester. A complete written report and a final oral examination are required.

2101510 Computer Methods for Civil Engineers 3(3-0-9)
Review of computer programming; elimination methods for linear equations; various decomposition and storage schemes, partial pivoting, errors and ill-conditioning; iterative methods for linear equations; iteration, Gauss-Seidel iteration and successive over-relaxation methods; interpolations and curve fitting; numerical integration; methods of successive approximations for buckling of columns and beam-columns; numerical solution of differential equations; finite difference solution of beams, plates and grids; solution of nonlinear equations; computer graphic. The emphasis is put on civil engineering application.

2101512 Advanced Concrete Technology 3(3-0-9)
Review of concrete technology; improvement of the quality of concrete by pozzolanic materials, mineral and chemical admixtures; high-performance concrete; fiber reinforced concrete; polymer concrete durable concrete; and other special concrete; repair and strengthening of concrete structures.
2101524 Computer Programming and Computer Tools for Graduate Research 3(3-0-9)  
Object-oriented programming using C++, event driven and GUI programming, data flow programming for data acquisition and automatic control in laboratory; use of MATLAB and Mathematica, numerical algorithm for linear system, numerical algorithm for non-linear system.

2101534 Computer Application for Geotechnical Engineering 3(3-0-9)  
Computer application for analyzing shallow foundation, slope stability, deformation and stability problems; analysis of tunnel lining and tunnel deformation due to adjacent construction activities.

2101535 Tunnel Engineering 3(3-0-9)  
History of tunneling; soil tunneling methods; types of linings and face support; stand-up times and tunnellman’s ground classification; groundwater control and soil modification methods; lining behavior and design; ground movements and changes of pore water pressure caused by tunnel construction; field observations. Monitoring, and instrumentation; building distortion/damage and relation to ground movements; fundamentals of tunnel engineering related to soil types and construction techniques; design of tunnel lining in various subsoil conditions; applications and techniques of tunnel construction for infrastructure systems.

2101536 Underground Construction 3(3-0-9)  
Condition : Consent of Faculty  
Soil investigation plans; soil profile; selection of soil properties; construction of shallow foundation construction of deep pile foundation; pile load test; pile integrity test; pilot pile test; blow count test; construction of basement by sheet pile bracing system; construction of deep basement by diaphragm wall system; caisson sinking in soft clay.

2101546 Introduction to Finite Element Method 3(3-0-9)  
Condition : Consent of Faculty  
Concepts of weak form of governing differential equation, weight residual method, minimization principle, equivalence between weak and strong forms, weak solution and its uniqueness; Galerkin approximation, space of test and trial functions, basis functions, quality and convergence of approximate solutions; finite element approximation, element-based shape functions, element stiffness matrix and load vector, matrix assembly procedure, treatment of boundary conditions, convergence of finite element solution; introduction to finite element method to two- and three-dimensional boundary value problems; applications of finite element programs to various boundary value problems in civil engineering.

2101550 Civil Engineering Project Planning 3(3-0-9)  
Condition : Consent of Faculty  
Concepts of civil engineering project planning; analysis; technical requirement; financial and economic feasibility; capital budgeting techniques; social and political impact considerations and environmental concern; multi-objective objective decision making.

2101551 Pavement Design 3(3-0-9)  
Condition : Consent of Faculty  
Principles of highway and airport pavement including pavement types and wheel loads; stresses in flexible and rigid pavements; consideration of properties of pavement components including the design test; methods of design of flexible and rigid pavement for highways and airports; methods of construction and maintenance.

2101553 Public Transit Systems Planning and Operations 3(3-0-9)  
Condition : Consent of Faculty  
Components of public transportation system; public transportation planning procedure; technological evolution of mass transit; selection of transit mode; transit station planning; basic operation elements; date collection and analysis; scheduling of service; fare policies; financing and cost structure of transit service.

2101554 Traffic and Parking Studies for Site Development 3(3-0-9)  
Condition : Consent of Faculty  
Survey and data collection for traffic studies; traffic forecasting methods; traffic impact studies; point of access studies; vehicular circulation analysis; parking studies; planning and design of parking facilities; legal requirements.

2101555 Travel Behavior Survey and Analysis 3(3-0-9)  
Condition : Consent of Faculty  
Dimensions and characteristics of urban travel; travel demand; theories of travel behavior; methodologies of travel survey; experimental design; theory of sampling; analytical methods in travel behavior research.

2101556 Air Transportation System 3(3-0-9)  
Condition : Consent of Faculty  
Introduction to air transportation; air transportation economics; air transportation supply: network and carrier; air transportation demand; passenger and cargo; air transportation planning and management; air transportation infrastructure.

2101557 Planning and Management of Airport System 3(3-0-9)  
Condition : Consent of Faculty  
Preparation of a layout and design of an airport system including studies of a proposed site; surface and subsurface drainage; runway and taxiway; grading plane and earthwork estimates; design of base courses and runway surfaces; accessory structures and lighting; airport operations.

2101558 Transportation and Logistics System Optimization 3(3-0-9)  
Condition : Consent of Faculty  
Introduction to modeling and operations research; linear programming; sensitivity analysis; integer programming; network optimization; heuristics; queuing system; applications of these tools to transportation and logistics problems.

2101559 Traffic Engineering 3(3-0-9)  
Condition : Consent of Faculty  
Theory of traffic flow, traffic studies, highway capacity analysis, traffic control devices, signal system, traffic system design and operations.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101605</td>
<td>Sustainable Transportation</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101601</td>
<td>Advanced Structural Theory</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101602</td>
<td>Behavior of Reinforced Concrete Members</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101603</td>
<td>Theory of Elasticity</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101604</td>
<td>Shell Structures</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101605</td>
<td>Stability of Structures</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101606</td>
<td>Dynamics and Vibrations</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101607</td>
<td>Advanced Mechanics of Materials</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101608</td>
<td>Plate Structures</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101609</td>
<td>Plastic Design of Steel Structures</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
<tr>
<td>2101610</td>
<td>Numerical and Approximate Methods of Structural Analysis</td>
<td>3(3-0-9)</td>
<td>Consent of Faculty</td>
</tr>
</tbody>
</table>

**Course Description in Civil Engineering (M.Eng, Ph.D.)**

**2101605 Sustainable Transportation** 3(3-0-9)
- Principles of sustainable transportation; social, economic, and environment components; planning; planning for sustainable transportation system; measures-public transport, non-motorized transport, and other innovative measures; mobility management; evaluation; institutional and regulatory issues.

**2101606 Dynamics of Structures** 3(3-0-9)
- Analysis of structural systems with single and multi degree of freedom; equations of motions; free and forced vibrations; vibration natural frequencies and mode shapes; energy theorems; numerical evaluation of dynamic response; response spectrum; modal response history and response spectrum analysis; response of inelastic SDF system; building codes on seismic design of structures.

**2101607 Rail Transport System** 3(3-0-9)
- This course covers the following topics: History of Rail Transport Development, Fundamental and Characteristics of Rail Operation, Rules of Safety, Composition of Rail System: infrastructure, Rolling Stock, Signaling and Communication, Case Studies of Rail Transport Development in Thailand and Neighboring Countries.

---

**2101601 Advanced Structural Theory** 3(3-0-9)
- Analysis of trusses; frames and arches; influence lines; continuous frame with non-prismatic members; building frames subjected to lateral loads; introduction to matrix analysis of structures.

**2101602 Behavior of Reinforced Concrete Members** 3(3-0-9)
- The behavior and strength of reinforced concrete members; beams subjected to pure bending, combined bending, and shear; columns under axial compression and eccentric loading; deflections; bond and cracking; review of research and pertinent literature; emphasis is placed on background, use and limitations of present design specifications.

---

**2101603 Theory of Elasticity** 3(3-0-9)
- Equations of equilibrium and continuity in elastic solid; two dimensional solutions of beams, wedges, disks and rings under various conditions of loading, strain concentration; strain energy methods of solution.

**2101604 Shell Structures** 3(3-0-9)
- Membrane theory of shells; rotation and translational shells; general theory of shells; axisymmetrical bending of shells of revolution; cylindrical shell roofs; prismatic shell roofs.

**2101605 Stability of Structures** 3(3-0-9)
- Buckling of concentrically and eccentrically loaded columns; lateral buckling of beams; built-up columns; stability of frameworks.

**2101606 Dynamics and Vibrations** 3(3-0-9)
- Analysis of system with single and multi degree of freedom; free and forced vibration; determination of natural frequencies of structures; distributed mass system; longitudinal and lateral vibration of flexural members; problems involving nonlinear force-displacement relation and damping.

**2101607 Advanced Mechanics of Materials** 3(3-0-9)
- Stress, strain, and displacement relationships; energy theorems; equilibrium and compatibility conditions; problems of plane stress and plane strain, beams on elastic foundation; beam-columns, flexure of curve members; torsion of non-circular and thin walled members, shear center, shear flow. Introduction to theorems of limit analysis.

**2101608 Plate Structures** 3(3-0-9)
- Differential equation for bending of plates; axisymmetrical bending of circular plates; orthotropic plates; combined action of lateral loads and in-plane forces; finite element method.

**2101609 Plastic Design of Steel Structures** 3(3-0-9)
- Ultimate load capacity of steel structures; method of analysis for structures in the plastic range; plastic design of continuous beams, frames, and connections. Secondary design problems to include the effect of shear and axial force upon plastic moment capacity.

**2101610 Numerical and Approximate Methods of Structural Analysis** 3(3-0-9)
- Numerical methods for system of linear equations; moments and deflections of beams, reciprocal relationship; buckling of axially loaded bars; approximate differentiation and integration; vibrations problems.

**2101611 Matrix Analysis of Structures** 3(3-0-9)
- Review of matrix algebra; matrix procedures for analysis of continuous beams, plane frames, space frames under static and quasi-static loading; stiffness and flexibility methods; techniques for solving large linear equation system; computer application.

**2101612 Experimental Structural Analysis** 3(2-3-7)
- Laboratory studies of structural models and components; experimental stress analyses; photoelastic method; electrical strain gauge and brittle lacquer methods.
2101614 Behavior of Steel Structures 3(3-0-9)
Researches which relate the basic behavior of structural steel members and frames to present design approximations. Discussions are emphasized on background, use and limitations of the current specifications.

2101615 Advanced Prestressed Concrete Structures 3(3-0-9)
Prestressing systems; behavior of prestressed concrete beams; moment-curvature relationship; load-deflection curves; ductility and fatigue; analysis and design of composite members, continuous flexural members, prestressed frames and segmental bridges.

2101616 Long Span Structural Systems 3(3-0-9)
Analysis and design of two-hinge ribbed and lamella arches, ribbed domes, two-way grid systems, space frames, and cable suspended systems.

2101617 Structural Building Components 3(3-0-9)
Analysis and design of structural components for buildings considering various types of construction materials; timber, metal, concrete, and synthetics. The components include floor systems, roof members, tilt-up walls, sandwich panels, precast members, bearing walls, shear walls and light-gauge steel members.

2101618 Finite Element Method for Civil Engineers 3(3-0-9)
Basic concepts of interpolation; finite element interpolation; introduction to the finite element techniques in mechanics; development of elements from various principles and application of the method to static continuum problems; convergence and compatibility requirement; assemblage of elements and boundary conditions; structure of a typical finite element computer program; introduction to the treatment of dynamics and stability and extension of the method to a generalized field problems; application in civil engineering problems.

2101619 Seismic Design of Structures 3(3-0-9)
Elementary engineering seismology; seismic waves; intensity and magnitude; response spectrum and design earthquakes; earthquake codes and analysis; response spectrum analysis; random vibrations; artificial generation of earthquake records; structural design and detailing for earthquake resistance of special structures: bridges, dams, and nuclear power plants.

2101620 Advanced Soil Mechanics I 3(3-0-9)
Soil formation; the nature of soil; stress within a soil mass; effective stress concept; stress-strain behavior; shear strength of cohesionless soil; one dimensional and two dimensional flow; theories of compressibility and consolidation; undrained and drained shear strength of cohesive soil; creep in soft soil.

2101621 Foundation Engineering 3(3-0-9)
Application of soil mechanics principles to stress distribution in earth masses; settlement analysis; bearing capacity of piles and caissons; lateral pressure for design of retaining walls, open cuts anchored bulkheads, cofferdams and culverts.

2101623 Field Exploration and Soil Testing 2(1-3-4)
Site investigation by conventional and geophysical methods; laboratory and field work in soil sampling, classification, and testing.

2101624 Elasticity in Soil Mechanics 3(3-0-9)

2101625 Soil Dynamics 2(2-0-6)
Vibration theory related to soils, soil structures and foundations, application to engineering design; foundations for dynamic loading including impact, pulsating and blast load.

2101626 Soil Stabilization 3(3-0-9)
Engineering properties of soils to be used as foundation and construction materials; the art of altering engineering properties of soils by means of mechanical, chemical, electrical and thermal stabilization, including dewatering, pile sinking techniques, underpinning and other special problems.

2101627 Engineering Geophysics 2(2-0-6)
Theory and application geophysics and geophysical methods as applied to civil engineering. Study of seismology, earth magnetic and electrical fields, gravity, and radioactivity. Conventional and geophysical methods of subsurface exploration and testing and identification of earth materials.

2101628 Advanced Soil Mechanics II 3(3-0-9)
Settlement analysis; shallow foundations; earth retaining structures structure and stability of slopes; normalized soil behavior concepts, measurement and selection of soil parameters for evaluation of stability of structures and predictions of pore pressure and untrained deformations.

2101629 Theoretical Soil Mechanics 3(3-0-9)
Stress and strain concepts; principal stresses and strains; invariants; octahedral stresses and strains; special matrices; plane stress; plan strain; stresses and displacements in soil mass as elastic body; yield criterion, theories of failure; plasticity; effect of wall movement surcharge on lateral earth pressures; bearing capacity and stability of slopes.

2101630 Physical and Mineralogical Properties of Soils 3(3-0-9)
Aspects of soil mineralogy and its composition applied to soil engineering problems; origin and occurrence of soils; nonclay minerals in soil; structures and properties of the clay minerals; classification and nomenclature of clay minerals; mineral identification; relations between soil composition engineering behavior.

2101631 Geomechanics 3(3-0-9)
General concept of numerical methods of soil mechanics; flow though porous media; finite element approaches to the problems of shallow foundation and deep foundation; one, two and three dimensional theories of consolidation.
2101632 Rock Mechanics 3(3-0-9)
Rock formation; mechanical properties of rock; stability of rock slopes, underground rock chambers; rock falls, ruptures of rock and methods of improving the properties of rock mass.

2101633 Advanced Engineering Geology 2(2-0-6)
Advanced study of soil and rock mechanics related to geological structures, site investigation by geological and geophysical methods, surveying of construction materials for civil engineering work.

2101634 Plasticity in Soil Mechanics 3(3-0-9)
General stress-strain behavior; yield criterion; limiting equilibrium equations; integration of a system of two partial differential equations; solution of Christianovitch on the weightless and purely cohesive soil; determination of stress exerted on the wall.

2101636 Interpretation of Field Exploration and Soil Testing 3(2-3-7)
Fundamentals of field exploration; necessity of field exploration, scope of exploration and related field tests; interpretation of field exploration report, concepts and methodologies of soil testing; tests for basic soil properties, advanced soil testing, selection of proper testing methods, interpretation of test results.

2101637 Advanced Soil Mechanics 3(3-0-9)
Soil classification, index properties, weight-volume relationship, permeability and seepage analysis, stress within soil mass, elastic solutions for stress, shear strength behavior and Mohr-Coulomb failure criteria, stress paths, deformation behavior, consolidation theory, secondary compression, settlement prediction.

2101639 Special Study in Soil Engineering 3(3-0-9)
Contemporary topics in soil engineering.

2101640 Highway Planning and Economics 3(3-0-9)
Principle of highway planning, finance, economics, and programming of improvements; highway need studies and highway facility studies for regional highway planning.

2101641 Traffic Engineering 3(2-3-7)
Analysis of traffic problems including filed studies; surveys and the interpretation of survey data; regulation and control methods and equipment’s

2101642 Geometric Design of Highways 3(3-0-9)
Design control and criteria; design speed, horizontal alignment, vertical alignment, cross section, geometric design of intersections at grades and interchanges.

2101644 Urban Transportation Planning 3(3-0-9)
Transportation systems and characteristics of traffic flow in urban areas; planning of urban transportation facilities; mathematical models for prediction of traffic flow; interrelationship of landuse and transportation.

2101645 Traffic Flow Theory 3(3-0-9)
Application of theoretical approaches to traffic engineering; integration mathematics, probability, control theory, experimental psychology and physical analogies as a means of describing vehicular traffic flow and providing an insight into contemporary traffic research procedures.

2101647 Public Transportation Planning 2(2-0-6)
Engineering problem in the mass movement of people in metropolitan areas; demand in relation to level of service, equipment, routes; running time and station spacing.

2101648 System Transportation Modeling 2(2-0-6)
An indepth study of data gathering and processing, trip general model using regression theory, trip distribution model using gravity model and abstract mode model; modal split, traffic assignment and evaluation process.

2101649 Probability Statistics and Decision for Civil Engineering 3(3-0-9)
Elements of probability theory; common probability model; probabilistic model and observed data; elementary Bayesian decision theory; analysis of independent random process.

2101650 Transportation Technology 3(3-0-9)
Multimodal transportation planning and facilities design; discussion of topics of special interest in transportation planning, including evaluation techniques, social and environmental problems in system design, and technology of transportation.

2101651 Traffic Characteristics and Operations 3(3-0-9)
Driver and vehicle characteristics affecting traffic flow; flow and capacity characteristics; statistical properties of traffic; safety analysis; headway and speed measurement; signing and signal control for efficient intersection control; parking characteristics and capacity analysis.

2101653 Computer Models in Transportation 3(2-3-7)
Analytical models and practical tools for planning and analysis of transportation supply; computer application in design and analysis of transportation networks; planning and analysis of transportation facilities. And routing and scheduling of transportation resources.

2101654 Computer Models in Transportation 3(2-3-7)
Introduction to engineering for disaster management and resilience: earthquake disasters-case studies and lessons from earthquake disasters learnt; seismic design concept; tsunami disaster-modeling, early warning system, and preparedness: field trips to disaster prone areas.

2101655 Civil Engineering and Disaster Recovery 2(2-0-6)
Problems and remedy measures of civil works after natural disaster, case studies from various countries, disaster management related to structures damaged by natural disaster, recovery of landslide induced by natural disaster, field trip to some organizations related to disaster recovery management or sites under.
2101656 Disaster Damage Mitigation and Recovery Management 2(2-0-6)
Mitigation of disaster damage; hazard maps; crisis control: basic principles and management learning for business continuity: structural and non-structural mitigation measures from the viewpoint of the government to that of local communities: disaster recovery: communication and recovery technologies; case studies.

2101660 Transportation Systems 3(3-0-9)
Introduction to transportation; importance of transportation in the economy; development of transportation technology; roles of public and private sectors; transportation organizations; transportation system components and functions; types of transportation; modes of transportation; key characteristics of transportation modes; intermodal transportation; general and mode-specific policy issues; social, economic, and political issues; careers in transportation sector.

2101661 Transportation Planning and Policy 3(3-0-9)
Policy context and transportation planning; decision making tools in transportation planning; modeling techniques in transportation; introduction to transportation economics; the four-step planning process and its limitation; alternative modeling approaches; transportation planning ethics.

2101662 Methods for Transportation Analysis 3(3-0-9)
Mathematical and statistical methods for transportation analysis; basic probability models and statistical analysis; introduction to mathematical programming; decision analysis; decision analysis, optimization and simulation.

2101664 Transportation Operations 3(3-0-9)
Techniques in transportation operational analysis, space-time diagram, cumulative plots, queuing theory, traffic flow theory, traffic control, transportation scheduling, operations of transportation terminals.

2101665 Highway Design 3(3-0-9)
Highway design procedures; basic design policies; geometric design and structure standards; cross section; design of traffic interchanges and intersections; highway capacity analysis; analysis of freeway and highway facilities; design of traffic control devices.

2101666 Transportation Systems 3(3-0-9)
The use of advanced surveillance, navigation, communication, and computer technology to monitor, analyze, and improve the performance of transportation systems; enabling technologies: application of technology technology to monitoring, analysis, evaluation, and prediction of transportation system performance and behavior, feasibility studies; human factors and institutional issues.

2101667 Logistics System Analysis 3(3-0-9)
Fundamentals of logistics management, framework for logistics system analysis, logistics system modeling, logistics network design, distribution planning and management, transportation system and operation analysis.

2101668 Evaluation of Transportation Project and Policy 3(3-0-9)
Basic microeconomics; Applications of microeconomic principles for transportation policy analysis; Evaluation of transportation projects and financing alternative.

2101669 Transport Policy 3(3-0-9)
Major policies concerning the transportation-related aspects of the environment, energy, economic development, community mobility/accessibility, freight transportation, advanced transportation systems, transportation safety and social justice; basic concepts in transportation policy formulation, research design and evaluation of legislation analysis and tracking, decision-making methods, public participatory techniques, transportation policy evaluation principles and methods.

2101670 Applied Mathematics I 3(3-0-9)
Ordinary equations; Fourier series; introduction to Fourier and Laplace transforms and some applications to boundary value problems; vector analysis; matrices and linear equations.

2101671 Applied Mathematics II 3(3-0-9)
Partial differential equations and boundary value problems; special functions; integral transform, calculus of variations and complex variables with emphasis on civil engineering applications.

2101683 Experimental Problems in Civil Engineering 3(2-3-7)
A variety of experimental and analytical techniques applied to problems in civil engineering; field and laboratory observation employing strain gauges, mechanical and electrical equipment, static and dynamic instrumentation.

2101685 Structural Limit Design 3(3-0-9)
Limit analysis theory. Application to continuous beams and frames; control of deflection and cracking; yield line analysis by virtual work and equilibrium methods; application to slab of various types; Hillerbor's strip method.

2101690 Construction Methods and Equipment 3(3-0-9)
Preparation of construction schedules; various types of construction; earth; concrete; underground, foundation; job facilities.

2101691 Special Studies 3(3-0-9)
Basic knowledge of research methodology in construction engineering and management; development of research topics and statement of research problem; techniques for literature review; academic and research writing; research methods and techniques; data collection; analysis of data and presentation; qualitative and quantitative research.

2101692 Analytical Methods in Construction Management 3(3-0-9)
Analytical method used in modern construction management from both builders' and owners' view;
techniques and methods applied from cost engineering, optimization techniques and work improvement; the use of modeling techniques as a tool for rational decision-making in construction environment from project conception to completion.

2101693 Problem Analysis in Construction Industry 3(2-3-7)
Various levels of management problems in construction industry; organization; planning and control of construction’s production process, marketing, labor, and legal issues; investigation and practice of problem-solving by participating in real-world problems of construction industry.

2101694 Contracting in Construction Business 3(3-0-9)
Basic principle of civil law; contracting law; various types of construction contracts; contract clauses affecting construction performances; FIDIC standard contract; standard method of measurement; criminal law related to construction.

2101695 Computer Applications in Construction 3(3-0-9)
A broad range of computer applications in construction with emphasis on engineering management, computer hardware and software components; operating, operating systems, programming language, and information technology; analysis, design, development and implementation of microcomputer-based system including spreadsheet, database and CAD for CM; the effective utilization of various construction management software; conception of decision support system.

2101696 Project Planning and Control 3(3-0-9)
Analytical techniques for planning and controlling the design and construction of project with emphasis on scheduling techniques and quality management system including planning with charts, critical path methods (CPM), resource allocation and leveling, time/cost trade-offs, cash flow analysis, and quality control/quality assurance.

2101697 Infrastructure Planning and Management 3(3-0-9)
An integrated approach to the planning, construction, operation, and maintenance of infrastructure through an understanding of the performance of infrastructure and life-cycle cost evaluation; approaches the management, available technologies, and decision supporting tools in infrastructure and facility planning and management; economic framework for identifying and analyzing investment and operations options; relevant issues such an environment, laws, and regulations.

2101698 Construction Business Management 3(3-0-9)
Construction organization strategic construction business development; marketing plan, operational plan. Financial planning and business valuation, quality control and management; construction process improvement.

2101699 Construction Systems Optimization and Simulation 3(3-0-9)
Systems analysis applied to modern construction engineering and management from both owner's and contractor's views; civil systems modeling and optimization techniques; applications of decision analysis and risk analysis; simulation techniques; computer programs for

2101721 Offshore Structural Engineering 3(3-0-9)
Physical environmental aspects of marine and offshore construction; wave, wind and current forms and conditions; geotechnical aspects of offshore construction; offshore site investigation; material and fabrication for marine structures; offshore structure and foundation design; produce, methods and equipment offshore construction.

2101790 Seminar in Civil Engineering I 1(0-3-1)
Review and discussion of problems and progresses in civil engineering by staff members, students, and participants.

2101791 Seminar in Civil Engineering II 3(0-9-3)
Discussion special topics related to advanced civil engineering; analysis of data, conclusion, and report presentation.

2101792 Seminar in Civil Engineering III 3(0-9-3)
Discussion of special topics related to advanced civil engineering concerning research projects; analysis of data, conclusion, and report presentation.

2101793 Graduate Seminar in Civil Engineering 0(0-0-0)
Self studies on the topics provided by the Division; oral presentation of the study outcome in conjunction with technical papers as wall as answers to technical questions and comments from the audience; special lectures by guest speakers.

2101800 Advanced Solid Mechanics 3(3-0-9)
Review of basic principles of solid mechanics; plane problems in linear elasticity, green’s functions for point loads on surface of semi-infinite plane; rigid punch problems; green’s function for point load in infinite plane; edge dislocations and cracks, Williams asymptotic expansion, stress intensity factors; complex variable representations for anti-plane shear and plane problems; three-dimensional linear elasticity, stress functions; representations of displacement field; green’s functions of infinite and semi-infinite spaces, rigid punch problem, Hertz problem, Eshelby’s equivalent method; introduction to composite media, macroscopic measures of stress and strain, averaging theorem, overall properties of multi-phase media; Somigliana’s identity, boundary integral equations for two and three-dimensional linear elasticity.

2101801 Fracture Mechanics 3(3-0-9)
Introduction to fracture mechanics, stress analysis of linear elastic cracked bodies, the stress field theory of fracture, the energy concepts on fracture, numerical and experimental determination of fracture properties, effects of variables on fracture toughness, fracture mechanics design, and elasto-plastic fracture; analysis of simple two-dimensional fracture problems; introduction to fatigue, fatigue crack growth, fracture criteria, and fracture control plans.

2101802 Inelastic Behavior of Materials 3(3-0-9)
Review of basic principles of solid mechanics; introduction to inelastic behavior of materials, aspects of material behavior and evidences from experiments;
nonlinear elasticity, total deformation theory for plasticity, J2 total deformation theory; incremental theory of plasticity, concept of yield surface, plastic flow rule, consistency condition, J2 flow theory, isotropic hardening; plasticity with nested yield surfaces, plasticity with a bounding surface; formulation of boundary value problems in plasticity, minimum principles, solutions of simple BVPs in plasticity; pressure-sensitive materials, time dependent materials; application of inelastic material behavior in finite element analysis, radial return method.

2101803 Nonlinear Analysis in Structural Mechanics 3(3-0-9)
Finite strain mechanics; total Lagrangian and updated Lagrangian finite element formulation, nonlinear solution methods, large displacement behavior of structures and large displacement analysis of structural problems, finite element formulation of inelastic problems.

2101804 Behavior of Reinforced Concrete Structure 3(3-0-9)
The behavior and strength of reinforced concrete structures subjected to flexure shear, torsion, axial and eccentric loading; determination of deflections, bond and cracking, review of research and pertinent literature, with emphasis on background, structural models, the performance and criteria approach of present design codes and specifications.

2101805 Limit State Design of Concrete Structures 3(3-0-9)
Limit state design criteria; structural reliability, structural behavior in flexure, shear, torsion, compression and bond; structural design for slab, frame, column, footing, and others; determination of serviceability limit states for structural performance.

2101806 Numerical and Approximate Methods For Structural Engineering 3(3-0-9)
Introduction to numerical computing; numerical methods for system of linear equations; numerical methods for linear least square problems; numerical methods for eigen value problem; numerical methods for system of nonlinear equations; method of interpolation; numerical integration and differentiation; approximate method for boundary value and initial value problems; introduction to optimization; applications to structural engineering problems.

2101810 Fire Safety Design of Structures 3(3-0-9)
Fire safety engineering; behavior of natural fires; properties of materials at elevated temperatures; design and detailing of structural elements for fire safety; design of frames for fire safety; assessment and repair of fire-damaged structures.

2101817 Structural Testing and Evaluation 3(3-0-9)
Concept of structural testing and evaluation; destructive and non-destructive testing; structural models and components for testing; full scale testing; testing standards; equipment and measurement techniques; date analysis and evaluation of structural performance.

2101818 Life Cycle of Concrete Structures 3(3-0-9)
Life Cycle and structural performance; importance and necessity of maintenance of structures; concrete deterioration mechanism and its prediction; concrete evaluation; remedial measures; surface repair; strengthening and stabilization; examples of management system for maintenance.

2101820 Geo-Environment Engineering 3(3-0-9)
Solid wastes management, waste compositions, design and monitoring of landfills, contaminant transports, fate transports, and soil remediation techniques.

2101821 Deep Foundation Design 3(3-0-9)
Behavior of pile foundation, estimating pile capacity, driven and bored pile grouting and non grouting behavior, pile driving analysis, pile integrity and sonic logging test, pile load test, Design of pile foundation, settlement analysis

2101824 Finite Element Method in Geotechnical Engineering 3(3-0-9)
Application of elastic wave and electricity for ground prospecting, Reflection survey, Refraction survey, Surface wave method, down-hole, up-hole and cross hole; Resistivity method for ground prospecting; Electro-magnetic prospecting.

2101831 Engineering Ground Modification 3(3-0-9)
Revision of mathematics and continuum mechanics, principle of finite element method, element discretisation, displacement functions and iso-parametric elements, element equation, numerical integration, direct stiffness assembly method, weighted residual and variational method, boundary conditions, solution methods, non-linear and dynamic problem.

2101832 Engineering Geophysics 3(3-0-9)
Aspects of soil mineralogy and its composition applied to soil engineering problems; origin and occurrence of soils; non-clay minerals in soil; structure and properties of the clay minerals; classification and nomenclature of the clay minerals; mineral identification; relation between soil composition engineering behaviors; Soil compaction, lime/cement-soil mixing behavior, preloading and prefabricated vertical drain (PVD) technique, cement grouting, cement columns, geotextile and geosynthetic.

2101833 Soil Dynamics and Earthquake Engineering 3(3-0-9)
Earthquake mechanisms, earthquake magnitude and energy, strong ground motions, seismic hazard assessment, wave propagation theory, basic soil dynamics, effects of earthquakes in geotechnical aspects; liquefaction, dynamic bearing capacity and lateral earth pressure.

2101834 Earth and Retaining Structure 3(3-0-9)
Slope stability problems, methods of slope stability analysis; Slope stability analysis under drained/undrained conditions and with/without ground water seepage; field stability observations using geotechnical instrument; Introduction to earth pressures; lateral earth pressure theories; analysis and design of retaining wall.
2101835 Earth and Retaining Structures 3(3-0-9)
Slope stability problems; methods of slope stability analysis; slope stability analysis under drained/undrained conditions and with/without groundwater seepage; field stability observations using geotechnical instruments; introduction to earth pressures; lateral earth pressures; lateral earth pressure theories; analysis and design of retaining wall.

2101840 Traffic Modeling and Simulation 3(3-0-9)
Traffic microsimulation fundamentals; the use of transportation and traffic simulation and modeling software; data collection and preparation; base model development; model calibration; interpretation of outputs; related statistical analysis.

2101841 Special studies in Transportation Engineering 3(3-0-9)
Individual’s problem solving in transportation engineering.

2101842 Advanced Transportation and Logistics System Optimization 3(3-0-9)

2101844 Road Safety 3(3-0-9)
Accident characteristics; sources of road traffic accidents; road safety indicators; statistical methods in traffic safety analysis; safety management system; road safety audit; counter measures; current research in road safety.

2101845 Advanced Pavement Design 3(3-0-9)
Advanced theorem of pavement design and method for evaluation of damage caused by heavy wheel load impacts on pavement containing excess water.

2101846 Railway Engineering 3(3-0-9)
Historical development of railways; principles of railway planning; geometric design; track structure; rolling stocks; signaling and operating system; financing and economics of railway development project; construction and maintenance of railway.

2101870 Construction Project Management 3(3-0-9)
Concept of construction project management, planning and scheduling techniques, estimating, and cost control techniques for construction projects; work breakdown structure; progress monitoring; construction resource management; project risk management; project quality control and quality assurance; new project management techniques.

2101871 Risk Management in Civil and Environmental Engineering Systems 3(3-0-9)
Fundamental concepts of risk, risk management process, risk analysis, risk response, risk monitoring and evaluation, risk management tools and techniques, reliability of civil and environmental engineering system, risk benefit assessment, acceptable risk, risk management system, applications and case studies in civil and environmental engineering systems.

2101873 Special Topics in Construction Engineering and Management 3(3-0-9)
Advanced topics in construction engineering and management; lean construction; advanced construction estimating.

2101811 Thesis 12 Credits

2101828 Dissertation 48 Credits

2101896 Comprehensive Examination 0(0-0-0)

2101897 Qualifying Examination 0(0-0-0)

2101894 Doctoral Dissertation Seminar 0(0-0-0)

2101896 Comprehensive Examination 0(0-0-0)
Comprehensive examination in Infrastructure in Civil Engineering; writing and oral examination.
DEPARTMENT OF ELECTRICAL ENGINEERING

The undergraduate curriculum is designed to provide students with a broad and firm foundation in physical science and electrical engineering, which is essential for an electrical engineering pursuing his/her career as a practitioner or researcher. Electrical engineering courses begin in the sophomore year with electric circuits, electrical machines and electromagnetic. During the junior year, the students have to study further fundamental subjects related to electrical power, electronics, communications, and control systems. Courses in engineering mathematics are also included in the curriculum to strengthen the students ability in analysis. During the senior year, students can select their specialization by taking subjects from the approved elective list as well as the Electrical Engineering Project. Laboratory works in various disciplines of electrical engineering are included in the curriculum. The objective of these courses is to develop the students' skills in operating test equipment, resourcefulness in solving practical problems, and ability to analyze test results.

The Department of Electrical Engineering offers two graduate programs leading to the degree of Master of Engineering and the degree of Doctor of Philosophy. For Master degree, the applicant must hold a Bachelor's Degree either in Electrical Engineering or in related fields of study and must also meet the requirements of the Graduate School.

The program consists of 36 credits, of which 3 are required core courses in applied mathematics, 9 are major requirement, 6 required elective courses in related fields, and 18 are thesis.

The major requirement consists of 12 strategic research areas (SRA) namely:
1. Advanced Control and Optimization
2. Biomedical Engineering
3. Embedded Systems and Robotics
4. High Voltage Engineering
5. Industrial Instrumentation
6. Microwave and Lightwave Communications
7. Multimedia and Signal Processing
8. Nanoelectronics and Photonics
9. Optoelectronics
10. Power Electronics
11. Power and Energy Systems
12. Telecommunications and Information Networking

For Ph.D. Program, the applicant must meet one of the following requirements:
1. The applicant who holds a Bachelor's Degree in Electrical Engineering must obtain the second honor degree or the minimum 3.25 grade point average and must also meet the requirement of the Graduate School.
2. The applicant who holds a Master's Degree in Electrical Engineering must obtain good or excellent in master thesis and must also meet the requirement of the Graduate School.

Moreover, each student has to pass the following requirements in order to achieve his or her study:
1. For the applicant who holds a Master’s Degree with more than 3.5 grade point average, must take credits from the seminar and listed elective courses with the approval of the major advisor.
2. For the applicant who holds a Master’s Degree with grade point average less than 3.5, is required to pass at least 12 credits from the listed elective courses with the approval of the major advisor and the seminar courses.

In addition to fulfilling the course requirement, the student is required to submit a thesis of 48 credits, satisfactorily pass an oral examination and one part or more of the thesis has been accepted to be published in international journal.

1. The applicant who holds a Bachelor’s degree is required to pass 24 credits from the listed elective and the seminar courses with the approval of the major advisor.

In addition to fulfilling the course requirement, the student is required to submit a thesis of 48 credits, satisfactorily pass an oral examination and one part or more of the thesis has been accepted to be published in international journal.
HEAD:
Komson Petcharaks, Dr.Sc. Techn. (Swiss Federal Inst. of Tech. Zurich)

PROFESSORS:
Bundhit Eua-arporn, Ph.D. (London)
David Bangerdpongchaisi, Ph.D. (Stanford)
Somsak Panyakeow, D.Eng. (Osaka)
Boonchai Techanumrit, D.Eng. (Kyoto)

ASSOCIATE PROFESSORS:
Chedsada Chinrungrueng, Ph.D. (U.C. Berkeley)
Chaodit Aswakul, Ph.D. (London)
Duang-nudee Wonglumsom, Ph.D. (Stanford)
Kulyos Audomwongsere, Ph.D. (Tokyo)
Lunchakorn Wuttisittikulkij, Ph.D. (Essex)
Mana Sryudthasak, D.Eng. (T.I.T.)
Nisachon Tangsangiumvisai, Ph.D. (London)
Prasit Teekaput, Ph.D. (VPI & Su)
Somchai Ratanathammaphan, D.Eng. (Chula)
Songphol Kanjanachuchai, Ph.D. (Cambridge)
Thavatchai Tayjasanant, Ph.D. (Alberta)
Watit Benjapolakul, D.Eng. (Tokyo)
Watcharapong Khovidhungiy, Ph.D. (UCLA)

ASSISTANT PROFESSORS:
Arporn Teeramongkonrasmee, Ph.D. (Chula)
Cherdkul Sopavanit, M.Eng. (Chula)
Chaiyachet Saivichit, Ph.D. (London)
Charnchai Pluemphitiwiyawet, Ph.D. (Carnegie Mellon)
Chanchana Tangwongsan, Ph.D. (Wisconsin)
Charin Wissawinthanon, Ph.D. (Minnesota)
Komson Petcharaks, Dr.Sc. Techn. (Swiss Federal Inst. of Tech. Zurich)

LECTURERS:
Apiwat Lek-Uthai, Dr.Ing. (Karlsruhe)
Buncha Yu Supmonchaisi, M.Eng. (Chula)
Channarong Banmongkol, D.Eng. (Nagoya)
Jakapan Lee, M.Eng. (T.I.T)
Somboon Chongchaikit, Dr.Ing. (Paris XI)
Panuwat Janpugdee, Ph.D. (USA)

Sotdhipong Phichaisawat, Ph.D. (Brunel, UK)
Surechai Chaitusaney, Ph.D. (Tokyo)
Suchin Arunsawatwong, Ph.D. (Manchester)
Suree Pumrin, Ph.D. (Washington)
Supatana Auethavekiat, Ph.D. (Tokyo)
Surapong Suwankawin, Ph.D. (Chula)

Suvit Nakpeerayuth, M.Eng. (Chula)
Somboon Sangwongwanich, D.Eng. (Nagoya)
Taptim Angkaew, D.Eng. (Osaka)
Wanchalerm Pora, Ph.D. (London)
Weerapun Rungseevijitprapa, Dr.-Ing. (Hannover)
Widhyakorn Asdornwised, D.Eng.(Chula)
### Electrical Engineering Curriculum

#### First Year Curriculum

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102201</td>
<td>ELECTRICAL ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>2102203</td>
<td>PROBABILITY AND STATISTICS FOR ELECTRICAL ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>2102209</td>
<td>ELECTRICAL ENGINEERING ESSENTIALS</td>
<td>3</td>
</tr>
<tr>
<td>2102213</td>
<td>CIRCUIT THEORY I AND LABORATORY</td>
<td>4</td>
</tr>
<tr>
<td>2103213</td>
<td>ENGINEERING MECHANICS I</td>
<td>3</td>
</tr>
<tr>
<td>2301207</td>
<td>CALCULUS III</td>
<td>3</td>
</tr>
<tr>
<td>2102202</td>
<td>ELECTRICAL ENGINEERING MATHEMATICS II</td>
<td>3</td>
</tr>
<tr>
<td>2102214</td>
<td>CIRCUIT THEORY II AND LABORATORY</td>
<td>3</td>
</tr>
<tr>
<td>2102222</td>
<td>ENGINEERING ELECTROMAGNETICS</td>
<td>3</td>
</tr>
<tr>
<td>2102253</td>
<td>ELECTRICAL MACHINES I AND LABORATORY</td>
<td>4</td>
</tr>
<tr>
<td>5500208</td>
<td>COMMUNICATION AND PRESENTATION SKILLS</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION II</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102311</td>
<td>ELECTRICAL MEASUREMENT AND INSTRUMENTATION</td>
<td>3</td>
</tr>
<tr>
<td>2102333</td>
<td>LINEAR CONTROL SYSTEMS I AND LABORATORY</td>
<td>4</td>
</tr>
<tr>
<td>2102360</td>
<td>ELECTRICAL POWER SYSTEM I</td>
<td>3</td>
</tr>
<tr>
<td>2102385</td>
<td>SEMICONDUCTOR DEVICES I</td>
<td>3</td>
</tr>
<tr>
<td>2102387</td>
<td>FUNDAMENTALS OF DIGITAL SYSTEMS AND LABORATORY</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION II</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102308</td>
<td>PROPERTIES OF ELECTRICAL ENGINEERING MATERIALS</td>
<td>3</td>
</tr>
<tr>
<td>2102371</td>
<td>PRINCIPLES OF COMMUNICATIONS AND LABORATORY</td>
<td>3</td>
</tr>
<tr>
<td>2102386</td>
<td>ELECTRONIC CIRCUITS AND LABORATORY</td>
<td>4</td>
</tr>
<tr>
<td>2102xxx</td>
<td>APPROVED ELECTIVES GROUP I</td>
<td>6</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION III</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102490</td>
<td>ELECTRICAL ENGINEERING PRE-PROJECT</td>
<td>1</td>
</tr>
<tr>
<td>2102xxx</td>
<td>APPROVED ELECTIVES GROUP I</td>
<td>6</td>
</tr>
<tr>
<td>2102xxx</td>
<td>APPROVED ELECTIVES GROUP I (LAB)</td>
<td>3</td>
</tr>
<tr>
<td>2102xxx</td>
<td>APPROVED ELECTIVES GROUP II</td>
<td>3</td>
</tr>
<tr>
<td>5500308</td>
<td>TECHNICAL WRITING FOR ENGINEERING</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102499</td>
<td>ELECTRICAL ENGINEERING PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVES GROUP II</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION IV</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Summer Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102499</td>
<td>ELECTRICAL ENGINEERING PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVES GROUP II</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION IV</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Total Credits for Graduation = 144
### Approved elective courses

<table>
<thead>
<tr>
<th>Category</th>
<th>Power</th>
<th>Control</th>
<th>Communications</th>
<th>Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>(At least 15 Breadth group 1 credits)</td>
<td>2102356 Electrical Machines II (3)</td>
<td>2102401 Random Processes for EE (3)</td>
<td>2102322 Telecommunication Transmission (3)</td>
<td>2102444 Introduction to Embedded Systems (3)</td>
</tr>
<tr>
<td></td>
<td>2102446 Fundamental of Power Electronics (3)</td>
<td>2102432 Linear Control Systems II (3)</td>
<td>2102423 Digital Signal Processing (3)</td>
<td>2102446 Fundamental of Power Electronics (3)</td>
</tr>
<tr>
<td></td>
<td>2102458 High Voltage Engineering I (3)</td>
<td>2102433 Digital Control Systems (3)</td>
<td>2102425 Data Communications (3)</td>
<td>2101447 Electronic Engineering Laboratory (1)</td>
</tr>
<tr>
<td></td>
<td>2102461 Electrical Power Systems II (3)</td>
<td>2102435 Industrial Automation (3)</td>
<td>2102472 Fundamental of Digital Communication(3)</td>
<td>2102488 Semiconductor Devices II (3)</td>
</tr>
<tr>
<td></td>
<td>2102459 High Voltage Engineering Laboratory (3)</td>
<td>2102436 Control and Instrumentation</td>
<td>2102473 Communication Engineering</td>
<td>2102489 Principle of Analog Circuit Design (3)</td>
</tr>
<tr>
<td></td>
<td>2102465 Electrical Power Laboratory (1)</td>
<td></td>
<td>Laboratory (1)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(At least 6 Credits)</td>
</tr>
</tbody>
</table>

**Notes**

A student must select 2 fields in the approved elective courses from Breadth group 1, with a minimum of 2 subjects in each selected field.

The total credits for approved elective group 1 must be at least 15.

In case, the student selects 2102401 RANDOM PROCESSES FOR EE and/or 2102446 FUNDAMENTAL of POWER ELECTRONICS, and/or 2102307 SIGNALS AND SYSTEMS he or she can declare them only in one field.

A student must select courses from Depth group 2 with a total of at least 6 credits.

The approved elective courses groups 1 and 2 can also be selected as free elective course(s).
NAME OF THE DEGREE
: Master of Engineering
: M. Eng.

PROFESSORS :
Bundhit Eua-arporn, Ph.D. (London)
Boonchai Techaumnat, D.Eng. (Kyoto)
David Banjerdpongchai, Ph.D. (Stanford)
Somsak Panyakeow, D.Eng. (Osaka)

ASSOCIATE PROFESSORS :
Chedsada Chirungrueng, Ph.D. (UC Berkeley)
Chaodit Saivichit, Ph.D. (London)
Duang-rudee Wonglumsom, Ph.D. (Stanford)
Kulyos Audomvongseree, Ph.D. (Tokyo)
Lunchakorn Wuttisittikulkij, Ph.D. (Essex)
Mana Sriyudthsak, D.Eng. (T.I.T.)
Nisachon Tangsangiumvisai, Ph.D. (London)
Prasit Teekaput, Ph.D. (VPI & Su)
Somchai Ratanathammaphan, Ph.D. (Chula)
Watit Benjapolakul, D.Eng. (Tokyo)

ASSISTANT PROFESSORS :
Arporn Teeramongkonrasmee, Ph.D. (Chula)
Cherdik Sopavanit, M.Eng. (Chula)
Chaiyachet Saivichit, Ph.D. (London)
Chanchana Tangwongsan, Ph.D. (Wisconsin)
Chompoon Songsiri, Ph.D. (UCLA)
Komson Petcharaks, Ph.D. (UCLA)
Manop Wongsaisuwan, D.Eng. (T.I.T.)
Naeboon Hoonchareon, Ph.D. (Purdue)
Pasu Kaewplang, Ph.D. (Chula)
Supavadee Aramvith, Ph.D. (Washington)
Sudhipong Phichaisawat, Ph.D. (Brunel, UK)
Suchin Arunsawatrong, Ph.D. (Manchester)
Suree Pumrin, Ph.D. (Washington)
Supatana Auehtheakiat, Ph.D. (Tokyo)
Surapong Suwankawin, Ph.D. (Chula)
Suvit Nakpeerasuth, M.Eng. (Chula)
Surachai Chaitusaneey, Ph.D. (Tokyo)
Somoon Sangwongwanich, D.Eng. (Nagoya)
Taptm Angkaew, D.Eng. (Osaka)
Wanchalerm Pora, Ph.D. (London)
Weerapun Kunseelittrapa, Dr.-Ing. (Hannover)
Widhyakom Asdomwised, D.Eng. (Chula)

LECTURERS :
Apiwat Lek-Uthai, Dr.Ing. (Karlsruhe)
Buncha Supmonchai, M.Eng. (Chula)
Channarong Banmongkol, D.Eng. (Nagoya)
Jaikanap Lee, M.Eng. (T.I.T.)
Somboon Chongchalik, Dr.Ing. (Paris XI)
Panuwat Janpugdee, Ph.D. (USA)

COURSE REQUIREMENTS

1. Required Courses
   (1.1) Core Course 3 credits from
   2102502 Random Signals and Systems 3(3-0-9)
   2102504 Introduction to Mathematical Analysis 3(3-0-9)
   2102505 Introduction to Optimization Techniques 3(3-0-9)
   2102507 Computational Techniques For Engineers 3(3-0-9)

   (1.2) 2102790 Electrical Engineering Seminar 2(2-0-6)

2) Elective Courses 9 credits from
   - Advanced Control and Optimization
     2102311 System Identification 3(3-0-9)
     2102536 Nonlinear Control Systems I 3(3-0-9)
     2102631 Optimal Control Systems 3(3-0-9)
     2102632 Stochastic Control Systems 3(3-0-9)
     2102635 Control System Theory 3(3-0-9)
     2102637 Multivariable Control Systems 3(3-0-9)
     2102638 Nonlinear Control Systems II 3(3-0-9)
     2102731 Infinite-Dimensional Control Systems 3(3-0-9)
   - Biomedical Engineering
     2102523 Statistical Signal Processing in Biomedical Engineering 3(3-0-9)
     2102547 Cognitive Engineering 3(3-0-9)
     2102585 Biomaterial Science 3(3-0-9)
     2102588 Biomedical Electronics 3(3-0-9)
     2102668 Biosensors 3(3-0-9)
     2102675 Pattern Recognition 3(3-0-9)
     2102676 Digital Image Processing 3(3-0-9)
     2102785 Advanced Sensor Theory 3(3-0-9)
     2102876 Adaptive Signal Processing 3(3-0-9)
   - Embedded Systems and Robotics
     2102540 Microcomputer Systems 3(3-0-9)
     2102544 Advanced Embedded Systems 3(3-0-9)
     2102545 Digital Integrated Circuits 3(3-0-9)
     2102546 Analog Integrated Circuits 3(3-0-9)
     2102581 Digital Circuit Design 3(3-0-9)
     2102641 Computer-Aided Analysis of Electronic Circuits 3(3-0-9)
     2102642 Computer Vision and Video Electronics 3(3-0-9)
     2102645 Embedded System Design 3(3-0-9)
   - High Voltage Engineering
     2102553 Fundamentals of Electromagnetic Compatibility 3(3-0-9)
     2102558 Insulation Coordination 3(3-0-9)
     2102650 Electrical Transients in Power Systems 3(3-0-9)
     2102656 Power System Protection 3(3-0-9)
     2102754 Electric Field Analysis in High Voltage Engineering 3(3-0-9)
     2102755 Power System Electromagnetic Transient Simulation 3(3-0-9)
   - Industrial Instrumentation
     2102540 Microcomputer Systems 3(3-0-9)
     2102543 Advanced Electric Motor Drives 3(3-0-9)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102544</td>
<td>Advanced Embedded Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102548</td>
<td>Switched-Mode Electrical Power Processing I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102581</td>
<td>Digital Circuit Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102616</td>
<td>Advanced Industrial Measurement</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102645</td>
<td>Embedded System Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102668</td>
<td>Biosensors</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102675</td>
<td>Pattern Recognition</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102676</td>
<td>Digital Image Processing</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

- **Microwave and Lightwave Communications**
  - 2102520 Optical Fiber Transmissions and Networks 3(3-0-9)
  - 2102521 Access Networks 3(3-0-9)
  - 2102520 Electromagnetic Theory 3(3-0-9)
  - 2102520 Computational Electromagnetics for Microwave and Photonics 3(3-0-9)
  - 2102564 Optical Communication 3(3-0-9)

- **Multimedia and Signal Processing**
  - 2102571 Multimedia Communication 3(3-0-9)
  - 2102573 Digital Communications 3(3-0-9)
  - 2102574 Information Theory 3(3-0-9)
  - 2102565 Fourier Transforms and its Applications 3(3-0-9)
  - 2102567 Pattern Recognition 3(3-0-9)
  - 2102567 Digital Image Processing 3(3-0-9)
  - 2102567 Speech Processing 3(3-0-9)
  - 2102567 Digital Video Processing 3(3-0-9)
  - 2102567 Adaptive Signal Processing 3(3-0-9)

- **Nanoelectronics and Photonics**
  - 2102549 Semiconductor Fabrication Technology 3(3-0-9)
  - 2102582 Photonic Devices in Optical Communication Systems 3(3-0-9)
  - 2102583 Introduction to Quantum Mechanics 3(3-0-9)
  - 2102584 Introduction to Nanoelectronics 3(3-0-9)
  - 2102589 Laser Engineering 3(3-0-9)
  - 2102563 Solar Cell Technology 3(3-0-9)
  - 2102580 Semiconductor Lasers 3(3-0-9)
  - 2102562 Solid-State Physics for Electronics Engineers 3(3-0-9)
  - 2102564 Guided-Wave Optics and Nanophotonics 3(3-0-9)

- **Optoelectronics**
  - 2102580 Optoelectronics 3(3-0-9)
  - 2102582 Photonic Devices in Optical Communication Systems 3(3-0-9)
  - 2102589 Laser Engineering 3(3-0-9)
  - 2102580 Semiconductor Lasers 3(3-0-9)

- **Power Electronics**
  - 2102543 Advanced Electric Motor Drives 3(3-0-9)
  - 2102548 Switched-Mode Electrical Power Processing I 3(3-0-9)
  - 2102566 Switched-Mode Electrical Power Processing II 3(3-0-9)

- **Power and Energy Systems**
  - 2102550 Power Electronics in Electrical Power Systems 3(3-0-9)
  - 2102551 Computational Methods for Power System Analysis and Design 3(3-0-9)
  - 2102552 Introduction to Distributed Generation 3(3-0-9)
  - 2102554 Power System Harmonics 3(3-0-9)
  - 2102555 Fundamentals of Power Quality 3(3-0-9)
  - 2102556 Power System Economics 3(3-0-9)
  - 2102559 Lighting System Design and Simulation 3(3-0-9)
  - 2102561 Power System Stability 3(3-0-9)
  - 2102566 Power System Protection 3(3-0-9)
  - 2102577 Power System Reliability 3(3-0-9)

- **Telecommunications and Information Networking**
  - 2102525 Internet and Network Security 3(3-0-9)
  - 2102577 Telecommunication Network 3(3-0-9)
  - 2102578 Satellite Communications 3(3-0-9)
  - 2102567 Reliability and Survivability of Communication Networks and Systems 3(3-0-9)
  - 2102562 Graph Theory and Combinatorial Optimization 3(3-0-9)
  - 2102569 Traffic Engineering and Queuing Theory 3(3-0-9)
  - 2102677 Broadband Network and Design 3(3-0-9)
  - 2102770 Wireless Communications and Networking 3(3-0-9)
  - 2102774 Telecommunications Switching, Transmission and Signaling 3(3-0-9)

3) **Approved Courses** 6 credits

- 2102598 Special Problems in Electrical Engineering I 3(3-0-9)
- 2102697 Special Problems in Electrical Engineering II 3(3-0-9)

4) **THESIS**

- 2102813 THESIS 18 credits
- 2102816 THESIS 36 credits

**NAME OF THE DEGREE**

- Doctor of Philosophy
- Ph.D.

**PROFESSORS:**

Bundhit Eua-arporn, Ph.D. (London)
David Banjerdpongchai, Ph.D. (Stanford)
Somsak Panyakeow, D.Eng. (Osaka)

**ASSOCIATE PROFESSORS:**

Boonchai Techaumnat, D.Eng. (Kyoto)
Chedsada Chinnrangrueng, Ph.D. (U.C. Berkeley)
Duang-rudee Wonglumsom, Ph.D. (Stanford)
Ekachai Leelarasamee, Ph.D. (U.C. Berkeley)
Lunchakorn Wuttisitithulij, Ph.D. (Essex)
Mana Srijuththsak, D.Eng. (T.I.T.)
Nisachon Tangsangjamvivai, Ph.D. (London)
Prasit Teekaput, Ph.D. (VPI & Su)
Somchai Ratanathammaphan, D.Eng. (Chula)
Songphol Karjanachuchai, Ph.D.(Cambridge)
Wattit Benjapolakul, D.Eng. (Tokyo)
Watcharapong Khovidhungij, Ph.D. (UCLA)

**ASSISTANT PROFESSORS:**

Arporn Teeramongkonrasmee, Ph.D. (Chula)
Chaodit Aswakul, Ph.D. (London)
Chaiyachet Saiwichit, Ph.D. (London)
LECTURERS:

Champasak Phumpraiyawej, Ph.D. (Carnegie Mellon)
Chanchana Tangwongsan, Ph.D. (Wisconsin)
Kulyos Petcharaks, Ph.D. (Tokyo)
Komson Petcharaks, Dr.Sc. Techn. (Swiss Federal Inst. of Tech. Zurich)
Kulyos Audomvongseree, D.Eng. (Tokyo)
Komson Petcharaks, Dr.Sc. Techn. (Swiss Federal Inst. of Tech. Zurich)
Manop Wongtsaiwan, D.Eng. (T.I.T.)
Naebboon Hoonchareon, Ph.D. (Purdue)
Pasu Kaewplang, Ph.D. (Chula)
Supatana Auethavekiat, Ph.D. (Tokyo)
Suree Pumrin, Dr.Ing. (Karlsruhe)
Thavatchai Tayjasanant, Ph.D.(Alberta)
Widhyakorn Asdornwised, D.Eng.(Chula)

LECTURE REQUIREMENTS

1) Required Courses

2102791 Electrical Engineering Seminar I 2(2-0-6)
2102792 Electrical Engineering Seminar II 2(2-0-6)
2102793 Electrical Engineering Seminar III 2(2-0-6)
2102794 Electrical Engineering Seminar IV 2(2-0-6)

2) Core Course 3 credits from

2102502 Random Signals and Systems 3(3-0-9)
2102504 Introduction to Mathematical Analysis 3(3-0-9)
2102505 Introduction to Optimization Techniques 3(3-0-9)
2102507 Computational Techniques for Engineers 3(3-0-9)

3) Elective Course 9 credits from

- Advanced Control and Optimization
  2102531 System Identification 3(3-0-9)
  2102536 Nonlinear Control Systems I 3(3-0-9)
  2102537 Optimal Control Systems 3(3-0-9)
  2102535 Control System Theory 3(3-0-9)
  2102537 Multivariable Control Systems 3(3-0-9)
  2102538 Nonlinear Control Systems II 3(3-0-9)
  2102532 Convex Optimization and Engineering Applications 3(3-0-9)

- Biomedical Engineering
  2102523 Statistical Signal Processing in Biomedical Engineering 3(3-0-9)
  2102547 Cognitive Engineering 3(3-0-9)
  2102586 Biomedical Science 3(3-0-9)
  2102588 Biomedical Electronics 3(3-0-9)
  2102688 Biosensors 3(3-0-9)
  2102675 Pattern Recognition 3(3-0-9)
  2102676 Digital Image Processing 3(3-0-9)
  2102785 Advanced Sensor Theory 3(3-0-9)
  2102786 Adaptive Signal Processing 3(3-0-9)

- Embedded Systems and Robotics
  2102540 Microcomputer Systems 3(3-0-9)
  2102544 Embedded Systems 3(3-0-9)
  2102546 Digital Integrated Circuits 3(3-0-9)
  2102581 Analog Integrated Circuits 3(3-0-9)
  2102581 Digital Circuit Design 3(3-0-9)
  2102641 Computer-Aided Analysis of Electronic Circuits 3(3-0-9)
  2102642 Computer Vision and Video Electronics 3(3-0-9)
  2102645 Embedded System Design 3(3-0-9)

- High Voltage Engineering
  2102553 Fundamentals of Electromagnetic Compatibility 3(3-0-9)
  2102558 Insulation Coordination 3(3-0-9)
  2102650 Electrical Transients in Power Systems 3(3-0-9)
  2102656 Power System Protection 3(3-0-9)
  2102754 Electric Field Analysis in High Voltage Engineering 3(3-0-9)
  2102755 Power System Electromagnetic Transient Simulation 3(3-0-9)

- Industrial Instrumentation
  2102540 Microcomputer Systems 3(3-0-9)
  2102544 Advanced Electric Motor Drives 3(3-0-9)
  2102548 Switched-Mode Electrical Power Processing I 3(3-0-9)
  2102581 Digital Circuit Design 3(3-0-9)
  2102616 Advanced Industrial Measurement 3(3-0-9)
  2102645 Embedded System Design 3(3-0-9)
  2102648 Biosensors 3(3-0-9)
  2102675 Pattern Recognition 3(3-0-9)
  2102676 Digital Image Processing 3(3-0-9)

- Microwave and Lightwave Communications
  2102520 Optical Fiber Transmissions and Networks 3(3-0-9)
  2102521 Access Networks 3(3-0-9)
  2102520 Electromagnetic Theory 3(3-0-9)
  2102625 Computational Electromagnetics for Microwave and Photonics 3(3-0-9)
  2102674 Optical Communication 3(3-0-9)

- Multimedia and Signal Processing
  2102571 Multimedia Communication 3(3-0-9)
  2102573 Digital Communications 3(3-0-9)
  2102574 Information Theory 3(3-0-9)
  2102605 Fourier Transforms and its Applications 3(3-0-9)
  2102675 Pattern Recognition 3(3-0-9)
  2102676 Digital Image Processing 3(3-0-9)
  2102874 Speech Processing 3(3-0-9)
  2102875 Digital Video Processing 3(3-0-9)
  2102876 Adaptive Signal Processing 3(3-0-9)
<table>
<thead>
<tr>
<th>COURSES DESCRIPTIONS IN ELECTRICAL ENGINEERING (B.ENG.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102201 Electrical Engineering Mathematics I 3(3-0-6) Condition: Prerequisite 2301108 First-order and higher-order ordinary differential equations; series solutions of ordinary differential equations; Fourier series; Fourier integral and transform; Laplace transform; partial fraction expansion; partial differential equations; boundary-value problem; applications in Electrical Engineering.</td>
</tr>
<tr>
<td>2102202 Electrical Engineering Mathematics II 3(3-0-6) Condition: Prerequisite 2301108 Systems of linear equations; elementary row operations; rank; matrix algebra; inverse of a matrix; LU factorization; determinants; vector spaces and subspaces; bases and dimensions; linear transformation and matrix representation; coordinate vectors; change of basis; eigenvalues and eigenvectors; diagonalization and similarity transformation; functions of a square matrix; Cayley-Hamilton theorem; infinite series; matrix exponentials; applications to differential equations; functions of a complex variable; analytic functions and derivatives; elementary functions; integration in the complex plane; Cauchy’s integral theorem; Taylor and Laurent series; residue theorem and applications; conformal mapping.</td>
</tr>
<tr>
<td>2102203 Probability and Statistics for Electrical Engineering 3(3-0-6) Condition: Prerequisite 2301108 Elements of probability: axioms of probability, conditional probability, independent events, Bayes’ theorem. random variables: discrete and continuous random variables, probability functions, function of r.v., expectation, variance, covariance, moments, functions generating functions, Markov’s and Chebyshev’s inequalities, the weak law of large numbers. special random variables: Bernoulli, binomial, multinomial, geometric, Poisson, hypergeometric, negative binomial, uniform, normal (Gaussian), exponential, gamma, chi-square, t, F. sampling: sample mean, sample variance.</td>
</tr>
</tbody>
</table>
histogram, sampling distributions from a normal population. Parameter estimation: method of moments, maximum likelihood method, confidence interval, bias, mean square error, hypothesis testing: types and probability of error, tests concerning mean and variance of normal populations.

2102206 Introduction to Electrical Engineering 1(0-3-0)
Basic knowledge and understanding of present trends of electrical engineering technology in various fields, i.e., electrical power, electronics, control, and communication, based on which the students can grasp the whole picture of electrical engineering. The course is composed of lectures, hands-on laboratories in basic applications and MATLAB, and study trip. The lectures will be given by the Department staffs and invited experts from the industries, and will cover the topics ranging from basic researches to state-of-the-art technologies of each field.

2102210 Circuit Theory I 3(3-0-6)
Condition : Prerequisite 2304108
Elementary concepts; resistive circuits; node and mesh equations; circuit theorems; first-order and second-order circuits; periodic waveforms; sinusoidal waveforms; steady-state AC circuits; electric power; three-phase circuits.

2102211 Electric Circuit Laboratory 1(0-3-0)
Condition : Prerequisite 2102210 or Consent of faculty
A laboratory work on electric circuits and measurements: multimeter; oscilloscope; dc circuits ac circuits; three-phase circuits; resonance; first-order and second-order transient responses.

2102212 Circuit Theory II 3(3-0-6)
Condition : Prerequisite 2102210 or 2102201
Network graphs; network equations in matrix forms; node and mesh analysis; definitions of loop and cut-set; state equations; transient responses; complete responses; impulse response; unit-step response; natural frequency; network functions; sinusoidal steady-state responses; frequency response; two-ports networks; small signal analysis.

2102222 Engineering Electromagnetics 3(3-0-6)
Condition: Prerequisite 2102201 or 2102204
Vector analysis; electrostatic fields in free space; electrostatic fields in dielectrics and conductors; Laplace equation and simple solution method; energy in electrostatic fields; convection current and conduction currents; magnetostatic fields; magnetic forces; energy in magnetostatic fields; electromagnetic induction and Maxwell’s equations; time-harmonic electromagnetic fields and their phasors; plane waves in an unbounded medium; free-space, dielectric and conductor; electromagnetic power transmission, Poynting's theorem.

2102252 Electrical Machines I 3(3-0-6)
Condition: Prerequisite 2102210
Basic principles of electromechanical energy conversion: electromagnetic forces, Faraday’s law, Ampere’s law, magnetic materials, magnetic circuits; dc machine constructions; steady-state analysis, characteristics, and testing of dc generators and dc motors; construction and characteristics of transformers; fundamentals of ac machines; ac machine constructions; rotating magnetic fields; steady-state analysis, characteristics, and testing of synchronous generators and induction motors.

2102300 Electrical Engineering Technology for Better Community 1(0-18-0)
Practice applying knowledge in electrical engineering through a project for the betterment of a community, developing teamwork skills, and raising awareness of public service mindset and social responsibility.

2102307 Signals and Systems 3(3-0-6)
Condition : Prerequisite 2102202,2102212
Classification of signals and systems; linear time-invariant (LTI) systems; time domain and frequency domain models of the continuous linear time-invariant (LTI) systems; convolution integral and impulse response; Fourier series and Fourier transforms; Bode plot of signals and LTI systems; Laplace transforms; analysis of LTI systems using Laplace transforms; applications to circuit analysis, feedback control, and communications.

2102308 Properties of Electrical Engineering Materials 3(3-0-6)
Condition : Prerequisite 2304108
Fundamentals; structures of solids; determination of structures; preparation of materials; mechanical, thermal, electrical, magnetic and optical properties of materials; dielectrics; superconductivity.

2102311 Electrical Measurements and Instrumentation 3(3-0-6)
Condition : Prerequisite 2102210
Units and standard instruments; shielding; safety; precision; voltage, current and power measurements; impedance measurement at low and high frequencies; transducers; magnetic measurements; digital techniques in measurement; noises; signal-to-noise ratio enhancement techniques.

2102322 Telecommunication Transmission 3(3-0-6)
Condition: Prerequisite 2102222
Transmission line theory; Smith chart and impedance matching techniques by using stubs transmission lines in telecommunication system, coaxial line and twin leads; plane wave transmission, polarization and reflection and refraction; waveguide principle; microwave waveguides; optical waveguides; principle of radiation and antennas; basic antenna parameters; free-space point-to-point transmit-receive systems; calculation of link budget; introduction to wave propagation in wireless systems.

2102331 Feedback Control Systems Laboratory 1(0-3-0)
Condition : Prerequisite 2102332
A Laboratory work on control systems; computer simulation of dynamic systems; position control and speed control of servomotor; PID tuning and computer control of industrial processes.
2102332 Linear Control Systems I 3(3-0-6) Condition: Prerequisite 2102207 or 2102211
Open-loop and closed-loop control systems; mathematical models of physical systems; linearization; block diagrams; signal flow graphs; basic control actions and compensations; time-domain responses; Routh-Hurwitz stability test; control system design by the root locus method; Bode and Nyquist plots; Nyquist stability criterion; Nichols charts; control system design by frequency response method.

2102355 Electrical Machines Laboratory I 1(0-3-0) Condition: Prerequisite 2102252, 2102232
Basic laboratory concerning electromechanical energy conversion: experimental topics related with the contents of the lecture course on electrical machines I: experiments on basic instruments and equipments in electrical power engineering, characteristics of various apparatus, i.e., magnetic cores, transformers, dc generators, dc motors, synchronous generators, induction motors and magnetic contactors.

2102356 Electrical Machines II 3(3-0-6) Condition: Prerequisite 2102252
Magnetic energy and coenergy; forces and torques in electromagnetic systems; transient behaviors of dc motors; structure and connection of three-phase transformers; parallel connection of transformers; characteristics of salient-pole synchronous generators; parallel operation of synchronous generators; transient behaviors of synchronous generators; synchronous motors; permanent magnet synchronous motors; brushless dc motors; characteristics and starting methods of synchronous motors; structure and operating principles of stepping motors; starting and braking methods of three-phase induction motors; speed control of induction motors; operating principles of induction generators; characteristic of single-phase induction motors.

2102360 Electrical Power Systems I 3(3-0-6) Condition: Prerequisite 2102252
Introduction to power systems; sources of electric energy; power system structure; load characteristics; basic power system calculation; electric power plants; transmission line parameters; transmission line model and performance analysis; power transformer model and per-unit system; electrical power distribution system; power system equipment.

2102370 Principles of Communications 3(3-0-6) Condition: Prerequisite 2102207 or (2102201 and 2102203)
An overview of signals, linear systems and Fourier transform; analog modulation: AM, DSB, SSB, VSB, FM and PM; random process and noise in communication systems; digital baseband transmission and power spectrum analysis; Nyquist's sampling theorem and quantization; pulse code modulation, delta modulation and time division multiplexing; digital modulation: ASK, PSK, FSK and QAM; information theory and source coding.

2102382 Electronic Circuits 3(3-0-6) Condition: Prerequisite 2102210
Current-voltage characteristics of electronic devices and their models; basic transistor amplifier circuits; transistor biasing; analysis of small-signal transistor amplifiers; frequency response of small-signal linear amplifiers; feedback amplifiers; operational amplifiers and their applications in linear and nonlinear circuits; oscillators; power amplifiers; power supplies; introduction to power electronics.

2102383 Fundamentals to Digital Systems 3(3-0-6)
Number systems and codes; Boolean algebra; minterms and maxterms; sum-of-products and product-of-sums; Karnaugh maps; two-level and multi-level gate circuits; medium-scale combinational circuits: multiplexer, encoder, and decoder; combinational circuit design; sequential circuits: latch, flip-flop, register, and counter; analysis of clocked sequential circuits: Moore and Mealy machines; circuits for arithmetic operations: adder, subtractor, and multiplier; MOS and CMOS logic; VHDL for digital system design; logic simulation and FPGA programming.

2102384 Electronics Laboratory I 1(0-3-0) Condition: Prerequisite 2102211 or 2110261
Electronics Laboratory II 3(3-0-6)
A laboratory work on basic properties of semiconductors and electronic devices: charge carriers in semiconductors, diodes, transistors, triggering devices, thyristors, optoelectronic devices and ultrasonic sensors; electronic circuits: transistor biasing, amplifiers, feedback amplifiers, linear and nonlinear application of op-amps, dc power supplies and digital circuits.

2102385 Semiconductor Devices I 3(3-0-6)
Crystal properties and growth of semiconductors; atoms and electrons; energy band and charge carriers in semiconductors; excess carriers in semiconductors; junctions; field-effect transistors; bipolar junction transistors; optoelectronic devices; power devices.

2102391 Electrical Engineering I 3(3-0-6) Condition: Prerequisite 2304104 and 2304108
DC circuit analysis; ac single-phase and three-phase circuit analysis; Kirchhoff's laws; complex power; basic principles, efficiency and connections of transformers; characteristics, operation, speed control and applications of dc motors, single-phase and three-phase induction motors; introduction to low-voltage electrical system design and protection.

2102392 Electrical Engineering Laboratory I 1(0-3-0) Condition: Corequisite 2102391
A laboratory work on electric circuits and machines: dc and ac circuits; three-phase circuits; transformers; dc generators; dc motors; induction motors.

2102401 Random Processes for Electrical Engineering 3(3-0-6) Condition: Prerequisite 2102203
Basic concepts of probability theory; random variables; stochastic processes; mean, covariances, and correlations; stationary random processes; analysis of random signals; power spectral density; response of linear systems to random signals; amplitude modulation by random signals; optimum linear estimators.
2102420  Principles of Antennas  3(3-0-6)
Condition: Prerequisite 2102322
Fundamental parameters of antennas; linear wire antennas; loop antennas; antenna arrays; linear array/planar array; antenna synthesis; calculation of self and mutual impedances by method of moment; broadband antennas; aperture antennas; horn antennas; microstrip antennas; reflector antennas; introduction to antenna measurements.

2102421  Principles of Microwave Engineering  3(3-0-6)
Condition: Prerequisite 2102322
Microwave network analysis; impedance matching and tuning circuits; microwave resonators; power dividers and directional couplers; microwave filters; design of microwave filters; ferromagnetic microwave media, monolithic microwave circuits; microwave oscillators and amplifiers; introduction to microwave systems, communication systems, radar systems, and microwave heating; microwave biological effects and safety.

2102422  Principles of Telecommunication  3(3-0-6)
Condition: Prerequisite 2102370
Introduction to telecommunications; layered communication architectures; transmission medium: wired and wireless; data link layer protocols: flow control and error control; medium access control; circuit switching and packet switching; throughput and delay performance analysis of communication link; introduction to network topology, flows and graph theory; routing principles in circuit-switched and packet-switched networks; introduction to queuing theory and basic simulation techniques; Overviews of cellular mobile phone networks, optical networks, Internet and satellite systems.

2102423  Digital Signal Processing  3(3-0-6)
Condition: Prerequisite 2102201
Signals: linear time-invariant system; z-transform and its inverse; convolution theorem; difference equations; group delay; some applications using discrete-Fourier transform (DFT) and fast Fourier transform (FFT); finite impulse response (FIR) filtering; infinite impulse response (IIR) filtering; transversal filters; lattice filters; sampling theory; sampling rate conversion; decimation; interpolation; polyphase filters; aliasing; word length effects; quantization error effects; roundoff noise effects in digital filters.

2102425  Data Communications  3(3-0-6)
Condition: Prerequisite 2102422 or Consent of faculty
Introduction to data communications and networks; layered protocols and network architectures; basics of data transmission (characteristics of transmission media, modulation, multiplexing); data link protocols (error correction, data link control protocols); point-to-point protocols at network layer (routers, flow control, error recovery); delay models in data networks; multiaccess communications (Aloha, CSMA, multi-access reservations); system design considerations.

2102426  Traffic Engineering in Communication Networks  3(3-0-6)
Condition: Prerequisite 2102422 or Consent of faculty
Traffic engineering overview; traffic characteristics; performance evaluation by computer simulation; introduction to traffic models in non-queuing/queuing systems; application of traffic engineering in communication networks.

2102427  Multimedia Compression Technology  3(3-0-6)
Condition: Prerequisite (2102207 and 2102423) or 2102307 or Consent of faculty

2102428  Introduction to Image Processing  3(3-0-6)
Condition: Prerequisite 2102203, 2102307 or Consent of faculty
Fundamentals of image processing; image enhancement and restoration; image segmentation; line and edge detection; morphology; optical flow; stereo vision; image representations; chain code; convex hull; boundary and area descriptors; pyramid and multiresolution image representations.

2102432  Linear Control Systems II  3(3-0-6)
Condition: Prerequisite 2102332
State-space representation of dynamic systems; mathematical modeling of complex engineering systems at level of details compatible with the design and implementation of modern control systems; system characteristics; controllability and stability; modifications of system characteristics using feedback, state feedback, optimal regulation and observers; extensive case study emphasizing computer-aided analysis and design.

2102433  Digital Control Systems  3(3-0-6)
Condition: Prerequisite 2102233
Introduction to digital control; linear discrete-time system analysis; sampled-data systems; discrete equivalents to continuous transfer functions; design of digital control systems using transform techniques; design of digital control systems using state-space methods: pole placement design, estimator design; quantization effects.

2102434  Industrial Control and Instrumentation  3(3-0-6)
Condition: Prerequisite 2102332
Industrial instrumentation: analog and digital devices; industrial control techniques in actual industrial systems; analysis, design, selection and maintenance of industrial control systems; applications to electromechanical, pneumatic, and hydraulic systems.

2102444  Introduction to Embedded Systems  3(3-0-6)
Condition: Prerequisite 2102383
Embedded system architecture; microprocessor/ microcontroller; memory; I/O and peripherals; embedded C programming; interrupt; DMA and embedded system networks.
2102446 Fundamentals of Power Electronics 3(3-0-9)
Condition: Prerequisite 2102210
Fundamental theories of power electronics for electrical power processing and control; basic converter and inverter topologies and their operations; static and dynamic characteristics as well as control techniques of semiconductor power devices: diodes. Transistors and thyristors; characteristics and models of passive components: inductors, transformers, capacitors and resistors; converter and inverter applications; switching power supplies, dc and ac motors drives, high voltage dc transmission.

2102456 Electrical System Design 3(3-0-6)
Condition: Corequisite 2102360
Types of electrical systems; system design concept and criteria; electrical devices, installation materials, symbol and circuit diagrams; load characteristics; power supplies; power distribution and wiring design; infrastructural system design: lighting, heating, air conditioning, grounding; motor load and motor control; specifications and cost estimations; residential and commercial electrical system design; power factor correction.

2102457 Fundamentals of Light and Lighting 3(3-0-6)
Condition: Consent of faculty
Light, eyes, vision, health and productivity; application of light in nonvisual processes; definition and terminology in light and lighting; photometry and colorimetry; principles of light generation; daylight, light sources and control gears; optical properties of material; construction, classification and characteristics of luminaries; principles of lighting calculation; indoor and outdoor lighting applications; lighting quality, energy efficiency and pollution impacts.

2102458 High Voltage Engineering I 3(3-0-6)
Condition: Consent of faculty
Generation and measurement of high voltages and currents; electric fields in homogeneous and heterogeneous materials; gaseous discharges; electric arcs; breakdown in liquid and solid dielectrics; high voltage test of electric apparatuses; lightning discharges and protections.

2102459 High Voltage Engineering Laboratory I 1(0-3-0)
Condition: Prerequisite 2102458
A laboratory work on high voltage engineering: generation of dc and ac high voltages and impulse voltages; measurement of electric field dielectric losses; breakdown characteristics, partial discharges; electrical tests of insulators; RIV test of insulators; BIL test on transformers; sparkover test on lightning arresters; behavior of air gaps under dc, ac and impulse voltages; characteristics of impulse voltage dividers; protective devices; grounding resistance measurement.

2102461 Electrical Power Systems II 3(3-0-6)
Condition: Prerequisite 2102380
Power system modeling; network equations; load flow analysis; economic operation of power systems; symmetrical faults; symmetrical components; unsymmetrical faults; over-voltage in power systems; electrical insulation; protective devices and power system protection; power system stability.

2102463 Electrical Power System Protection 3(3-0-6)
Condition: Prerequisite 2102360
Introduction and philosophies of power system protection; phasor and polarity; symmetrical components revision; input sources for relay; key principles of system protection; system grounding principles; generator, transformer, reactor, shunt capacitor, bus, motor and line protection.

2102464 Fundamentals of Electric Motor Drives 3(3-0-6)
Condition: Prerequisite 2102356
Moments of inertia of various components in electrical drive systems; operating region of drives; braking methods of motors; calculation of motor ratings for various loads; torque-speed characteristics of dc motors used in drive systems; control circuits and control methods of dc motors; torque-speed characteristics and equivalent circuits of induction motors used in drive systems; control circuits and control methods of induction motors; servo drive systems.

2102473 Communication Engineering Laboratory 1(0-3-0)
Condition: Prerequisite 2102370
Hands-on laboratory in three major areas related to communication engineering, namely, telecommunications, electromagnetic waves and digital signal processing.

2102474 Communication System Design 3(3-0-6)
Condition: Prerequisite 2102422
Trends of telecommunication; wiring (twisted pair, coaxial, optical fiber and standard interfaces such as RS-232); switching, PABX and call center; architectures, characteristics and standards of local area network (LAN); metropolitan area network (MAN) and wide area network (WAN); intelligent buildings; Internet and intranet; cable and security management; design of intelligent buildings; design of MAN and WAN; economic consideration; traffic and future planning for expansion; applications and case studies.

2102479 Optical Fiber Communication 3(3-0-6)
Condition: Prerequisite 2102322
Overview of optical fiber communications; wave guiding in optical fibers, mode theory for dielectric circular waveguides; signal distortion in optical fibers due to loss and dispersion; optical sources, laser diodes; modulation techniques; photodetector, optical receiver operation; digital transmission systems, power budget analysis; dispersion management; optical fiber amplifiers; principle and components in WDM systems.

2102487 Industrial Electronics 3(3-0-6)
Condition: Prerequisite 2102382
Industrial sensors and their characteristics; signal conditioning; signal transmission; sequence control; programmable sequence controller and PLC; process control; distributed control system (DCS); man-machine-interface (MMI) software.

2102488 Semiconductor Devices II 3(3-0-6)
Condition: Prerequisite 2102385
Review of physics and properties of semiconductors; compound semiconductor; P-N
juncture; metal-semiconductor junctions; heterojunctions; MESFET; heterojunction transistor (HEMT and HBT); microwave devices; high speed photonic devices and integrated circuits.

2102489 Principles of Analog Circuit Design 3(3-0-6)
Condition: Prerequisite 2102382
Transistor fabrication in integrated circuits; transistor modeling in integrated circuits; passive devices in integrated circuits; one- and two-transistor amplifiers; differential amplifiers; current sources and active loads; voltage and current references; output stages; operational amplifier analysis; frequency response; feedback, stability, and compensation; basic operational amplifier design; basic communication circuits; commercial analog circuits; applications of analog circuits.

2102490 Electrical Engineering Pre-Project 1(0-2-1)
Condition: Consent of Faculty
Problem framework; guidelines for problem solving and solution of an electrical engineering project.

2102491 Electrical Engineering II 3(3-0-6)
Condition: Prerequisite 2102391
Conduction in metals and semiconductors; P-N junctions; characteristics of semiconductor devices; transistor amplifiers; operational amplifier circuits and applications; digital circuits: basic gates, Boolean algebra, combinational circuits and sequential circuits; relay sequential circuits; industrial instrumentation; power electronics; phase controlled rectifiers and motor speed controls.

2102499 Electrical Engineering Project 3(0-6-3)
Condition: Consent of Faculty
Practical and interesting projects or problems in various fields of electrical engineering: power, electronics, control systems and communications.

COURSE DESCRIPTIONS IN ELECTRICAL ENGINEERING (M.ENG., PH.D.)

2102502 Random Signals and Systems 3(3-0-9)
Statistical independence and conditional probability; Hilbert space of Znth order random variables; conditional mean and covariance of multidimensional Gaussian distribution; Bayesian estimator; stationary discrete-time random signals; discrete-time linear systems with random signals input-output relation; rational spectral densities factorization; continuous-time stationary Gaussian processes and spectral factorization; ergodic processes; Hilbert space of square integrable functions on a time interval; karhunen-loeve vs. Fourier series expansion of random signals; discrete-time Kalman filtering problem formulation; innovation sequence and update formula; propagate formula; Kalman filter equations.

2102504 Introduction to Mathematical Analysis 3(3-0-9)
Mathematical proofs; basic set theory; the real number system; topology on the real line; sequence and convergence; limit and continuity of functions; vector spaces and linear operators; normed linear spaces; bounded operators; inner-product spaces; orthogonality and orthonormal bases; adjoint operators; applications to electrical engineering topics.

2102505 Introduction to Optimization Techniques 3(3-0-9)
Condition: Prerequisite 2102202 or 2102205 or Consent of Faculty
Review of linear algebra; solution of nonlinear equations; optimality conditions for unconstrained optimization; numerical methods for unconstrained optimization: steepest descent, Newton’s, variable metric and conjugate gradient methods; optimality conditions for constrained optimization; numerical methods for constrained optimization; penalty and barrier function methods, sequential quadratic programming; solution of linear programs by the simplex method.

2102507 Computational Techniques for Engineers 3(3-0-9)
Condition: Prerequisite 2102202 or 2102205 or Consent of Faculty
Mathematical preliminaries; computer arithmetic; solutions of nonlinear equations; solving system of linear equations; approximating functions; numerical differentiation and integration; numerical solutions of ordinary differential equations.

2102520 Optical Fiber Transmissions and Networks 3(3-0-9)
Overview of optical fiber telecommunication; enabling technologies for optical fiber transmissions; standard for optical fiber transmission; signal propagation in optical fiber; design of optical fiber point-optical fiber telecommunication; enabling technologies for optical fiber transmissions; standard for optical fiber transmission; signal propagation in optical fiber; design of optical fiber point-to-point link; dispersion compensation methods and their optimum design rules; wavelength division multiplexed (WDM) transmission systems; Dense WDM (DWDM); long-haul EWDW transmission design; enabling technologies for optical fiber networks; standard for optical fiber networks; first generation optical networks; access networks; FTTx; SONET and SDH optical ring network; FTTx; SONET and SDH optical ring network; DWDM networks; ring, mesh, and broadcast-and-selective topologies; design of DWDM optical local-area-network (LAN), DWDM optical metropolitan-area network (MAN), and DWDM optical wide-area network (WAN); engineering DWDM network; fiber system installations; fiber system tests and measurements; recent trends in fiber-optic transmissions and networks.

2102521 Access Networks 3(3-0-9)
Condition: Consent of Faculty
Overview of access networks, access networks and core networks; xDSL: Variety of DSL versions; Standards of xDSL systems and components; Transmission of DSL signal in twisted pair and limitations; xDSL system design; business models in xDSL, HFC: standards of HFC and Docsis; HFC systems and components; transmission of video and data in HFC and limitations; HFC system design; business model in HFC, FTTx: variety of FTTx versions; standards of FTTx; FTTx systems and components; transmission of optical signals in FTTx system and
limitations; FTTx system design; business models in FTTx, PLC; standards of PLC system; PLC systems and components; transmission of PLC signals in power system; PLC system design WiMAX : standards of WiMAX; WiMAX systems and components; of PLC signals in power system; PLC system, PLC system design, WiMAX: standards of WiMAX; WiMAX systems and components; transmission of WMX signals WiMAX system design; business models in WiMAX, WIFI: standards of WIFI; WiFi systems and components; transmission of WIFI signals; WiFi system design, other minor access networks: Bluetooth UWB, FSO; comparison of access networks nature of access networks; future trends.

2102523 Statistical Signal Processing in Biomedical Engineering 3(3-9)
Condition: Prerequisite 2102207 or Consent of Faculty
Characterization of signals and linear time-invariant systems; conversion of continuous-time signals to discrete-time signals; modeling of stochastic signals from white noise; energy and power signals; the principles of autocorrelation for discrete-time signals; linear prediction and optimum linear filtering; Least-Squares methods for system modeling and filtering design; all topics focused on biomedical engineering perspective.

2102525 Internet and Network Security 3(3-9)
Condition: Consent of Faculty
Overview of internet TCP/IP protocol and multimedia traffic; medium access controls protocols; wireless LAN networks; gigabit Ethernet; dynamic routing protocols (RIP and OSPF), LAN switching transport layer protocols; UDP and TCP, IP multicast, NAT, DHCP, DNS, SNMP; routing mechanism and congestion control algorithms; future broadband networks: WDM technology, advanced network architecture, network simulation, performance analysis, and measurement; network security; basic concept of cryptography: secret-key, public-key, digital signatures; authentication and identification schemes; intrusion detection: viruses; security of electronic mail and the World Wide Web; electronic commerce: payment protocols, electronic cash and firewalls.

2102531 System Identification 3(3-9)
Condition: Prerequisite 2102332 or Consent of Faculty
Models for linear time-invariant and time-varying systems; nonparametric time- and frequency-domain methods; parameter estimation methods; convergence and consistency; asymptotic distribution of parameter estimates; computing the estimate; recursive identification methods; experiment design; choice of identification criterion; model structure selection and model validation.

2102536 Nonlinear Control Systems I 3(3-9)
Condition: Prerequisite 2102432 or Consent of Faculty
Introduction to nonlinear control systems; state-space and phase-plane analyses; describing functions; Lyapunov stability; circle and Popov criteria; nonlinear control systems design.

2102540 Microcomputer Systems 3(3-0-9)
Condition: Prerequisite 2102444 or Consent of Faculty
Microcomputer hardware: CPU, bus, memory, I/O units; interfacing techniques and programming; interfacing peripherals; software design techniques; real time systems and programming; microcomputer operating systems; high-level languages; microcomputer applications in control and instrumentation.

2102543 Advanced Electric Motor Drives 3(3-9)
Condition: Prerequisite 2102356 or Consent of Faculty
Modeling and dynamic equations of dc motors; control principles of motor drives; semiconductor devices used in motor drive systems; various converter topologies for dc motor drives; modeling and dynamic equations of induction and synchronous motors; control principles of induction and synchronous motors; various inverter topologies for ac motor drives.

2102544 Advanced Embedded Systems 3(3-9)
Condition: Consent of Faculty
Hardware and software platforms for embedded systems; devices and buses; embedded programming; real time operating system; hardware-software co-design in an embedded system; testing.

2102545 Digital Integrated Circuits 3(3-9)
Condition: Consent of Faculty
Internal circuits of different families of gates; TTL, ECL, NMOS and CMOS; internal configuration of large scale integrated circuits including ROM, RAM, PAL, PLA and FPGA; dynamic digital circuits such as domino and clocked circuits.

2102546 Analog Integrated Circuits 3(3-9)
Condition: Consent of Faculty
MOS transistor models; operational amplifier design; stability and frequency compensation of feedback amplifiers; switched-capacitor circuits; effect of nonlinearity and mismatch; oscillators and phase lock loops.

2102547 Cognitive Engineering 3(3-9)
Introduction to cognitive science from Descartes concepts to Informatics; Psychophysics: visual system, auditory system and somatosensory system; human cognitive function: sensory-motor system, perception, memory, learning, reasoning, decision making and problem solving; instrumentation and cognitive process: signal detection, image perception, speech recognition; applications of sensors and actuators in cognitive process; examples of computational modeling and brain process: artificial intelligence, neural network.

2102548 Switched-Mode Electrical Power Processing I 3(3-9)
Condition: Prerequisite 2102382 or Consent of Faculty
Analysis of PWM converters and their derivatives; phase-controlled rectifier an PWM inverter operations and characteristics; PWM converters modeling using circuit averaging and averaged-switch modeling technique; dc and ac models of PWM converters; converters transfer functions; modeling of Pulse-Width Modulators; control of PWM converters; applications of phase-controlled rectifiers PWM converter and
inversors; analysis of resonant inversors using fundamental frequency approximation and their applications.

2102549 Semiconductor Fabrication Technology 3(3-0-9)
Condition: Prerequisite 2102395 or Consent of Faculty
Integrated circuit fabrication technologies: crystal growth, vapor phase epitaxy, liquid phase epitaxy, molecular beam epitaxy, thermal oxidation, thermal diffusion, ion implantation, chemical vapor deposition, metallization, lithography, annealing, assembly and packaging, future trends.

2102550 Power Electronics in Electrical Power Systems 3(3-0-9)
Condition: Consent of Faculty
Basic structure of electrical power system networks; fundamentals of power flow in power systems; basic characteristics of transmission systems; compensation in transmission systems; interconnection of power systems through FACTS and HVDC; active and reactive power flow control; voltage and current compensation for power quality; power electronic circuits for conversion of renewable energy generation.

2102551 Computational Methods for Power System Analysis and Design 3(3-0-9)
Condition: Prerequisite 2102461 or Consent of Faculty
Power network representation and reconfiguration algorithms; problem formulation and solution methods for the studies fundamental to planning, design and operation of electric power systems including power flow, security assessments, optimal power flow and fault calculations; dynamic simulation for power system studies.

2102552 Introduction to Distributed Generation 3(3-0-9)
Condition: Co-requisite 2102461 or Consent of Faculty
Introduction to Distributed Generation (DG); technologies of DG; power generation systems: synchronous, induction, converter; DG impact on load flow and voltage profiles; DG impact on fault and protection; and DG impact on power quality.

2102553 Fundamental of Electromagnetic Compatibility 3(3-0-9)
Condition: Consent of Faculty
EMI/EMC understanding and measurements; sources of EMI; definition and effect of EMI; EMI measurements and methods; EMC/ EMI limitation and protection with suitable equipment and system grounding; ground system tests and maintenance; shielding theory, materials and performance; different types of filter selection and usage.

2102554 Power System Harmonics 3(3-0-9)
Condition: Consent of Faculty
Harmonic and interharmonic definition and terminology; harmonic and interharmonics sources; effect of harmonics and interharmonics; harmonic flow in power system; harmonic standards; harmonic mitigation techniques; and tuned filter designs and applications.

2102555 Fundamentals of Power Quality 3(3-0-9)
Condition: Consent of Faculty
Definitions and technical terms of power quality; sources and effects of power quality disturbances; harmonics and interharmonics analysis voltage quality; analysis; voltage fluctuations and flicker analysis; Power quality standards and mitigation techniques.

2102556 Power System Economics 3(3-0-9)
Economic dispatch problems; economic dispatch considering transmission system losses; introduction to unit commitment planning; microeconomic theory; power pool structure; bilateral contract structure; power system analysis considering market structures.

2102557 High Voltage Engineering II 3(3-0-9)
Condition: Prerequisite 2102458 or Consent of Faculty
Properties of dielectric materials; insulations and their applications; constructions and performance of high voltage equipments: transformers, circuit breakers, insulators, cables, isolators, lightning arresters, capacitors, bushings; non-destructive test of insulating materials and high voltage equipments; partial discharge measurements, capacitance and dielectric loss measurement; design and layout of high voltage power systems.

2102558 Insulation Coordination 3(3-0-9)
Condition: Prerequisite 2102458 or Consent of Faculty
Switching overvoltage between phase and ground, between phase and phase at substation; lightning overvoltage on transmission line and at substation; lighting protection for transmission line and substation; selection of lightning arrester; insulation coordination according to IEC60071.

2102559 Lighting System Design and Simulation 3(3-0-9)
Condition: Consent of Faculty
Lighting system design process and standards; lamps and luminaries applications; lighting design principles for interior; lighting model simulation; computer simulation and case studies for interior space; daylighting design and consideration for energy efficiency; lighting system installation and maintenance; lighting design principles for exterior; computer simulation and case studies for exterior space.

2102571 Multimedia Communication 3(3-0-9)
Condition: Consent of Faculty
Introduction to multimedia communication; image coding standards; video coding standards; audio coding standards; speech coding standards; IP networks; wireless networks; multimedia communication protocols; multimedia communication applications.

2102573 Digital Communications 3(3-0-9)
Signals and Spectra, Random Signals and Power Spectral Density, Source Coding, Predictive Coding, Vector Quantizing, Transform Coding, Formatting and Baseband Transmission, Correlative Coding, Baseband Detection, Error Performance, Intersymbol Interference, Equalization, Digital Bandpass Modulations, Coherent and Noncoherent Detection, Bit and Symbol Error Rate, Spread-Spectrum Techniques, Direct-Sequence, Frequency Hopping, Fading Channels, Flat-Fading,
Frequency-Selective Fading, Doppler Shift, Diversity and Interleaver; Channel Codings, Block and Cyclic Codes, Hamming and BCH Codes, Convolutional Codes, Viterbi Decoding, Reed-Solomon Codes, Interleaving and Concatenated Codes, Turbo Codes,

2102574 Information Theory 3(3-0-9)
Information theory; probability and entropy; the source coding theorem; symbol codes; stream codes; communication over a noisy channel; the noisy-channel coding theorem; error-correcting codes; constrained noiseless channels; marginalization; low-density parity-check codes; convolutional codes and turbo codes; other modern codes.

2102577 Telecommunication Network 3(3-0-9)
Condition: Consent of Faculty
Telecommunication network fundamentals; multiplexing and switching; OSI principle; various network equipment technologies; network interconnection; signaling in network and applications; various network interconnection types; network management activities; telecommunication network management; network evaluation; network performance.

2102578 Satellite Communications 3(3-0-9)
Fundamentals of satellite communication; satellite orbits; satellites; satellite link design; modulation and multiplexing; multiple access; earth station; error control coding; polarization; interference; VSAT; various types of satellites and their operations such as geostationary, nongeostationary, low earth orbit, direct broadcast and global positioning systems.

2102580 Optoelectronics 3(3-0-9)
Condition: Prerequisite 2102385 or Consent of Faculty
Physics of optical radiation; interaction between optical radiation and matter; principles and applications of optoelectronic devices; sources, detectors as well as other optical materials, devices, components and equipments.

2102581 Digital Circuit Design 3(3-0-9)
Condition: Prerequisite 2102292 or Consent of Faculty
Introduction to digital circuit design; synthesis of logic circuit; CAD tools and VHDL; standard chips, programmable logic devices and gate arrays; optimized implementation of logic functions; combinational circuit design; synchronous sequential circuit design; controller; digital system design; microcontroller; digital system design; microcontroller based design.

2102582 Photonic Devices in Optical Communication Systems 3(3-0-9)
Condition: Prerequisite 2102222, 2102385 or Consent of Faculty
Fundamentals of semiconductor physics; electronic and optical properties of semiconductors; optical processes in semiconductors; junction theory; propagation of light; waveguide theory; couplers and coupled-mode theory; operating principles, structures and properties of LEDs, laser diodes, photodetectors optical modulators/switches, optical amplifiers and semiconductor optical amplifiers (SOAs); the fabrication technology of photonic devices.

2102583 Introduction to Quantum Mechanics 3(3-0-9)
Condition: Prerequisite 2102204, 2102205, 2102222 or Consent of Faculty
Schroedinger’s equation; bound states; wave packets and uncertainty relations; scattering by simple barriers; WKB approximation; expectation values and operators; variational principle; expansion principle and matrix formulation; perturbation theory.

2102584 Introduction to Nanoelectronics 3(3-0-9)
Condition: Prerequisite 2102390, 2102385
Introduction to nanotechnology, nanoscale fabrication (e.g. photolithography, electron-beam lithography, self-assemble growth); nanoscale characterisations (e.g. SEM, TEM, AFM); 1D quantum structure (quantum wires); 0D quantum structure (quantum dots); single electron devices, carbon nanotubes; molecular electronics, DNA chips, quantum dot cellular automata; MEMS/NEMS; spintronics.

2102585 Biomaterial Science 3(3-0-9)
Condition: Consent of Faculty
Biological interactions with materials or any invasion: protein adsorption, blood coagulation, inflammation, immunology, hypersensitivity and infection; various types of biomaterials that have been used in biomedical applications: metals, synthetic polymers, hydrogel, ceramics, composites, and natural materials.

2102588 Biomedical Electronics 3(3-0-9)
Condition: Consent of Faculty
Electrical signals in human body; action potential in cells; electrodes; amplifiers; transducers; electronic monitoring systems: ECG, EEG, EMG; blood pressure and blood flow measurement; catheterisation; electrical hazards and prevention; medical instrumentation; computer in medicine.

2102589 Laser Engineering 3(3-0-9)
Condition: Prerequisite 2102385 or Consent of Faculty
Fundamental theory: energy states in atoms, electron-population inversion, spontaneous emissions, stimulated emissions; principles of lasers; coherent light; gas lasers; solid-state lasers, semiconductor lasers; applications of lasers in medical science, precision measurement, telecommunications, material processing, spectroscopy, display hologram and nonlinear optics.

2102598 Special Problems in Electrical Engineering 3(3-0-9)
Condition: Consent of Faculty
Special problems assigned by the instructor with consent of the head of the Department.

2102601 Power and Energy Technologies in Smart Grids 3(3-0-9)
Condition: Consent of Faculty
Introduction to Smart Grids; fundamentals of power system operation and control; distributed generation, microgrid and active networks; introduction to wide area
monitoring and wide area protection systems; renewable energy generation; grid connection codes; renewable energy policy and regulation; energy storage; electric vehicle.

2102602 Information and Communication Technologies in Smart Grids 3(3-0-9)
Substation operation and related communication within substation; equipment in distribution system; communication between control centers; architecture and components of Automatic Meter Infrastructure/Automatic Meter Reading including phasor measurement unit, digital fault recorder and interoperability; energy efficiency within home, building and factory; communication channels in smart: wired, wireless, optical fiber; network layer, sensing/control and control protocol; database management and cyber security.

2102605 Fourier Transforms and its Applications 3(3-0-9)
Fourier's theorem; Fourier transforms of functions; discrete Fourier transform; other related transforms; applications to electric networks, sampling, antennas, noise waveforms, Fourier optics and statistics.

2102616 Advanced Industrial Measurement 3(3-0-9)
Roles of industrial measurement; functional elements and characteristics of industrial measuring system; analysis, design, selection and applications. of sensors in industrial measuring system; factory automation, processautomation, and precision machinery; future trend of industrial sensors.

2102620 Electromagnetic Theory 3(3-0-9)
Maxwell’s equations; theorem of electromagnetic energy and power; properties of materials in electromagnetic fields; boundary conditions; theorems of electromagnetic fields, duality principle, uniqueness, image theory, equivalence principle, induction theorem, reciprocity; potential functions; electromagnetic wave equations, plane wave functions, cylindrical wave functions, spherical wave functions; mathematical tools for electromagnetic fields, separation of variables technique, transverse resonance method, perturbation and variational techniques, Green’s functions, geometric algebra; solution methods for electrostatic, magnetostatic, and quasi-static fields problems; plane wave propagation problems, propagation in unbounded medium, multilayered medium, and anisotropic medium; wave guidance problems, field analysis in typical waveguides, modal expansion method; resonators and filters; radiation problems, radiation from current sources and apertures; scattering problems, scattering by cylinder, wedge, and sphere; optical waves, optical waveguides, optical wave propagation in photonic crystal.

2102625 Computational Electromagnetics for Microwave and Photonics 3(3-0-9)
Basic concept of numerical modeling for electromagnetic problems; computational methods and programming techniques for solving linear electromagnetic wave problems in frequency domain for microwave and photonic applications such as finite-element method (FEM), boundary-element method (BEM), finite-volume method (FVM), and meshless method; computational methods and programming techniques for solving linear electromagnetic problems in time domain such as finite-difference time-domain (FDTD), finite-element time-domain (FETD), and finite-volume time-domain (FVTD).

2102627 Reliability and Survivability of Communication Networks and Systems 3(3-0-9)
Fundamental probability; overview of network reliability; approaches to calculating network reliability; generic reliability and maintainability concept; overview of network survivability; fiber transport system components and signals; APS; dual homing; self healing rings; SONET analysis; DCS networks; survivable network design; IP and ATM network survivability;

2102628 Graph Theory and Combinatorial Optimization 3(3-0-9)
Introduction to graph theory; concept of paths, cycles and trees; various types of graphs; transshipment problem; shortest path problem; maximum flows problem; minimum cost flows problem; network optimization; matching; Matriods and greedy algorithms; applications.

2102629 Traffic Engineering and Queuing Theory 3(3-0-9)
Fundamentals of traffic engineering and queuing theory: quality of service and system performance analysis; computer simulation technique; single-service and multi-service loss network theory and its applications; congestion analysis, blocking probability, system utilization and revenue approximation, overflow traffic management, traffic prioritization; delay-system analysis and queuing theory: single queue models, queueing network models, mean value analysis; traffic characterization of broadband and multimedia services; applications in mobile communications and internet.

2102631 Optimal Control Systems 3(3-0-9)
Discrete-time linear quadratic regulator; calculus of variations; continuous-time linear quadratic regulator; time-optimal control; constrained control input problem; the Pontryagin’s maximum principle; singular control; dynamic programming; optimal controller design; computational methods in optimal controller synthesis.

2102632 Stochastic Control Systems 3(3-0-9)
Review of probability; laws of large numbers; linear state-space models driven by white noise; sequential decision making via dynamic programming; unified approach to optimal control of stochastic dynamic systems; applications to LQG control; Kalman filter and its properties; implementation issues, including the solution of the Riccati equation; nonlinear filtering filtering and the extended Kalman filter.
2102635 Control System Theory 3(3-0-9)  
Condition: Consent of Faculty  
Review of linear algebra; least-squares methods and minimum norm methods; mathematical descriptions of dynamic systems; solutions of linear dynamic equations; stability, controllability, observability; internal stability of interconnected systems; state feedback; linear quadratic regulation; observers and observer-based compensation; introduction to nonlinear systems.

2102637 Multivariable Control Systems 3(3-0-9)  
Condition: Consent of Faculty  
Performance issues in multivariable systems; uncertainties and robustness; multivariable control system designs: frequency domain methods, LOG and LTR methods, parameter optimization methods; H∞ and H2 control; model reduction.

2102638 Nonlinear Control Systems II 3(3-0-9)  
NONLIN CONT SYS II  
Condition: Consent of Faculty  
Input-output stability; small gain theorems; basic of differential geometry; feedback linearization; geometric nonlinear control theory; nonlinear control system design.

2102641 Computer-Aided Analysis Of Electronic Circuits 3(3-0-9)  
Condition: Consent of Faculty  
Methods for formulating circuit equations; modified nodal analysis; methods for solving matrix equation; AC analysis of linear circuits; methods for finding DC operating point of nonlinear circuits; time domain simulation of nonlinear dynamical circuits; computation of sensitivities of circuit variable with respect to parameters; symbolic analysis of linear circuits.

2102642 Computer Vision and Video Electronics 3(3-0-9)  
Condition: Consent of Faculty  
Human vision; geometric camera models; image segmentation; object recognition; video signals and standards; video input and output circuits; computer vision and digital video applications.

2102645 Embedded System Design 3(3-0-9)  
Condition: Consent of Faculty  
Practical examples; performance evaluation; complex system designs: automotive, multimedia, biomedical instrumentation, measurement instrumentation, and robot.

2102650 Electrical Transient In Power Systems 3(3-0-9)  
Condition: Consent of Faculty  
Introduction to electrical transient; switching transient: simple and abnormal switch transients, transients in three phase circuits; transient in conversion equipment; electromagnetic phenomena under transient conditions; lighting effects on power systems; traveling wave on transmission line; effects of transient voltage on transformer windings; protection of systems and equipment against transient overvoltage and insulation co-ordination; computer aids to the calculation of electrical transients.

2102651 Power System Stability 3(3-0-9)  
Condition: Prerequisite 2102461 or Consent of Faculty  
Basics and descriptions of power system stability problems; mathematical reviews of state-space analysis and numerical integration; reference frame theory; synchronous machine representation in stability studies; power network representations and characteristics; excitation system components and functions; active power and frequency control; transient stability; small-signal stability; methods of improving transient and small-signal stability.

2102656 Power System Protection 3(3-0-9)  
Condition: Consent of Faculty  
Principles of power system protection; relays and their operating principles and characteristics; and protection of generators, motors, transformers, buses and lines.

2102663 Solar Cell Technology 3(3-0-9)  
Condition: Consent of Faculty  
Band theory of semiconductors; optical properties of semiconductor: structure of solar cells; characteristics of solar cells; equivalent circuit of solar cells; p-n junction silicon solar cells; polycrystalline silicon solar cells; amorphous silicon solar cells; gallium arsenide solar cells; Cu2S/CdS. solar cells; photovoltaic system design; concentrated sunlight system; photovoltaic system applications.

2102668 Biosensors 3(3-0-9)  
Condition: Consent of Faculty  
Necessary concepts relevant to the principle of measuring chemical and biological phenomena with emphasis on integrating these concepts of develop to apply and to construct novel instruments for observing, examining, and controlling various phenomena in the field of biotechnology, medical engineering for both fundamental research and process development in industrial production.

2102674 Optical Communication 3(3-0-9)  
Condition: Consent of Faculty  
An outline of optical communication systems; properties of laser light; characteristics of optical communication; fundamentals of optical fiber; light sources; modulation and demodulation; optical devices; optical communication and applications.

2102675 Pattern Recognition 3(3-0-9)  
Condition: Prerequisite 2102284 or Consent of Faculty  
Statistical pattern recognition: linear discriminant functions, Bayesian decision theory, maximum-likelihood and Bayesian parameter estimation.

2102676 Digital Image Processing 3(3-0-9)  
Condition: Consent of Faculty  
Image perception; image digitization; image enhancement; image restoration; image segmentation; image compression; morphological image processing; image representation and description.

2102677 Broadband Network And Design 3(3-0-9)  
Condition: Consent of Faculty  
Demand for ATM broadband network; ATM fundamentals; ATM broadband network operation, administration and maintenance (OAM) fundamentals;
ATM network management; quality of service (QoS) and ATM performance; policing in ATM networks; 3G/4G wireless network architectures; next-generation wireless networks; wireless access technologies; demand for broadband network services; network design approaches; introductory graph theory and topological design; campus/LAN/WAN design; leased-line network consideration; requirements definition and service provider selection; network planning and management; network design project management.

2102680  **Semiconductor Lasers**  3(3-0-9)
*Condition: Prerequisite 2102620 and 2102385 or Consent of Faculty*

A review of semiconductor physics; optical process in semiconductor; junction theory; waveguide theory; coupler-mode theory; fundamental of semiconductor lasers; semiconductor laser structure and its characteristics; quantum well lasers; dynamic single-mode lasers; vertical cavity surface emitting lasers; array lasers; quantum wire and quantum dot lasers; quantum cascade lasers; semiconductor laser modeling; the fabrication technology of semiconductor lasers.

2102682  **Solid-State Physics for Electronics Engineers**  3(3-0-9)
*Condition: Consent of Faculty*

Crystal structures and lattices; dynamics of crystal lattices; lattice vibration and thermal properties of crystals; crystalline defects; elementary quantum mechanics; modern theory of solids; quantum theory of metals; quantum theory of electrons in periodic lattices; semiconductors and their electrical and optical properties; dielectric materials and insulation; magnetism and magnetic resonances; superconductivity; optical properties of materials.

2102684  **Guided-Wave Optics and Nanophotonics**  3(3-0-9)
*Condition: Consent of Faculty*

Optical waveguides: planar, two-dimensional and three-dimensional waveguides; interaction between optical waveguides; optical waveguide devices; photonic crystals and photonic band gaps; photonic-crystal fibers and supercontinuum light generation; structures and optical properties of quantum nanostuctures; quantum wells, quantum wires, quantum dots, and interaction between these structures; their applications in nanoelectronic and nanophotonic devices; coupled quantum nanostructures.

2102686  **Switched-Mode Electrical Power Processing II**  3(3-0-9)
*Condition: Prerequisite 2102548 or Consent of Faculty*

Modeling of PWM converters using state-space averaging technique; state-space averaging of non-ideal converters; Analysis of PWM converters operating in discontinuous conduction mode; modeling of DCM PWM converters; current-mode control of PWM converters; current-programmed control; current-programmed converter model; transfer functions; analysis of basic converters using single resonant converters; analysis of resonant inverters and resonant converters;

2102697  **Special Problems in Electrical Engineering II**  3(3-0-9)
*Condition: Consent of Faculty*

Special problems in various fields of electrical engineering.

2102731  **Infinite-Dimensional Control System**  3(3-0-9)
*Condition: Consent of Faculty*

Semigroup theory and infinitesimal generator; Hille-Yosida theorem; contractive semigroups; dual semigroups; Riesz-spectral operators; invariant subspaces; problem formulation; abstract Cauchy problem, perturbed systems and composite systems; boundary control; basic system properties; stability, controllability, observability, exponential stabilizability and detectability; compensator design for infinite-dimensional systems.

2102732  **Convex Optimization and Engineering Applications**  3(3-0-9)
*Condition: Prerequisite 2102505 or Consent of Faculty*

Convex sets, functions, and optimization problems; basics of convex analysis; least-squares, linear and quadratic programs, semidefinite programming, minimax, extremal volume, and other problems; localization methods: cutting-plane, ellipsoid algorithms; optimality conditions, duality theory, theorems of alternative, and applications; interior-point methods; applications to control systems and other engineering topics.

2102754  **Electric Field Analysis in High Voltage Engineering**  3(3-0-9)

Basics of electric field analysis: practical problems in the field analysis of high-voltage systems: Introduction to numerical methods in field analysis; charge simulation method: surface charge method; boundary element method; examples of field analysis; comparison of methods: advanced topics.

2102755  **Power System Electromagnetic Transient Simulation**  3(3-0-9)

Analysis of power system transient phenomena: lightning surges, switching surges, temporary overvoltage; modeling technique of lines and cables, transformers, rotating machines, arresters, protective systems.

2102757  **Power System Reliability**  3(3-0-9)
*Condition: Consent of Faculty*

Reliability evaluation and reliability indices; comparison between deterministic and probabilistic criterias; operating state modeling of power system equipment; generation system modeling; generation system reliability evaluation; generation system expansion planning; interconnection system reliability evaluation; operating reserve; composite system reliability evaluation; distribution system reliability evaluation.

2102770  **Wireless Communications and Networking**  3(3-0-9)

Overview of future broadband wireless systems for voice video data and multimedia services; wireless channel characterization, narrowband and wideband; techniques for combating fading; adaptive equalizer, channel coding and diversity; spread spectrum, multicarrier modulation, CDMA, OFDM, multuser systems,
multiple input/output systems (MIMO), adaptive modulation; wireless networks: IEEE802 wireless LANs, cellular mobile phone systems design, PDAs, smart homes and appliances, sensor networks, automated motorways, Ad-Hoc networks design and applications.

2102774 Telecommunications Switching, Transmission and Signaling  3(3-0-9)
Telecommunications traffic; congestion; mathematical model of telecommunications traffic; lost-call systems; queuing systems; switching networks; single-stage networks; gradings; link systems; grades of service of link systems; non-blocking networks; space and time switching; time-division switching networks; grades of service of time-division switching networks; non-blocking time-division switching networks; synchronization; telecommunications transmission systems; transmission of the 64-kbps signal; PCM primary rate transmission; higher order PCM transmission; optical fiber transmission system; SDH transmission system; subscriber networks; signaling; signalling networks; signalling system No. 7 levels.

2102785 Advanced Sensor Theory  3(3-0-9)
Condition : Consent of Faculty
Principle and theory of physical and chemical sensors; thermodynamics and sensor operation; sensor fabrication technology; micro-machining; sensor fusion; intelligent sensors; data processing and analytical methods.

2102790 Electrical Engineering Seminar I  2(2-0-6)
Condition : Consent of Faculty
Seminar in current research topics in electrical engineering including technical writing and presentation techniques of research works and thesis. Literature reviews of international journal papers relevant to the research topic. Submit a summary report in the forms of technical paper and thesis proposal which describes the motivation, problem formulation, main results and, examples.

2102791 Electrical Engineering Seminar I  2(2-0-6)
Preliminary lectures by instructors; seminar on current and new topics in electrical engineering, in which each student is required to present an oral and written report.

2102792 Electrical Engineering Seminar II  2(2-0-6)
Preliminary lectures by instructors; seminar on current and new topics in electrical engineering, in which each student is required to present an oral and written report.

2102793 Electrical Engineering Seminar III  2(2-0-6)
Preliminary lectures by instructors; seminar on current and new topics in electrical engineering, in which each student is required to present an oral and written report.

2102794 Electrical Engineering Seminar IV  2(2-0-6)
Preliminary lectures by instructors; seminar on current and new topics in electrical engineering, in which each student is required to present an oral and written report.

2102796 Advanced Topics in Electrical Engineering I  3(3-0-9)
Interesting topics or new developments in the field of electrical engineering.

2102797 Advanced Topics in Electrical Engineering II  3(3-0-9)
Interesting topics or new developments in the field of electrical engineering.

2101874 Speech Processing  3(3-0-9)
Condition : Consent of Faculty
Sampling; scalar quantization; vector quantization; speech modeling; speech perception; psychoacoustic; waveform coding; vocoders; hybrid coding; feature extraction; phonemes; statistical model training (HMM); speaker verification; text-to-speech (TTS); noise reduction techniques.

2101875 Digital Video Processing  3(3-0-9)
Condition : Consent of Faculty
Analog and digital video; video sampling and rate conversion; video modeling; two-dimensional motion estimation; foundation of video coding; binary coding, quantization, transform coding; image and video compression standards; error control in video communications.

2101876 Adaptive Signal Processing  3(3-0-9)
Condition : Consent of Faculty
Adaptive filtering and linear time-invariant filters together with their applications; linear optimum filtering including the principle of orthogonality and minimum mean-square (LMS) algorithm, and the method of least-squares and recursive least-squares.

2102813 Thesis  18 credits
2102816 Thesis  36 credits
2102828 Dissertation  48 credits
2102829 Dissertation  60 credits
2102830 Dissertation  72 credits
2102894 Doctoral Dissertation Seminar  0(0-0-0)
2102897 Qualifying Examination  0(0-0-0)
DEPARTMENT OF MECHANICAL ENGINEERING

Mechanical Engineering is a very broad field of science, engineering, and technology. It encompasses virtually all aspects of everyday life. To get a fresh perspective, it can be broadly identified according to the foundation, role, and purpose of mechanical engineering as:

- The science, engineering, and technology that are foundation to research and development, design and manufacturing, and installation and maintenance of devices, machines, or systems that transform, transmit, or utilize energy for the benefit of humankind. These devices, machines, or systems generally involve the transform of energy into motion and motion into energy;
- People who study and practice mechanical engineering can therefore
- function in many different roles such as researchers, inventors, designers, practicing engineers, etc.;
- work in many different areas such as power generation, distribution and utilization; engine, vehicle and transportation; material, design and manufacturing; dynamics, control and robotics; machinery and maintenance; refrigeration, air conditioning and building technology; energy resource, management, utilization and conservation; environment technology; MEMS and nanotechnology, etc.;
- work in many different places, both public and private sectors, such as in industry, factory, hospital, large building and structure, consulting company, governmental office, university, etc.

MISSION

The mission of the Department of Mechanical Engineering is to provide firm-founded and creative-minded mechanical engineers for the advancement of mechanical engineering and for the development of the country.
- Its integrated educational programs emphasize
- fundamental knowledge of advanced mathematics, sciences, engineering, and mechanical engineering;
- general knowledge in social sciences and humanity;
- mathematical, scientific, and engineering methodologies;
- design and conduct of experiments, analysis of data, and meaningful physical interpretation of data;
- identification, formulation, and solving engineering problems;
  o conceptualization of objectives and constraints,
  o identification of governing physical principles,
  o application of fundamental analytical tools as well as modern engineering tools, with sound appreciation of its capabilities and limitations and with sound understanding of the underlying physics and physical insights.
- open-ended problems, design projects, and research;
- effective written and verbal communication skills;
- independent study experiences as well as teamwork efforts;
- appreciation of engagement in life-long learning;
- appreciation of the roles and responsibilities of mechanical engineers in society.

DEGREES OFFERED

The Department of Mechanical Engineering offers three degree programs (Bachelor of Engineering, B.Eng.) in Mechanical Engineering, Automotive Engineering, and Naval Architecture and Marine Engineering, at the undergraduate level. At the graduate level, the department offers a Master of Engineering (M.Eng.) and a Doctor of Philosophy (Ph.D.), in Mechanical Engineering. Details for each program are given in the following sections.

HEAD:
- Witaya Wannasuphoprasit Ph.D. (Northwestern)

PROFESSORS:
- Pramote Dechaumphai Ph.D. (Old Dominion)
- Somsak Chaiyapinunt Ph.D. (Oregon State)
- Viboon Sangeraphunsiri Ph.D. (Georgia Tech.)

ASSOCIATE PROFESSORS:
- Asi Bunyajitrakula Ph.D. (UC, Irvine)
- Angkee Sripakagorn Ph.D. (Washington)
- Boonchai Lertnuwat D.Eng. (Tokyo)
- Chaioke Kunpanitchakit Ph.D. (Wisconsin-Madison)
- Chittin Tangthiang Ph.D. (Penn State)
- Kanit Wattanawichien Ph.D. (University of Melbourne)
- Kuntinee Maneeratana Ph.D. (London)
- Pairod Singhathanadgid Ph.D. (Washington)
- Phongsaen Pitakwatchara Ph.D. (Tokyo)
- Ratchatin Chanchean Ph.D. (Chula)
- Thitima Jintawan Ph.D. (Washington)
- Thanyarat Singhanart Ph.D. (Tokyo)

ASSISTANT PROFESSORS:
- Alongkorn Pimpin D.Eng. (Tokyo)
- Chatsthai Hongsa-Utain Dipl.Eng. (Braunschweig)
- Chanat Ratnasumawong D.Eng. (Tokyo Tech.)
- Chanyaphan Virulai D.Eng. (Tokyo)
- Jirapong Kasivitnamay D.Eng. (Tokyo)
- Nopdanai Ajavakorn D.Eng. (California)
- Niphon Wansophark D.Eng. (Chula)
- Nuksit Noomwong Ph.D. (TUAT)
- Pairat Tangoomprasert Ph.D. (Tokyo)
- Sompong Putivitsutik Ph.D. (London)
- Sunhapos Chatranuwathana Ph.D. (Michigan)
- Tul Manawatana Ph.D. (Stevens Inst. Of Tech.)
- Thanyarat Mekumpompong M.Eng. (Canterbury)
- Witaya Wannasuphoprasit Ph.D. (Northwestern)
- Werayut Srituravanich Ph.D. (UCLA)
LECTURERS:

Chirdpun Vitooraporn Ph.D. (M.I.T.)
Tawan Paphapote M.S. (Illinois)
สรัล ศาลากิจ Ph.D. (U.S.A.)
กฤษดฏา พนมเชิง Post Doc. (U.S.A.)
สุรัฐ ขวัญเมือง Ph.D. (U.S.A.)

MECHANICAL ENGINEERING UNDERGRADUATE PROGRAMS

The general aim of the Department of Mechanical Engineering is to give the student an understanding of theoretical principles and also, through experiment and design work, to provide him/her with confidence in solving practical problems. In accordance with the credit system of study, the Department provides an undergraduate curriculum for three programs: Mechanical Engineering, Naval Architecture and Marine Engineering, and Automotive Engineering. Students who plan to further their study for higher degrees, as well as those who wish to specialize in any of the fields offered, are strongly urged to consult their advisors in order to select and prepare the required elective programs.

NAME OF THE DEGREE

: Bachelor of Engineering
: B.Eng.

COURSE REQUIREMENTS

Mechanical Engineering Program
Total credits for graduation 147 credits
1. General Education 30 credits
2. Basic Science 27 credits
3. Basic Engineering Science 26 credits
4. Program Core Courses 46 credits
5. Elective Courses 12 credits
6. Free Electives 6 credits

Naval Architecture and Marine Engineering Program
Total credits for graduation 148 credits
1. General Education 30 credits
2. Basic Science 27 credits
3. Basic Engineering Science 26 credits
4. Program Core Courses 53 credits
5. Elective Courses 6 credits
6. Free Electives 6 credits

Automotive Engineering Program
Total credits for graduation 147 credits
1. General Education 30 credits
2. Basic Science 27 credits
3. Basic Engineering Science 26 credits
4. Program Core Courses 52 credits
5. Elective Courses 6 credits
6. Free Electives 6 credits
# Study Program: Mechanical Engineering
## First Year Curriculum

### Common to all Engineering Students

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103211</td>
<td>STATICS</td>
<td>3</td>
<td>2100311</td>
<td>ENG ESSENTIALS</td>
<td>3</td>
</tr>
<tr>
<td>2103241</td>
<td>THERMODYNAMICS I</td>
<td>3</td>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2301215</td>
<td>MULTIVARIABLE CALCULUS</td>
<td>3</td>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2301216</td>
<td>LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS</td>
<td>3</td>
<td>2103320</td>
<td>DES MECH ELEM</td>
<td>3</td>
</tr>
<tr>
<td>2603284</td>
<td>STAT PHYS SCIENCE</td>
<td>3</td>
<td>2103361</td>
<td>EN THERM DESIGN I</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td>2103460</td>
<td>ME EXP LAB III</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

### Third Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103212</td>
<td>DYNAMICS</td>
<td>3</td>
<td>2103231</td>
<td>MECH OF MAT I</td>
<td>3</td>
</tr>
<tr>
<td>2103260</td>
<td>ME EXP LAB I</td>
<td>2</td>
<td>2103265</td>
<td>ME DES PROJ</td>
<td>2</td>
</tr>
<tr>
<td>2103305</td>
<td>MFR PROC ME</td>
<td>3</td>
<td>2103409</td>
<td>INTRO MECHANICS</td>
<td>3</td>
</tr>
<tr>
<td>2103351</td>
<td>FLUID MECHANICS I</td>
<td>3</td>
<td>2103489</td>
<td>MECH ENG PRE-PROJECT</td>
<td>1</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>3</td>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td>xxxxxxxx</td>
<td>ELECTIVE ELECTIVES</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

### Fourth Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103301</td>
<td>DES MTHD ME</td>
<td>3</td>
<td>2103304</td>
<td>AUTO CONTROL I</td>
<td>3</td>
</tr>
<tr>
<td>2103306</td>
<td>MECH MACHINERY</td>
<td>3</td>
<td>2103499</td>
<td>MECH ENG PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2103322</td>
<td>MECH MACHINERY</td>
<td>3</td>
<td>OR 2100499</td>
<td>ENG PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2103360</td>
<td>ME EXP LAB II</td>
<td>2</td>
<td>XXXXXXXX</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>2103463</td>
<td>HEAT TRANSFER</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

### Fifth Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103300</td>
<td>AUTO CONTROL</td>
<td>3</td>
<td>2103306</td>
<td>MECH MACHINERY</td>
<td>3</td>
</tr>
<tr>
<td>2103322</td>
<td>MECH MACHINERY</td>
<td>3</td>
<td>2103499</td>
<td>MECH ENG PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2103360</td>
<td>ME EXP LAB II</td>
<td>2</td>
<td>XXXXXXXX</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>2103463</td>
<td>HEAT TRANSFER</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

### Sixth Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103231</td>
<td>MECH OF MAT I</td>
<td>3</td>
<td>2103265</td>
<td>ME DES PROJ</td>
<td>2</td>
</tr>
<tr>
<td>2103409</td>
<td>INTRO MECHANICS</td>
<td>3</td>
<td>2103489</td>
<td>MECH ENG PRE-PROJECT</td>
<td>1</td>
</tr>
<tr>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>ELECTIVE ELECTIVES</td>
<td>6</td>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

### Summer Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100301</td>
<td>ENG PRACTICE</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Seventh Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103360</td>
<td>ME EXP LAB II</td>
<td>2</td>
<td>XXXXXXXX</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>2103463</td>
<td>HEAT TRANSFER</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

### Eighth Semester

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103360</td>
<td>ME EXP LAB II</td>
<td>2</td>
<td>XXXXXXXX</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>2103463</td>
<td>HEAT TRANSFER</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

### Total Credits for Graduation = 147
### STUDY PROGRAM: AUTOMOTIVE ENGINEERING
#### FIRST YEAR CURRICULUM
##### COMMON TO ALL ENGINEERING STUDENTS

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THIRD SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>SIXTH SEMESTER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103211</td>
<td>STATICS</td>
<td>3</td>
<td>2100311</td>
<td>ENG ESSENTIALS</td>
<td>3</td>
</tr>
<tr>
<td>2103241</td>
<td>THERMODYNAMICS I</td>
<td>3</td>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2301215</td>
<td>MULTIVARIABLE CALCULUS</td>
<td>3</td>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2301216</td>
<td>LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS</td>
<td>3</td>
<td>2103320</td>
<td>DES MECH ELEM</td>
<td>3</td>
</tr>
<tr>
<td>2603284</td>
<td>STAT PHYS SCIENCE</td>
<td>3</td>
<td>2103482</td>
<td>MECH VEHICLES II</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
<td>2103433</td>
<td>INTRO MECH VIBRAT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>18</strong></td>
<td></td>
<td>2103471</td>
<td>INTER COMB ENGIN</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>20</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FOURTH SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>SUMMER SEMESTER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103212</td>
<td>DYNAMICS</td>
<td>3</td>
<td>2100301</td>
<td>ENG PRACTICE</td>
<td>2</td>
</tr>
<tr>
<td>2103231</td>
<td>MECH OF MAT I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104257</td>
<td>MFR PROC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104258</td>
<td>MFR MFR LAB</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103351</td>
<td>FLUID MECHANICS I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103481</td>
<td>AUTOMOTIVE ENG</td>
<td>4</td>
<td>2103483</td>
<td>AUTOMOTIVE SYS DES</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>3</td>
<td>2103461</td>
<td>AE ENG LAB</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>20</strong></td>
<td>2103555</td>
<td>ENGINE EMIS &amp; CONT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2103489</td>
<td>MECH ENG PRE-PROJECT</td>
<td>1</td>
</tr>
<tr>
<td><strong>FIFTH SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>EIGHTH SEMESTER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103382</td>
<td>MECH VEHICLES I</td>
<td>3</td>
<td>2103499</td>
<td>MECH ENG PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2103408</td>
<td>AUTOMOTIVE CONTROL</td>
<td>3</td>
<td>XXXXXXX</td>
<td>ELECTIVES COURSES</td>
<td>3</td>
</tr>
<tr>
<td>2103335</td>
<td>VEH STRUC ANAL I</td>
<td>3</td>
<td>XXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>2103322</td>
<td>MECH MACHINERY</td>
<td>3</td>
<td>XXXXXXX</td>
<td>ELECTIVES COURSES</td>
<td>3</td>
</tr>
<tr>
<td>2103463</td>
<td>HEAT TRANSFER</td>
<td>3</td>
<td>XXXXXXX</td>
<td>FREE ELECTIVES</td>
<td>6</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>18</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>15</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION = 147**
# Study Program: Naval Architecture and Marine Engineering
## First Year Curriculum
### Common to all Engineering Students

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>210321</td>
<td>Statics</td>
<td>3</td>
<td>2100311</td>
<td>Eng Essentials</td>
<td>3</td>
</tr>
<tr>
<td>2103241</td>
<td>Thermodynamics I</td>
<td>3</td>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2301215</td>
<td>Multivariable Calculus</td>
<td>3</td>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2301216</td>
<td>Linear Algebra and</td>
<td>3</td>
<td>2103232</td>
<td>Des Mech Elem</td>
<td>3</td>
</tr>
<tr>
<td>DIFFERENTIAL EQUATIONS</td>
<td></td>
<td>3</td>
<td>2103232</td>
<td>Shipbuilding Eng</td>
<td>3</td>
</tr>
<tr>
<td>2603284</td>
<td>Stat Phys Science</td>
<td>3</td>
<td>2103352</td>
<td>Ship Buoy &amp; Stab</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>General Education</td>
<td>3</td>
<td>2103361</td>
<td>EN THERM DESIGN</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>18</strong></td>
<td></td>
<td></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

### Third Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>210321</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>2103241</td>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>2301215</td>
<td>Multivariable Calculus</td>
<td>3</td>
</tr>
<tr>
<td>2301216</td>
<td>Linear Algebra and</td>
<td>3</td>
</tr>
<tr>
<td>DIFFERENTIAL EQUATIONS</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2603284</td>
<td>Stat Phys Science</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

### Sixth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100311</td>
<td>Eng Essentials</td>
<td>3</td>
</tr>
<tr>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2103232</td>
<td>Des Mech Elem</td>
<td>3</td>
</tr>
<tr>
<td>2103352</td>
<td>Shipbuilding Eng</td>
<td>3</td>
</tr>
<tr>
<td>2103361</td>
<td>EN THERM DESIGN</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

### Fourth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103212</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>2103231</td>
<td>Mech of Mat I</td>
<td>3</td>
</tr>
<tr>
<td>2103260</td>
<td>ME EXP Lab I</td>
<td>2</td>
</tr>
<tr>
<td>2103305</td>
<td>Fluid Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>2103351</td>
<td>Fluid Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

### Summer Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100301</td>
<td>Eng Practice</td>
<td>2</td>
</tr>
</tbody>
</table>

### Seventh Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103437</td>
<td>Ship Design I</td>
<td>3</td>
</tr>
<tr>
<td>2103473</td>
<td>Ship Resis &amp; Power</td>
<td>3</td>
</tr>
<tr>
<td>2103443</td>
<td>Refrigeration</td>
<td>3</td>
</tr>
<tr>
<td>2103489</td>
<td>MECH ENG Pre-Project</td>
<td>1</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Electives Courses</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Free Electives</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

### Fifth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103304</td>
<td>Auto Control I</td>
<td>3</td>
</tr>
<tr>
<td>2103322</td>
<td>Mech Machinery</td>
<td>3</td>
</tr>
<tr>
<td>2103462</td>
<td>Fluid Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>2103463</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

### Eighth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103471</td>
<td>Inter Comb Eng</td>
<td>3</td>
</tr>
<tr>
<td>2103433</td>
<td>Intro Mech Vibrat</td>
<td>3</td>
</tr>
<tr>
<td>2103499</td>
<td>Mech Eng Project</td>
<td>3</td>
</tr>
<tr>
<td>2103393</td>
<td>ME Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Electives Courses</td>
<td>3</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Free Electives</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

Total Credits for Graduation = 147
## APPROVED ELECTIVES FOR UNDERGRADUATE PROGRAMS FOR 2016

<table>
<thead>
<tr>
<th>Mechanical Engineering</th>
<th>Naval Architecture and Marine Engineering</th>
<th>Automotive Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102505</td>
<td>2103302</td>
<td>2103302</td>
</tr>
<tr>
<td>2102532</td>
<td>2103363</td>
<td>2103303</td>
</tr>
<tr>
<td>2102537</td>
<td>2103364</td>
<td>2103314</td>
</tr>
<tr>
<td>2103204</td>
<td>2103371</td>
<td>2103331</td>
</tr>
<tr>
<td>2104303</td>
<td>2103382</td>
<td>2103362</td>
</tr>
<tr>
<td>2103404</td>
<td>2103510</td>
<td>2103382</td>
</tr>
<tr>
<td>2103405</td>
<td>2103530</td>
<td>2103411</td>
</tr>
<tr>
<td>2103406</td>
<td>2103532</td>
<td>2103412</td>
</tr>
<tr>
<td>2103407</td>
<td>2103535</td>
<td>2103413</td>
</tr>
<tr>
<td>2103421</td>
<td>2103540</td>
<td>2103414</td>
</tr>
<tr>
<td>2103432</td>
<td>2103541</td>
<td>2103415</td>
</tr>
<tr>
<td>2103433</td>
<td>2103542</td>
<td>2103416</td>
</tr>
<tr>
<td>2103434</td>
<td>2103543</td>
<td>2103421</td>
</tr>
<tr>
<td>2103454</td>
<td>2103544</td>
<td>2103422</td>
</tr>
<tr>
<td>2103435</td>
<td>2103545</td>
<td>2103431</td>
</tr>
<tr>
<td>2103462</td>
<td>2103552</td>
<td>2103432</td>
</tr>
<tr>
<td>2103464</td>
<td>2103555</td>
<td>2103433</td>
</tr>
<tr>
<td>2103465</td>
<td>2103560</td>
<td>2103434</td>
</tr>
<tr>
<td>2103466</td>
<td>2103566</td>
<td>2103435</td>
</tr>
<tr>
<td>2103467</td>
<td>2103567</td>
<td>2103436</td>
</tr>
<tr>
<td>2103471</td>
<td>2103570</td>
<td>2103437</td>
</tr>
<tr>
<td>2103472</td>
<td>2103571</td>
<td>2103438</td>
</tr>
<tr>
<td>2103475</td>
<td></td>
<td>2103439</td>
</tr>
<tr>
<td>2103476</td>
<td></td>
<td>2103440</td>
</tr>
<tr>
<td>2103477</td>
<td></td>
<td>2103441</td>
</tr>
<tr>
<td>2103478</td>
<td></td>
<td>2103442</td>
</tr>
<tr>
<td>2103479</td>
<td></td>
<td>2103443</td>
</tr>
<tr>
<td>2103481</td>
<td></td>
<td>2103444</td>
</tr>
<tr>
<td>2103485</td>
<td></td>
<td>2103445</td>
</tr>
<tr>
<td>2103486</td>
<td></td>
<td>2103446</td>
</tr>
<tr>
<td>2103487</td>
<td></td>
<td>2103447</td>
</tr>
<tr>
<td>2103494</td>
<td></td>
<td>2103448</td>
</tr>
<tr>
<td>2103495</td>
<td></td>
<td>2103449</td>
</tr>
<tr>
<td>2103496</td>
<td></td>
<td>2103450</td>
</tr>
<tr>
<td>2103497</td>
<td></td>
<td>2103451</td>
</tr>
<tr>
<td>2103498</td>
<td></td>
<td>2103452</td>
</tr>
<tr>
<td>2103499</td>
<td></td>
<td>2103453</td>
</tr>
<tr>
<td>2103500</td>
<td></td>
<td>2103454</td>
</tr>
<tr>
<td>2103501</td>
<td></td>
<td>2103455</td>
</tr>
<tr>
<td>2103502</td>
<td></td>
<td>2103456</td>
</tr>
<tr>
<td>2103503</td>
<td></td>
<td>2103457</td>
</tr>
<tr>
<td>2103504</td>
<td></td>
<td>2103458</td>
</tr>
<tr>
<td>2103505</td>
<td></td>
<td>2103459</td>
</tr>
<tr>
<td>2103506</td>
<td></td>
<td>2103460</td>
</tr>
<tr>
<td>2103507</td>
<td></td>
<td>2103461</td>
</tr>
<tr>
<td>2103508</td>
<td></td>
<td>2103462</td>
</tr>
<tr>
<td>2103509</td>
<td></td>
<td>2103463</td>
</tr>
<tr>
<td>2103510</td>
<td></td>
<td>2103464</td>
</tr>
<tr>
<td>2103511</td>
<td></td>
<td>2103465</td>
</tr>
<tr>
<td>2103512</td>
<td></td>
<td>2103466</td>
</tr>
<tr>
<td>2103513</td>
<td></td>
<td>2103467</td>
</tr>
<tr>
<td>2103514</td>
<td></td>
<td>2103468</td>
</tr>
<tr>
<td>2103515</td>
<td></td>
<td>2103469</td>
</tr>
<tr>
<td>2103516</td>
<td></td>
<td>2103470</td>
</tr>
<tr>
<td>2103517</td>
<td></td>
<td>2103471</td>
</tr>
<tr>
<td>2103518</td>
<td></td>
<td>2103472</td>
</tr>
<tr>
<td>2103519</td>
<td></td>
<td>2103473</td>
</tr>
<tr>
<td>2103520</td>
<td></td>
<td>2103474</td>
</tr>
<tr>
<td>2103521</td>
<td></td>
<td>2103475</td>
</tr>
<tr>
<td>2103522</td>
<td></td>
<td>2103476</td>
</tr>
<tr>
<td>2103523</td>
<td></td>
<td>2103477</td>
</tr>
<tr>
<td>2103524</td>
<td></td>
<td>2103478</td>
</tr>
<tr>
<td>2103525</td>
<td></td>
<td>2103479</td>
</tr>
<tr>
<td>2103526</td>
<td></td>
<td>2103480</td>
</tr>
<tr>
<td>2103527</td>
<td></td>
<td>2103481</td>
</tr>
<tr>
<td>2103528</td>
<td></td>
<td>2103482</td>
</tr>
<tr>
<td>2103529</td>
<td></td>
<td>2103483</td>
</tr>
<tr>
<td>2103530</td>
<td></td>
<td>2103484</td>
</tr>
<tr>
<td>2103531</td>
<td></td>
<td>2103485</td>
</tr>
<tr>
<td>2103532</td>
<td></td>
<td>2103486</td>
</tr>
<tr>
<td>2103533</td>
<td></td>
<td>2103487</td>
</tr>
<tr>
<td>2103534</td>
<td></td>
<td>2103488</td>
</tr>
<tr>
<td>2103535</td>
<td></td>
<td>2103489</td>
</tr>
<tr>
<td>2103536</td>
<td></td>
<td>2103490</td>
</tr>
<tr>
<td>2103537</td>
<td></td>
<td>2103491</td>
</tr>
<tr>
<td>2103538</td>
<td></td>
<td>2103492</td>
</tr>
<tr>
<td>2103539</td>
<td></td>
<td>2103493</td>
</tr>
<tr>
<td>2103540</td>
<td></td>
<td>2103494</td>
</tr>
<tr>
<td>2103541</td>
<td></td>
<td>2103495</td>
</tr>
<tr>
<td>2103542</td>
<td></td>
<td>2103496</td>
</tr>
<tr>
<td>2103543</td>
<td></td>
<td>2103497</td>
</tr>
<tr>
<td>2103544</td>
<td></td>
<td>2103498</td>
</tr>
<tr>
<td>2103545</td>
<td></td>
<td>2103499</td>
</tr>
<tr>
<td>2103546</td>
<td></td>
<td>2103500</td>
</tr>
<tr>
<td>2103547</td>
<td></td>
<td>2103501</td>
</tr>
<tr>
<td>2103548</td>
<td></td>
<td>2103502</td>
</tr>
<tr>
<td>2103549</td>
<td></td>
<td>2103503</td>
</tr>
</tbody>
</table>

**Remark:** Approved electives are subjected to change and will be announced by the department.
MECHANICAL ENGINEERING GRADUATE PROGRAMS

The mechanical engineering department offers a graduate program leading to the degrees of Master of Engineering and Doctor of Philosophy in Mechanical Engineering. The program is housed in the Mechanical Engineering Department which offers three different majors: Solid Mechanics, Heat transfer/Thermodynamics/Fluids, and Control/Dynamics/Manufacturing. Approximately one hundred and thirty graduate students are full-time students in the department. Students who have demonstrated record of high academic achievement normally receive a kind of financial support which may be in a form of educational grant from different supporting organizations, or as teaching or research assistants, as well as the eligibility for waiving the tuition fee.

Presently, there are approximately 30 faculty members who are associated with the graduate program in the mechanical engineering department. The department is involved in research activities in a number of different fields. Several faculty members are associate technical editors for journals. A large number of technical papers resulted from faculty research and student theses have been published annually.

MASTER DEGREE PROGRAM

NAME OF THE DEGREE
: Master of Engineering
: M.Eng.

ADMISSION
The applicant must hold a Bachelor's Degree in Mechanical Engineering or related fields and meet the Graduate School requirements.

DEGREE REQUIREMENTS

There are two programs in the degree of Master of Engineering in Mechanical Engineering.

Program A1
This program is for students who have demonstrated high academic achievement and are approved from the graduate program committee. Students do not need to study course work. 36 credits for thesis are required in the program A1.

Program A2
Each of the following area of study consists of 18 credits for course work, one credit for engineering seminar, and 18 credits for thesis. One of the three programs below must be chosen:
1. Solid Mechanics area of study
2. Heat Transfer/Thermodynamics/Fluids area of study
3. Control/Dynamics/Manufacturing area of study
A successful candidate must obtain an overall grade point average of at least 3.00.

For both programs, a period of study is not more than 8 regular semesters. The student must also demonstrate his or her power of the original thought and ability to organize his or her finding by presenting an acceptable thesis accompanied by an oral examination.

Students are also required to pass the thesis proposal within 4 regular semesters otherwise they will be dismissed from the Department according to the Graduate School Regulation.

COURSE REQUIREMENTS
(For Program A2)

1) Required Courses for all area of study

2103790 Seminar in Mechanical Engineering 1(0-3-1)

2) Additional Required Courses for each area of study

2.1) Solid Mechanics:
2103601 Advanced Engineering Mathematics 3(3-0-9)
3 credits are to be chosen from the
2103612 Elasticity 3(3-0-9)
2103614 Continuum Mechanics 3(3-0-9)

2.2) Heat Transfer/Thermodynamics/Fluid:
2103601 Advanced Engineering Mathematics 3(3-0-9)
6 credits are to be chosen from the
2103602 Measurement and Instrumentation 3(2-3-7)
2103650 Advanced Engineering Thermodynamics 3(3-0-9)
2103651 Advanced Fluid Mechanics 3(3-0-9)
2103652 Combustion Theory 3(3-0-9)
2103655 Convection Heat Transfer 3(3-0-9)

2.3) Control/Dynamics/Manufacturing:
2103603 Mathematic for Control Engineers 3(3-0-9)
2103631 Control of Dynamic Systems 3(3-0-9)

3) Approved Elective Courses for each area of study

2.1) Solid Mechanics:
9 credits are to be chosen from the
2103510 Mechanics of Composite Materials 3(3-0-9)
2103511 Introduction to Continuum Mechanics 3(3-0-9)
2103540 Failure Analysis and Non-destructive Testing 3(2-3-4)
2103541 Vibration Monitoring and Analysis 3(2-3-4)
2103542 Radiographic Testing 3(2-3-4)
2103543 Ultrasonic Testing 3(2-3-4)
2103544 Eddy Current Testing 3(2-3-4)
2103545 Surface Method Testing 3(2-3-4)
2103570 Micro Fabrication Technology 3(3-0-9)
2103571 Micro and Nano Electromechanical Systems (MEMS-NEMS) 3(3-0-9)
2103602 Measurement and Instrumentation 3(2-3-7)
2103612 Elasticity 3(2-3-4)
2103613 Plasticity 3(3-0-9)
2103614 Continuum Mechanics 3(3-0-9)
2103615 Mechanical Vibrations 3(3-0-9)
2103616 Optimum Design of Complex Mechanical Elements 3(3-0-9)
2103618 Theory of Plates 3(3-0-9)
2103619 Theory of Shells 3(3-0-9)
2103620 Theory of Elastic Stability I 3(3-0-9)
2103621 Energy Principles in Solid Mechanics 3(3-0-9)
2103622 Analysis of Composite Structure 3(3-0-9)
2103623 Fatigue of Metals 3(3-0-9)
2.2) Heat Transfer/Thermodynamics/Fluid:
9 credits are to be chosen from the

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>An Introduction to Computational Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Engine Emissions and Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Gas Turbine Performance</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Compressible Fluid Dynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Turbulent Shear Flows</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Measurement and Instrumentation</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>Advanced Numerical Methods</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Finite Element Method</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Combustion Theory</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fluid Dynamics Aspects of Wind Turbines</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Conduction Heat Transfer</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Convection Heat Transfer</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Radiation Heat Transfer</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Internal Combustion Engine</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Utilization of Alternative Fuels</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fundamentals of Turbulence</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Refrigeration and Air Conditioning</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Design of Thermal Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Computational Fluid Dynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Finite Element Method for Computational Fluid Dynamics</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

2.3) Control/Dynamics/Manufacturing:
9 credits are to be chosen from the

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanics of Composite Materials</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Industrial Robots I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Computer-Aided Design and Computer-Aided Manufacturing</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>Mechanical Elements</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Measurement and Instrumentation</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>Advanced Numerical Methods</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Mechanical Vibrations</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Optimum Design of Complex</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Dynamic</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Finite Element Method</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Industrial Robots II</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Applied Nonlinear Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Dynamics System Modeling and Simulation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Combustion Theory</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fluid Dynamics Aspects of Wind Turbines</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

4) Elective Courses

4.1) Solid Mechanics:
3 credits

4.2) Heat Transfer/Thermodynamics/Fluid:
none

4.3) Control/Dynamics/Manufacturing:
3 credits

Elective courses are to be chosen from the following list:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanics of Composite Materials</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Introduction to Continuum</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Industrial Robots I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Computer-Aided Design and Computer-Aided Manufacturing</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>Mechatronics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Failure Analysis and Non-destructive Testing</td>
<td>3(2-3-4)</td>
</tr>
<tr>
<td>Vibration Analysis and Non-destructive Testing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Radiographic Testing</td>
<td>3(2-3-4)</td>
</tr>
<tr>
<td>Ultrasonic Testing</td>
<td>3(2-3-4)</td>
</tr>
<tr>
<td>Eddy Current Testing</td>
<td>3(2-3-4)</td>
</tr>
<tr>
<td>Surface Method Testing</td>
<td>3(2-3-4)</td>
</tr>
<tr>
<td>An Introduction to Computational Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Engine Emissions and Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fundamental of Engine Fuel Control Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Intake Manifold and Induction</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>System Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Gas Turbine Performance</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Compressible Fluid Dynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Turbulent Shear Flows</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Micro Fabrication Technology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Micro and Nano Electromechanical Systems (MEMS-NEMS)</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Measurement and Instrumentation</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>Advanced Numerical Methods</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Elasticity</td>
<td>3(2-3-4)</td>
</tr>
<tr>
<td>Plasticity</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Continuum Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Mechanical Vibrations</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Optimum Design of Complex</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Dynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Theory of Plates</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Theory of Shells</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Theory of Elastic Stability I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Energy Principles in Solid</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Analysis of Composite Structure</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fatigue of Metals</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Finite Element Method</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Thermal Stress Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Industrial Robots II</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Mechanical Elements</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Applied Nonlinear Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Applied Optimal Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Dynamics System Modeling and Simulation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Combustion Theory</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Fluid Dynamics Aspects of Wind Turbines</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>
1. The applicant must have bachelor degree in mechanical engineering or master degree in mechanical engineering/related fields. The applicant with bachelor degree must have average grade point of not less than 3.25 based on a 4 point grading system or receiving second class honor degree. The applicant with master degree must earn the thesis qualification at the good or excellent level. Both the bachelor and master degree applicants must possess other qualifications which the Doctor of Philosophy Program Committee considers sufficient to enter the programme.

2. The applicant must present three letters of recommendation written by persons who are engaging in teaching the graduate study and/or his or her academic advisors.

3. The applicant must possess other qualifications which fulfill the regulations governing the study in Chulalongkorn University’s Graduate School and the standard of study for the Doctor of Engineering Degree, 1981.

DEGREE REQUIREMENTS

The applicant with bachelor degree must take 24 credits of the listed elective courses. The applicant with master degree may take 0-12 credits of the listed elective courses depending on the consideration of the Program Committee. Both the bachelor and master degree applicants are required to submit a dissertation of 48 credits and satisfactory pass an oral examination. In addition, the applicant must fulfill the requirements of the graduate school by passing the English examination and publishing technical paper in an international journal.
<table>
<thead>
<tr>
<th>COURSES DESCRIPTIONS IN MECHANICAL ENGINEERING (UNDERGRADUATE LEVEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103106 Engineering Drawing 3(1-4-4)</td>
</tr>
<tr>
<td>Introduction, Lettering, Apply geometry, Orthographic projection principle, Orthographic writing, Pictorial sketch of Orthographic reading. Dimensioning, Threaded fastener, Assembly drawing, Introduction to computer-aid drafting.</td>
</tr>
</tbody>
</table>

| 2103211 Statics 3(3-0-6) |
| Force system, resultants, equilibrium; structures and machines; distributed forces; friction, friction in machines; principle of virtual work; stability. |

| 2103212 Dynamics 3(3-0-6) |
| Condition: Corequisite 2103211 or 2103213 |
| Kinematics and kinetics of particles and planar rigid body; Newton's second law; equations of motion; work and energy; impulse and momentum of particles and planar rigid body; fundamental theory of vibration; free vibration and natural frequency. |

| 2103231 Mechanics of Materials I 3(3-0-6) |
| Condition: Corequisite 2103211 or 2103213 |
| Concept of stress and strain; stress and strain components; plane stress and plane strain; Mohr's circle of plane stress; Hooke's law and modulus of elasticity; engineering stress-strain diagrams; working stress design; stress in axial loading including statically indeterminate problems and temperature changes; thin-walled pressure vessel; torsion of circular shaft; statically indeterminate shaft; beam; stress in beam; deflection of beam; statically indeterminate beam; Euler's formula; combined stress. |

| 2103241 Thermodynamics I 3(3-0-6) |
| Some introductory comments, some concepts and definitions, properties of pure substances, work and heat, the first law of thermodynamics, the first law analysis for a control volume, the second law of thermodynamics, entropy, second law analysis for a control volume, power and refrigeration system. |

| 2103260 Mechanical Engineering Experimentation and Laboratory I 2(1-3-2) |
| Understanding the configuration and underlying principles/theories of mechanical engineering devices or systems; basic knowledge in measurement and instrumentation; basic concept in experimentation; conducting simple experiments using simple devices or systems. |

| 2103301 Design Methodology for Mechanical Engineering 3 (2-2-5) |
| Design process; defining design problems, conceptual design, evaluating conceptual design; configuration design; introduction to simple mechanisms and mechanical devices; standard parts in mechanical works; conceptual design project. |

| 2103303 Numerical Methods for Mechanical Engineering 3(3-0-6) |
| Digital computer principles and computer languages; root of algebraic and transcendental equations; solution of simultaneous algebraic equations; curve fitting; numerical integration and differentiation; numerical integration of ordinary differential equations; initial-value problems, ordinary differential equations, boundary-value problems. |

| 2103304 Automatic Control I 3(3-0-6) |
| Introduction to control system; mathematical models of systems; state-space description; dynamics simulation; feedback control system characteristics; the performance of feedback control systems; the stability of linear feedback systems; essential principles of feedback, the root-locus method; frequency response methods; stability of the frequency domain, time-domain analysis of control systems; the design and compensation of feedback control systems. |

| 2103305 Manufacturing Process for Mechanical Engineering 3(2-2-5) |
| Manufacturing process: casting, turning, milling, welding, heat treatment; manufacturing process selection for materials and shapes; manufacturing process selection for linear tolerance and geometric tolerance; surface roughness; metrology and examination techniques. |

| 2103306 Computer-Aided Mechanical Engineering Design 3(3-0-6) |

| 2103320 Design of Mechanical Elements 3(3-0-6) |
| Condition: Prerequisite 2103241 |
| Properties of materials, theory of failure; fatigue analysis for mechanical design, design of various interesting mechanical elements. |

| 2103322 Mechanics of Machinery 3(3-0-6) |
| Condition: Prerequisite 2103241 |
| Basic Mechanisms; Position, velocity and acceleration of Linkages, Graphical linkage synthesis; Linkage synthesis; Static and dynamic force analysis; Static and dynamic balancing of a simple rotating and reciprocating machine. |

| 2103325 Mechanical Engineering Design Project 2(0-4-2) |
| Condition: Corequisite 2103320, 2103322 and 2103361 |
| Conducting a practical interesting design; project presentation and complete report writing. |

| 2103331 Ship Strength I 3(3-0-6) |
| Quasi-static analysis of hull primary response; introduction to the probabilistic approach and strength of plated structures and ship's structural components; combined stresses and failure theories; framing systems; brittle fracture and fatigue failure modes; structural details; midship section synthesis, including classification society rules and techniques of stress superposition, material and fabrication consideration. |

| 2103332 Shipbuilding Engineering 3(3-0-6) |
| Ship types; shipbuilding materials and material testing; classification societies and related regulation; welding and cutting processes in shipbuilding; classification society weld testing; fabrication of main
ship structural items; keel and bottom construction; shell platting, framing systems and decks; bulkheads and pillars; superstructures, etc.; fabrication of minor ship structural items; pumping and piping system; ventilation, refrigeration and insulation; shipbuilding process; shipyard layout and facilities; shipbuilding quality control; shipyard management and organization; industrial relations and psychology.

2103342 Thermodynamics II 3(3-0-6)  
Condition: Prerequisite 2103241  
Gaseous mixture; thermodynamic relations; fuel and chemical reactions; irreversibility, availability or exergy and second law efficiency; compressible flow.

2103351 Fluid Mechanics I 3(3-0-6)  
Condition: Prerequisite 2103241  
Introduction and fundamental concepts: fluid as a continuum, velocity field, nature of forces in fluid; fluid statics: fluid in rigid-body motion; Reynolds' transport theorem; governing equations for fluid motion in integral form: conservation of mass, linear momentum, angular momentum, and energy; introduction to kinematics of fluid motion: Eulerian and Lagrangian description of fluid motion, substantial derivative, translation, rotation, vorticity and circulation, deformation; introduction to governing equations for fluid motion in differential form: conservation of mass, stress in fluid motion, resultant force due to stress, the Navier-Stokes equation; introduction to inviscid flow: Euler's equation, Bernoulli's equation; dimensional analysis and similarity; introduction to internal viscous flow: fully-developed laminar flow, flow in pipes and ducts, flow measurements; introduction to external viscous flow: boundary layer flow, flow about immersed bodies.

2103352 Ship's Buoyancy and Stability 3(2-3-4)  
Condition: Corequisite 2103351  
Ship geometry; ship's lines, nomenclature of form floating; buoyancy; computations of areas, volumes and moments, the properties of floating bodies, hydrostatic curves; equilibrium and initial stability: equilibrium of floating objects, initial stability, metacentric radius, the inclining experiment, trim, stability curves; cross curves, stability characteristics; weight effects of stability; weight effects of stability; weight addition weight removal, grounding and docking; impaired stability and control of damage, free surface, flooding, permeability, estimate of the damaged ship's condition.

2103360 Mechanical Engineering Experimentation and Laboratory II 2(1-3-2)  
Condition: Prerequisite 2103260  
Basic concepts and framework of experimentation; uncertainty analysis; analysis of data; interpretation of experimental results; analysis of characteristics and physical behavior of the system from experimental results via the use of physical observation and knowledge of basic physical principles; practices in applying principles and theories and evaluating the results of the application of such principles and theories in thermodynamics, fluid or solid mechanics systems.

2103361 Energy and Thermal-Fluid System Design I 3(3-0-6)  
Condition: Prerequisite 2103241 and 2103351  
Characteristics and performance of energy thermal-fluid systems; analysis; modeling; energy transformation; design constraints; economic concept in engineering design; parametric study; introduction to optimization.

2103382 Mechanics of Vehicles I 3(3-0-6)  
Condition: Prerequisite 2103211  
Dynamics of wheels, vehicle's resistance forces and power requirement; performance & fuel consumption; dynamics of breaking.

2103393 Mechanical Engineering Laboratory For No-N-ME 1(0-3-0)  
Condition: Prerequisite 2103241 or 2103295 or 210326121  
Experiments are designed to familiarize non mechanical students with experimental technique and instrumentations in the field of mechanical engineering. This course involves students working together in small groups on various experimental problems including gasoline and diesel engines, air compressor, hydraulic pump and turbine, friction loss in pipe and refrigeration cycle.

2103408 Automotive Control 3(3-0-6)  
Basic electronics; principle of feedback control system; digital control system; control device in automotive; sensors, controller, actuator; various control systems in automobile; system failure analysis.

2103409 Introduction to Mechatronics 3(3-0-6)  
Introduction to Mechatronic Systems: Digital circuits; OP-AMP and analog circuits; Sensors and Measurement Systems; Actuators; Microprocessor Programming, Project in Mechatronics.

2103437 Ship Design I 3(3-0-6)  
Condition: Prerequisite 2103352  
Ship types and rules of construction, international convention, ship owner's requirement, choice of vehicles; tendering and specifications; general design characteristics; estimation of principal parameters and dimensions; mass equations and estimation of masses, capacities, stability and trim; body plan design, choice of form and modification; producing of line plan general arrangement, inboard, inboard profile, out board profile, transverse sections through engine room and others; engine foundations, stumtube, struts, propellers rudders; engine room layout, piping systems; electric and electronic system, refrigerating systems and others.

2103460 Mechanical Engineering Experimentation and Laboratory III (ME EXP LAB III) 2(1-3-2)  
Condition: Prerequisite 2103380  
Concepts in experimentation and design of an experiment, setting up specifications and objectives of an experiment; systematic design of an experiment according to the specifications and objectives using tools such as data reduction diagram (DRD) and uncertainty analysis, and knowledge and application of basic physical principles, and knowledge of instruments and measurement; outlining the process of extracting experimental results and conclusions from the designed experiment; outlining of data collection and data analysis schemes; outlining of experimental project phases, tasks, and schedule; design documentation and review by oral and written presentation; practices in the design of an experiment in the project-based setting; introduction to modern instrumentation and data acquisition through demonstration.
2103461 Automotive Engineering Experimentation and Laboratory 2(1-3-2)
Basic concepts and framework of experimentation; uncertainty analysis; analysis of data; interpretation of experimental results; analysis of characteristics and physical behavior of the system from experimental results via the use of physical observation and knowledge of basic physical principles; practices in applying principles and theories in automotive systems.

2103462 Fluid Mechanics II 3(3-0-6)
Condition: Prerequisite 2103241 and 2103351
Fundamental concepts in fluid mechanics: methods of description of fluid motion, kinematics of fluid motion, stress at a point, the Navier-Stokes equation; inviscid irrotational flows: vorticity and circulation, velocity potential, stream function, Euler's equation of motion, Bernoulli's equation; elementary plane flows, flows, superposition of elementary plane flows, lift and circulation; laminar viscous flows: Poiseuille flow, Couette flow, flow between rotating concentric cylinders; laminar boundary layers: displacement and momentum thicknesses, thin shear layer assumption and laminar boundary layer equation, flat plate boundary layer, momentum integral equation; introduction to turbulent flows: mean flow and turbulence, the Reynolds-Average Navier-Stokes equation, turbulent flows in channel and pipe, turbulent boundary layers; lift and drag of immersed bodies; introduction to compressible flows: local isentropic reference states, steady one-dimensional compressible flows with area change, with friction, and with heat transfer, normal shock.

2103463 Heat Transfer 3(3-0-6)
Condition: Prerequisite 2103241 and 2103351
Modes of heat transfer; heat conduction equation; steady, one-dimensional heat conduction; steady, two-dimensional heat conduction; unsteady, one-dimensional heat conduction; Introduction to convection heat transfer; velocity and thermal boundary layer; forced convection along external surfaces; forced convection inside tubes; free convection; introduction to thermal radiation; blackbody radiation; real surface emission; surface absorption, reflection and transmission; view factor; radiation exchanger between blackbody; radiation exchanger between real surface; heat exchanger design; boiling and condensation.

2103471 Internal Combustion Engines 3(3-0-6)
Condition: Prerequisite 2103241
Fundamental of how the design and operation of internal combustion engine effect their performance and fuel requirements. Study of fluid flow, thermodynamics, combustion, heat transfer and friction phenomena, and fuel properties, reliance to engine power, efficiency, and emissions. Examination of design features and operating characteristics of different types of engine: spark-ignition, compression-ignition.

2103473 Ship Resistance and Powering 3(3-0-6)
Condition: Prerequisite 2103351
Frictional resistance, residuary resistance, wave making resistance, Froude's law of comparison; model tests; powering of ships; estimation of effective horse power; propulsion and propellers horsepower, wake thrust deduction, hull efficiency, propellers, geometry of the screw propeller, propellers and law of similarity, design procedure.

2103481 Automotive Engineering 4(3-3-6)
Condition: Consent of Faculty
Basic principles; suspension system; body and chassis, brake system; steering system; front wheel geometry; transmission system, automotive equipment; performance factors.

2103483 Automotive System Design 3(1-4-4)
A practical interesting automotive system design project assigned by the instructor; the project must be completed within one semester; a complete written design report is required.

2103489 Mechanical Engineering Pre-Project 1(0-2-1)
Condition: Senior Standing or Consent of Faculty
Conduct and complete design processes for a mechanical engineering project in a team as well as documenting and presenting the processes in a professional manner.

2103499 Mechanical Engineering Project 3(0-6-3)
Condition: Senior Standing or Consent of Faculty
Conduct and complete a mechanical engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

COURSES DESCRIPTIONS IN MECHANICAL ENGINEERING (GRADUATE LEVEL)

2103510 Mechanics of Composite Materials 3(3-0-9)
Basic concepts of fiber reinforced composite materials and their application, stress and strain analysis of continuous fiber composite materials; Hooke’s law and hygrothermal behavior of orthotrophic lamina; classical lamination theory, failure criterion, and design concepts, as applied to composite structures; analysis of composite beams and plates; introduction to material fabrication and testing.

2103530 Industrial Robots I 3(3-0-9)
Introduction Industrial Robots; robot reference frames; manipulator kinematics; inverse manipulator kinematics; Jacobian; manipulator dynamics; introduction to robot controls; trajectory generation; mechanism design; introduction to hybrid force/position control; summary.

2103532 Computer Aided Design and Computer Aided Manufacturing 3(2-3-7)
Introduction to CAD/CAM; basic concept of CAD/CAM/CAE; product design and strategy; 3D modeling concept; techniques for geometry modeling; surface design; computer aided manufacturing concept; the design and manufacturing interface; NC programming & verification; link to manufacture; CAD/CAM standard and data exchange; rapid-prototyping concept; total approach to product development.
2103535 Mechatronics 3(3-0-9)
Introduction to mechanical system interfacing; combinational digital logic; industrial electronic components; industrial sensors; simple computer structure; low level programming techniques; embedded control computers; microcontroller; stepping motors; DC motors; analog/digital conversion; position and velocity measurement; amplifiers; projects related to mechatronics.

2103540 Failure Analysis and Non-destructive Testing 3(2-3-7)
Condition: Consent of Faculty
Failure analysis; film interpretation; inspection standards; radiation scattering, image quality indicator; film and film protection: biological effects of radiation, safety and instruments; radiation principle; radiation safety and studies; and projects.

2103541 Vibration Monitoring and Analysis 3(2-3-7)
Condition: Consent of Faculty
Predictive maintenance; mechanical vibration; Fourier series and Fast Fourier Transform; vibration signals; diagnosis; setup of alarm band; case studies; and projects.

2103542 Radiographic Testing 3(2-3-7)
Condition: Consent of Faculty
Nondestructive testing; manufacturing processes and their discontinuities; radiation sources: X-ray, γ-ray, and instruments; radiation principle; radiation safety and protection; biological effects of radiation, safety instruments; radiographic inspection procedures; geometrical unsharpness, contrast and definition, radiation scattering, image quality indicator; film and film processing; film interpretation; inspection standards.

2103543 Ultrasonic Testing 3(2-3-7)
Condition: Consent of Faculty
Nondestructive testing; manufacturing processes and their discontinuities; theory of wave: characteristics and behavior of waves; ultrasonic instruments; probes, operations; ultrasonic inspection procedures: instrument calibration, normal probe inspection, angle probe inspection, immersion testing; inspection standards.

2103544 Eddy Current Testing 3(2-3-7)
Condition: Consent of Faculty
Nondestructive testing; manufacturing processes and their discontinuities; theory of eddy current: impedance plane diagram, correlations between coil impedance and sample properties; eddy current instruments: probes, operations; eddy current inspection procedures: frequency selection, instrument calibration, flat surface inspection, tube inspection; signal analysis; inspection standards.

2103545 Surface Method Testing 3(2-3-7)
Condition: Consent of Faculty
Nondestructive testing; manufacturing processes and their discontinuities; visual testing; liquid penetrant testing; types and properties of penetrant; inspection procedures; quality control and calibration of PT inspection system; inspection standards; magnetic particle testing; theory of magnetism; magnetic induction techniques: circular field, longitudinal field; inspection procedures; quality control and calibration of MT inspection system; inspection standards.

2103552 An Introduction to Computational Fluid Mechanics 3(3-0-9)

2103555 Engine Emissions and Control 3(3-0-9)
Air pollution system, effects of pollutants; engine fundamentals, engine emissions; emission control techniques; instrumentation and techniques for measuring emissions.

2103556 Fundamental of Engine Fuel Control System 3(3-0-9)
Fuel properties; fuel tank; carburetor; fuel injection system; injector; injection timing and control strategies; injector quality evaluation and testing; throttle body analysis and design; idle air control; fuel rail; fuel pumps and pressure regulator; fuel control systems for alternative fuels.

2103557 Catalytic Converters - Theory and Application 3(3-0-9)
Fundamental of pollution formation in IC engine; anatomy of a converter; converter design for optimizing flow; chemical reactions; catalyst performance and application; catalyst deactivation and contamination; performance control and calibration.

2103558 Intake Manifold and Induction System Design 3(3-0-9)
Engine intake manifold design; primary design parameters and tuning, analysis methods; multicylinder wave dynamics; flow losses in induction systems; testing method for performance evaluation; noise in induction system, silencers.

2103560 Gas Turbine Performance 3(3-0-9)
Condition: Prerequisite 2103342 and 2103351 or Consent of Faculty
Introduction, thermodynamics of gas turbine cycle: efficiency and output of hypothetical cycle of intercooling, reheat and regenerative separately and in combination; the aeroturbo-propeller engine; the turbojet engine, the bypass jet engine, the supersonic turbojet engine; component matching problem.

2103566 Compressible Fluid Dynamics 3(3-0-9)
Condition: Consent of Faculty
Thermodynamics of motion; physical acoustics; wave equation; speed of sound; quasi-one-dimensional flow with friction and heat addition; shock waves and related discontinuities; one-dimensional unsteady flow; two-dimensional steady flow; method of characteristics; nozzle design; linearized flow; flow visualization using optical techniques.

2103567 Turbulent Shear Flows 3(3-0-9)
Characteristics of turbulent flows; Reynolds equations; dynamics of turbulence; free turbulent shear flows; jets, wakes, mixing layers, channel and pipe flows; turbulent transport of scalar quantities.
2103570 Micro Fabrication Technology  3(3-0-9)
    Photo-lithography, etching, deposition, thermal oxidation, diffusion, ion implantation, bulk and surface micromachining, metrology, packaging, advanced lithography and the applications of micro and nanofabrication.

2103571 Micro and Nano Electromechanical Systems (MEMS-NEMS)  3(3-0-9)
    Overview of MEMS, review of engineering mechanics and thermo-fluid engineering, electromechanics and light phenomena, micro system design of micromechanical devices, MEMS materials; review of micro fabrication, applications of MEMS, micro sensor, micro actuator, micro fluidic systems, display technologies, future trends.

2103601 Advanced Engineering Mathematics  3(3-0-9)
    Numerical and graphical methods of approximate solution; finite difference method; calculus of variations, solution of classical partial differential equations of mathematical physics including application of conferral mapping and the Laplace transformation.

2103602 Measurement and Instrumentation  3(2-3-7)
    Generalized performance characteristic of instruments; static and dynamic characteristics, study of measurement method for temperature, pressure, mass flow, stress-strain and vibration; experimental design and data analysis.

2103603 Mathematics for Control Engineers  3(3-0-9)
    System representation; linear system analysis; state-space solutions and realizations; stability; controllability and observability; minimal realization; nonlinear systems analysis; phase plane analysis; Lyapunov theory for autonomous system; introduction to Lyapunov theory for non-autonomous systems; differential geometry; Lie derivative and Lie bracket; the Frobenius theorem; describing function analysis; Fourier series; Fourier integral; discrete-time mathematics: notations, tensor and operations, mathematical physics including application of conferral mapping and the Laplace transformation.

2103604 Advanced Numerical Methods  3(3-0-9)
    Solution of equation; numerical Instabilities and their cure; simultaneous linear algebraic equations; numerical differentiation and integration; least squares approximations; ordinary differential equations; boundary value problems; partial differential equations.

2103612 Elasticity  3(3-0-9)
    Two and three dimensional stress and strain analysis, theory of elasticity, Hooke's law for two and three dimensional problems, equilibrium conditions, compatibility conditions; stress function: two and three dimensional problems in Cartesian, polar and curvilinear coordinate systems; introduction to three dimensional elasticity.

2103613 Plasticity  3(3-0-9)
    Stress tensors and tensor notations, yield criteria, stress-strain relations, plastic-elastic problems, introduction to incremental plasticity theory, plane strain compression, slip-line fields, friction effects, extrusion, deep drawing, rolling, limit analysis, upper bound and lower bound solutions.

2103614 Continuum Mechanics  3(3-0-9)
    Introduction to continuum mechanics; Essential mathematics: notations, tensor and operations, transformation, integral theorems of Gauss and Stokes; Kinematics of deformation and motion; Stress principles; Governing equations; Constitutive equations; Applications (heat conduction, solid mechanics, fluid mechanics); Introduction to computational modelling.

2103615 Mechanical Vibrations  3(3-0-9)
    One degree of freedom systems; applications of vibration principles to various types of practical problems; multi-degrees of freedom systems, formulation of equation, numerical solving methods, continuous system, non-linear vibration.

2103616 Optimum Design of Complex Mechanical Elements  3(3-0-9)
    Techniques for optimum design with application to simple mechanical elements in problem with practical constraints.

2103617 Advanced Dynamics  3(3-0-9)
    Kinematics and kinetics of particles; variable mass problems; rigid body dynamics; Lagrange's equation; Hamilton's principle; Hamilton's canonical equations; Hamilton-Jacobi theory.

2103618 Theory of Plates  3(3-0-9)
    Solution of equation; numerical Instabilities and their cure; simultaneous linear algebraic equations; numerical differentiation and integration; least squares approximations; ordinary differential equations; boundary value problems; partial differential equations.

2103619 Theory of Shells  3(3-0-9)
    Solution of equation; numerical Instabilities and their cure; simultaneous linear algebraic equations; numerical differentiation and integration; least squares approximations; ordinary differential equations; boundary value problems; partial differential equations.

2103620 Theory of Elastic Stability I  3(3-0-9)
    Stability of mechanical models and elastic beams by classical, kinetic, and energy approaches; snapthrough and bifurcation buckling; buckling of beams on elastic foundation; approximate methods for critical loads, buckling of rings and arches.

2103621 Energy Principles in Solid Mechanics  3(3-0-9)
    Variational calculus; energy principles of structural mechanics; Hamilton's principle and Lagrange's equations; formulation and solution of engineering problems by direct variational methods.
2103622 Analysis of Composite Structures 3(3-0-9)
Concept and analysis structural response of laminated composite components; bending, vibration and stability of laminated composite structures; interlaminar stresses; effect of shear deformation on structural response; numerical modeling of laminated plates.

2103623 Fatigue of Metals 3(3-0-9)
Fatigue damage process; analysis and design against fatigue failure through stress-based, strain-based and fracture mechanics-based approaches; problems of high temperature fatigue.

2103625 Advanced Finite Element Method 3(3-0-9)
Procedures of the finite element method for structural, thermal and fluid differential equations; nonlinear structural static and dynamic problems with discrete and continuum structures; transient nonlinear heat transfer problems with conduction, convection and radiation; steady and unsteady nonlinear incompressible and compressible fluid flow problems.

2103626 Thermal Stress Analysis 3(3-0-9)

2103630 Industrial Robots II 3(3-0-9)
Condition: Prerequisite 2103530 or Consent of Faculty
Arm kinematics, homogenous transformation, Denavit-Hartenberg representation, kinematic equations for manipulators, inverse kinematics solutions, differential relationships of arm kinematics, arm dynamics, Lagrange-Euler equations of motion of robot manipulator arms, Newton-Euler formulation, computer simulation of arm dynamics, control of multiple-joint manipulator arms.

2103631 Control of Dynamic Systems 3(3-0-9)
Classical control; linear system theory; response of linear, lumped-parameter stationary systems; stability of linear lumped-parameter stationary systems; scalar input-output systems and feedback control; frequency response; introduction to multi-variable control systems; linear digital control.

2103632 Applied Nonlinear Control 3(3-0-9)
Introduction; phase plane analysis; describing function analysis; feedback linearization; sliding control; adaptive control.

2103633 Applied Optimal Control 3(3-0-9)
Introduction; parameter optimization problems, optimization problems for dynamic systems, optimization problems for dynamic systems with path constraints, optimal feedback control, linear system with quadratic criteria.

2103634 Dynamic System Modeling and Simulation 3(3-0-9)
Mechanical background; mathematical modeling and numerical solution of engineering problems; modeling of mechanical systems; model representation and response; modeling of electrical, hydraulic and thermal system; modeling of mixed systems; time response analysis of linear dynamic systems; introduction to optimization and numerical solution; solution techniques for non-linear systems; signal processing.

2103650 Advanced Engineering Thermodynamics 3(3-0-9)
Review of principles and essential concepts; thermodynamic properties relations of mixtures and solutions, chemical reactions, introduction to phase and chemical equilibrium; thermodynamics of high speed flow.

2103651 Advanced Fluid Mechanics 3(3-0-9)
Review of principles and concepts; Cartesian tensor; transport equ.; special model for steady laminar flow; shear flows, boundary layer equations, the concept of similarity; turbulent flow.

2103652 Combustion Theory 3(3-0-9)
Review of combustion processes, review of chemical thermodynamics, combustion theory, analysis, equation of Arrhenius, activation energy, reaction orders, chain reactions, premixed laminar flames, thermal theories, comprehensive theory, Spalding's theory, ignition, minimum ignition energy, quenching distance, application in combustion engineering.

2103653 Fluid Dynamic Aspects of Wind Turbines 3(3-0-9)
Basic fluid dynamics, aerodynamic theory, boundary layers, aerofoils; basic wind turbines; characteristics and mathematical modelling. principles of testing.

2103654 Conduction Heat Transfer 3(3-0-9)
Introduction; definition of concept and statement of general laws; formulation of heat conduction equations; lumped integral and differential formulation of general laws; initial and boundary conditions. solutions for steady and unsteady problems, one; two and three dimensional problems; method of solution, separation of variables, Laplace transform, partial solution, etc.

2103655 Convection Heat Transfer 3(3-0-9)
Physics of radiation; radiation properties, radiation shapes factor; radiative exchange between surfaces; radiation through absorbing and transmitting media, radiation properties of gases; solar radiation.

2103658 Advanced Internal Combustion Engine 3(3-0-9)
Standard air engine cycle, theory of combustion, fuel and combustion, reaction kinetics, reaction rates of air and fuel, engine combustion, gas exchange processes, heat transfer, principle of flow and combustion process modelling, engine's performance prediction.

57
2103659 Utilization of Alternative Fuels 3(3-0-9)
Special requirements for the use of alternative fuels in furnaces, the use of alternative fuels in transport, engine-fuels matching and optimisation, alternative engines, durability, vehicle fuel storage options, engine-vehicle matching.

2103660 Fundamentals of Turbulence 3(3-0-9)
Stochastic tools in turbulence: Reynolds equations; mean and turbulent kinetic energy equations; Reynolds-stress transport equation; dynamics of one- and two-point velocity correlations; dynamic equation for the energy spectrum; isotropic turbulence; homogeneous shear-flow turbulence; transport processes in turbulent flows.

2103663 Advanced Refrigeration and Air Conditioning 3(3-0-9)
Condition: Prerequisite 2103443, 2103454 or Consent of Faculty
Low temperature refrigeration, refrigeration system study, industrial applications of refrigeration, air conditioning system and building thermal environmental influences on air conditioning design, ventilation, direct contact, transfer processes between moist air and water, flow in ducts and a unconfined spaces, automatic control, testing, adjusting and balancing, economic factors in air conditioning, noise, and vibration control.

2103664 Design of Thermal System 3(3-0-9)
Condition: Prerequisite 2103443
Engineering design, design of a workable system, economics, equation fitting and mathematical modelling, system simulation, optimization, Lagrange multipliers, search methods, dynamic programming, linear programming.

2103665 Advanced Computational Fluid Dynamics 3(3-0-9)
Mathematical and Numerical aspects of heat transfer and Fluid mechanics, finite difference and finite volume methods for solving basic governing equations of fluid flow and heat transfer; continuity, momentum and energy, discretisation methods for two and three dimensional problems, boundary conditions, numerical schemes and solvers, consistency, stability and convergence, advanced numerical techniques for CFD, applications of the method for some engineering problems.

2103666 Finite Element Method for Computational Fluid Dynamics 3(3-0-9)
Finite element method for solving fluid dynamics problems with complex geometries under different boundary conditions; solutions the problem of potential flows, inviscid and viscous flows, incompressible and compressible flows; finite element equations and corresponding computer programs in each case.

2103701 Selected Topics in Mechanical Engineering 3(3-0-9)
Topics are drawn from various fields of current interest in mechanical engineering.

2103720 Theory of Elastic Stability II 3(3-0-9)
Condition: Prerequisite 2103619, 2103620 or Consent of Faculty
Linear and nonlinear theories for shell buckling; stability of thin stiffened and unstiffened plates and cylindrical shells under various loads; edge effects; imperfection sensitivity studies.

2103721 Fracture Mechanics 3(3-0-9)
Condition: Prerequisite 2103612 or Consent of Faculty
Rheology, model and law of material evolution in time, model of elastic material; model of non-elastic material; linear model of Newton, Maxwell and Voight Kehin; application of Zener’s solid; elementary crystal model linear solid generalization; dynamic equation. Fracture mechanics, Griffith criteria; stress intensity, influence of plastic zone at notch root; crack opening displacement.

2103722 Elasticity II 3(3-0-9)
Condition: Prerequisite 2103612
Torsion, bending of bars, axisymmetric stress and deformation in a solid of revolution, thermal stress, the application of finite difference equations in elasticity, strain energy.

2103723 Plasticity II 3(3-0-9)
Condition: Prerequisite 2103612
Numerical approximation of some elastic-plastic problems, study of residual stresses induced by plastic deformation, shakedown analysis of elastic-plastic system, finite element formulation of small strain elastic-plastic deformation, introduction to large strain elastic-plastic deformation.

2103724 Contact Mechanics 3(3-0-9)
Condition: Prerequisite 2103612
Stress analysis of a wedge loaded along the faces, motion and forces at a point of contact, line loading of an elastic half space, point loading of an elastic half space, normal contact of elastic solids, Hertz theory, non-Hertzian normal contact of elastic bodies, normal contact of inelastic solids, tangential loading and sliding contact, rolling contact of elastic bodies, rolling contact of inelastic bodies.

2103790 Seminar in Mechanical Engineering 1(0-3-1)
Discussion of special topics in the advent of mechanical engineering; written report is required.

2103811 Thesis 12 credits
2103813 Thesis 18 credits
2103816 Thesis 36 credits
2103828 Dissertation 48 credits
2103829 Dissertation 60 credits
2103894 Doctoral Dissertation Seminar 0(0-0-0)
2103897 Qualifying Examination 0(0-0-0)
DEPARTMENT OF INDUSTRIAL ENGINEERING

The courses in industrial engineering are designed to produce engineers specializing in problem solving and decision making functions. To this end, production, planning and control, work study, quality assurance and control, systems and procedures analysis of emphasized in general, practical applications of production oriented operations research techniques, data processing, and computer programming fundamentals are also stressed. As well as the aforementioned techniques, the department is also making an effort in developing studies on human aspects industry as exemplified by the topics of human relationship in industry, ergonomics (Small group activities) and industrial law.

The Department of Industrial Engineering provides the Bachelor of Engineering degree, the Master of Engineering degree, and the Doctor of Philosophy (Ph.D.).

HEAD:

Paveena Chaovalitwongse, Ph.D. (Florida)

PROFESSORS:

Parames Chutima, Ph.D. (Nottingham)

ASSOCIATE PROFESSORS:

Jittra Rukijkanpanich, D.Eng. (A.I.T.)
Jirapat Ngaoprasertwong, M.Sc. (Iowa)
Natcha Thawesaengskulthai, Ph.D. (Nottingham)
Paveena Chaovilaiwongse, Ph.D. (Florida)
Somkiet Tangjitsitcharon, D.Eng. (Kobe)
Suthas Ratanakukangwan, E.S.S. (Toulouse)
Wipawee Thammaphornphilas, Ph.D. (Pittsburgh)

ASSISTANT PROFESSORS:

Angsumalin Senjuntichai, D.Eng. (A.I.T.)
M.S.I.E. (Minnesota)
Daricha Sutivong, Ph.D. (Stanford)
Haruetai Mekaroonreung, MS. (VPI & SU)
Naragain Phumchusri, Ph.D. (Georgia Tech)
Napassavong Osotsilp, Ph.D. (Wisconsin-Madison)
Oran Kittithreepromchai, Ph.D. (Georgia Tech)
Pramual Suteecharuwat, Ph.D. (TITECH)
Prasert Akkharapratthompong, M.Eng. (Keio)

Seeronk Prichanont, Ph.D. Wisconsin-Madison)
Somchai Puajindanetr, Ph.D. (LONDON)
Surapong Sirikulvadhana, MS,EE,MS,IEOR

LECTURERS:

Arisara Jiamsanguanwong D.Eng.(Tokyo Tech)
Phairoat Ladavichitkul, Ph.D. (Texas Tech)
Pisit Jarumaneeroj, Ph.D. (Georgia Tech)
Poom Luangjarmekorn, M.Eng. (Nagoya) (Michigan Ann Arbor)
Worachok Chaiwong, M.Eng. (Chula)

INDUSTRIAL ENGINEERING UNDERGRAD PROGRAMS

The department provides two undergraduate programs of study: a general program and a co-operative education program. Similar to all other engineering curriculums, the general program requires 2 credits of engineering practice during the summer semester. The co-operative education program offers a whole semester longer time for students to practice their skills in real workplaces.
# INDUSTRIAL ENGINEERING CURRICULUM OF BACHELOR’S DEGREE

## FIRST YEAR CURRICULUM

### COMMON TO ALL ENGINEERING STUDENTS

#### GENERAL STUDY PROGRAM

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>THIRD SEMESTER</td>
<td>SIXTH SEMESTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103213</td>
<td>ENGINEERING MECHANICS I</td>
<td>3</td>
<td>2104352</td>
<td>FACILITY DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2104251</td>
<td>INTRODUCTION TO MANUFACTURING SYSTEMS</td>
<td>2</td>
<td>2104358</td>
<td>INTRODUCTION TO SAFETY</td>
<td>3</td>
</tr>
<tr>
<td>2104253</td>
<td>ENGINEERING STATISTICS I</td>
<td>3</td>
<td>2104354</td>
<td>INDUSTRIAL COST ANALYSIS</td>
<td>3</td>
</tr>
<tr>
<td>2301312</td>
<td>DIFFERENTIAL EQUATIONS</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5500208</td>
<td>COMMUNICATION AND PRESENTATION SKILLS</td>
<td>3</td>
<td>2104359</td>
<td>SIMULATION PROGRAMMING</td>
<td>3</td>
</tr>
<tr>
<td>2104255</td>
<td>APPLICATION DEVELOPING FOR INDUSTRIAL ENGINEERING</td>
<td>3</td>
<td>2106362</td>
<td>INDUSTRIAL ENGINEERING LAB II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
<td>5500308</td>
<td>TECHNICAL WRITING FOR ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOURTH SEMESTER</td>
<td>SUMMER SEMESTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103261</td>
<td>FUNDAMENTALS OF THERMO-FUID ENGINEERING</td>
<td>3</td>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2 (S/U)</td>
</tr>
<tr>
<td>2103392</td>
<td>ME LAB FOR NON ME</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104252</td>
<td>OPERATIONS MANAGEMENT</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104254</td>
<td>ENGINEERING STATISTICS II</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104256</td>
<td>QUALITY MANAGEMENT</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104257</td>
<td>MANUFACTURING PROCESSES</td>
<td>3</td>
<td>2104491</td>
<td>INDUSTRIAL ENGINEERING</td>
<td>1</td>
</tr>
<tr>
<td>2104258</td>
<td>MANUFACTURING PROCESSES LABORATORY</td>
<td>1</td>
<td>xxxxxxxx</td>
<td>ELECTIVE</td>
<td>6</td>
</tr>
<tr>
<td>2104259</td>
<td>OPERATIONS RESEARCH</td>
<td>3</td>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>xxxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>FIFTH SEMESTER</td>
<td>EIGHTH SEMESTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2102391</td>
<td>ELECTRICAL ENGINEERING I</td>
<td>3</td>
<td>2104409</td>
<td>INDUSTRIAL BUSINESS MANAGEMENT</td>
<td>3</td>
</tr>
<tr>
<td>2102392</td>
<td>ELECTRICAL ENGINEERING LABORATORY I</td>
<td>1</td>
<td>2104425</td>
<td>MAINTANANCE ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>2104351</td>
<td>WORK DESIGN</td>
<td>3</td>
<td>2104499</td>
<td>INDUSTRIAL ENGINEERING PROJECT</td>
<td></td>
</tr>
<tr>
<td>2104353</td>
<td>ENGINEERING ECONOMY</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104355</td>
<td>COMPUTER AND INFORMATION TECHNOLOGY FOR IE</td>
<td>2</td>
<td>2100499</td>
<td>SENIOR PROJECT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>QUALITY CONTROL</td>
<td>2</td>
<td>xxxxxxxx</td>
<td>ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>2104357</td>
<td>ENGINEERING EXPERIMENTAL DESIGN</td>
<td>3</td>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>2104361</td>
<td>INDUSTRIAL ENGINEERING LAB</td>
<td>1</td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION = 144**
### INDUSTRIAL ENGINEERING CURRICULUM OF BACHELOR'S DEGREE

**FIRST YEAR CURRICULUM**

**COMMON TO ALL ENGINEERING STUDENTS**

**CO-OPERATIVE EDUCATION PROGRAM**

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>ENGINEERING MECHANICS I</td>
<td>3</td>
<td>2104352</td>
<td>FACILITY DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2104251</td>
<td>INTRODUCTION TO MANUFACTURING SYSTEMS</td>
<td>2</td>
<td>2104358</td>
<td>INTRODUCTION TO SAFETY ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>2104253</td>
<td>ENGINEERING STATISTICS I</td>
<td>3</td>
<td>2104354</td>
<td>INDUSTRIAL COST ANALYSIS AND BUDGETING</td>
<td>3</td>
</tr>
<tr>
<td>2301312</td>
<td>DIFFERENTIAL EQUATIONS</td>
<td>3</td>
<td>5500208</td>
<td>COMMUNICATION AND PRESENTATION SKILLS</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>DIFFERENTIAL EQUATIONS</td>
<td>3</td>
<td>2104359</td>
<td>SIMULATION PROGRAMMING</td>
<td>3</td>
</tr>
<tr>
<td>2104255</td>
<td>APPLICATION DEVELOPING FOR INDUSTRIAL ENGINEERING</td>
<td>3</td>
<td>2106362</td>
<td>INDUSTRIAL ENGINEERING LAB II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
<td>5500308</td>
<td>TECHNICAL WRITING FOR ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FOURTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103261</td>
<td>FUNDAMENTALS OF THERMO-FLUID ENGINEERING</td>
<td>3</td>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2 (S/U)</td>
</tr>
<tr>
<td>2103392</td>
<td>ME LAB FOR NON ME</td>
<td>1</td>
<td>2100499</td>
<td>SENIOR PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2104252</td>
<td>OPERATIONS MANAGEMENT</td>
<td>2</td>
<td>2104409</td>
<td>INDUSTRIAL BUSINESS MANAGEMENT</td>
<td>3</td>
</tr>
<tr>
<td>2104254</td>
<td>ENGINEERING STATISTICS II</td>
<td>3</td>
<td>2104425</td>
<td>MAINTENANCE ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>2104256</td>
<td>QUALITY MANAGEMENT</td>
<td>2</td>
<td>2104351</td>
<td>WORK DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2104257</td>
<td>MANUFACTURING PROCESSES</td>
<td>3</td>
<td>2104353</td>
<td>ENGINEERING ECONOMY</td>
<td>3</td>
</tr>
<tr>
<td>2104258</td>
<td>MANUFACTURING PROCESSES LABORATORY</td>
<td>1</td>
<td>2104355</td>
<td>COMPUTER AND INFORMATION TECHNOLOGY FOR IE</td>
<td>2</td>
</tr>
<tr>
<td>2104259</td>
<td>OPERATIONS RESEARCH</td>
<td>3</td>
<td>2104361</td>
<td>INDUSTRIAL ENGINEERING LAB</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FIFTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102391</td>
<td>ELECTRICAL ENGINEERING I</td>
<td>3</td>
<td>2104409</td>
<td>INDUSTRIAL BUSINESS MANAGEMENT</td>
<td>3</td>
</tr>
<tr>
<td>2102392</td>
<td>ELECTRICAL ENGINEERING LABORATORY I</td>
<td>1</td>
<td>2104425</td>
<td>MAINTENANCE ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>2104351</td>
<td>WORK DESIGN</td>
<td>3</td>
<td>xxxxxxx</td>
<td>ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>2104353</td>
<td>ENGINEERING ECONOMY</td>
<td>3</td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>9</td>
</tr>
<tr>
<td>2104355</td>
<td>COMPUTER AND INFORMATION TECHNOLOGY FOR IE</td>
<td>2</td>
<td>2104361</td>
<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>2104365</td>
<td>QUALITY CONTROL</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104357</td>
<td>ENGINEERING EXPERIMENTAL DESIGN</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104361</td>
<td>INDUSTRIAL ENGINEERING LAB</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION = 144**
NAME OF THE DEGREE
: Master of Engineering
: M. Eng.

COURSE REQUIREMENTS

1) Required Courses 6 credits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2104688</td>
<td>Research Methodology in Industrial Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>and Operations Management</td>
<td>(S/U)</td>
</tr>
<tr>
<td>2104690</td>
<td>Quantitative Data Analysis for Industrial</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Engineering</td>
<td></td>
</tr>
</tbody>
</table>

2) Approved Elective 9 credits

The students must select 2 fields in the approved elective courses with a minimum of 2 subjects in each selected field.

- Operations Research
  - Quality Management and Control
  - Production Engineering
  - Safety Engineering and Ergonomics
  - Industrial Management

Remark: Approved electives and subjects to change, with approval from the committee of the program or Industrial Engineering Department.

3) Free Elective 12 credits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2104505</td>
<td>Machinery and Instrument Appraisal</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104506</td>
<td>Engineering Project Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104507</td>
<td>Logistics and Supply Chain Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104509</td>
<td>Warehouse and Warehousing Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104511</td>
<td>Introduction to Virtual Environments</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104512</td>
<td>Production And Operations Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104513</td>
<td>Industrial Engineering Integration</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104515</td>
<td>Responsible Care</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104516</td>
<td>Quality Improvement</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104518</td>
<td>Quality System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104520</td>
<td>Visual Factory</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104521</td>
<td>Computer Programming for Industrial Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104523</td>
<td>Introduction to Stochastic Models</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104524</td>
<td>Operations &amp; Service Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104525</td>
<td>Work Process Design and Improvement</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104555</td>
<td>System Safety</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104559</td>
<td>Risk Management for Industry</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104601</td>
<td>Engineering Economic Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104602</td>
<td>Analysis of Business System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104603</td>
<td>Advanced Quality Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104604</td>
<td>Advanced Quality Management and Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104609</td>
<td>Reliability Theory in Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104611</td>
<td>Inventory Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104612</td>
<td>Computer Simulation Techniques</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104613</td>
<td>Principle of Optimization</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104615</td>
<td>Engineering Experimental Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104616</td>
<td>Activity Scheduling</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104617</td>
<td>Industrial Scheduling</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104624</td>
<td>Factory and Production Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104625</td>
<td>Computerized Statistical Data Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104562</td>
<td>Materials and Processing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104627</td>
<td>Product and Production Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104637</td>
<td>Coordination and Communication</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104640</td>
<td>Decision Analysis in Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104644</td>
<td>Advanced Maintenance Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104645</td>
<td>Advanced Industrial Organization and Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104650</td>
<td>Project Management Concepts</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104651</td>
<td>Engineering Economic Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104652</td>
<td>Product and Production Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104653</td>
<td>Coordination and Communication</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104654</td>
<td>Decision Support Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104655</td>
<td>Advanced Maintenance Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104656</td>
<td>Applied Biomechanics</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2104657</td>
<td>Work Physiology</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2104658</td>
<td>Hazardous Material and Fire Protection Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104659</td>
<td>Strategic Planning for Engineers</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104660</td>
<td>Project Management Concepts</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104661</td>
<td>Advanced Work Design</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2104662</td>
<td>Seminar in Safety Engineering</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2104663</td>
<td>Research Problems in Industrial</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td></td>
<td>Engineering I (OR techniques)</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>2104692</td>
<td>Research Problems in Industrial Engineering II</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>(Production techniques)</td>
<td></td>
</tr>
<tr>
<td>2104693</td>
<td>Research Problems in Industrial Engineering III</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>(Management Techniques)</td>
<td></td>
</tr>
<tr>
<td>2104694</td>
<td>Research Problems in Industrial Engineering IV</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>(Safety)</td>
<td></td>
</tr>
<tr>
<td>2104711</td>
<td>Advanced Manufacturing Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104723</td>
<td>Artificial Intelligence for Industrial Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2104741</td>
<td>Comparative Engineering Management</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

**Remark**: The student can select other courses offered by the Industrial Engineering, which will be announced by the Industrial Engineering Department.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2104811</td>
<td>Thesis</td>
<td>12</td>
</tr>
</tbody>
</table>

12 credits
## INDUSTRIAL ENGINEERING CURRICULUM OF MASTER'S DEGREE

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FIRST SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104688</td>
<td>RES METHOD IEOM</td>
<td>3</td>
<td>2104811</td>
<td>THESIS</td>
<td>3</td>
</tr>
<tr>
<td>2104690</td>
<td>QUAN DATA ANAL IE</td>
<td>3</td>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>6</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVES</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SECOND SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
<td>2104811</td>
<td>THESIS</td>
<td>6</td>
</tr>
<tr>
<td>2104811</td>
<td>THESIS</td>
<td>3</td>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL CREDITS FOR GRADUATION = 39</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## INDUSTRIAL ENGINEERING CURRICULUM OF DOCTORAL DEGREE

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FIRST SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104781</td>
<td>DOCTORAL SEMINAR</td>
<td>(1)*</td>
<td>2104784</td>
<td>DOCTORAL SEMINAR</td>
<td>(1)*</td>
</tr>
<tr>
<td></td>
<td>IN INDUSTRIAL ENGINEERING I</td>
<td></td>
<td></td>
<td>IN INDUSTRIAL ENGINEERING IV</td>
<td></td>
</tr>
<tr>
<td>2104828</td>
<td>DISSERTATION</td>
<td>6</td>
<td>2104828</td>
<td>DISSERTATION</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td><strong>SECOND SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104782</td>
<td>DOCTORAL SEMINAR</td>
<td>(1)*</td>
<td>2104785</td>
<td>DOCTORAL SEMINAR</td>
<td>(1)*</td>
</tr>
<tr>
<td></td>
<td>IN INDUSTRIAL ENGINEERING II</td>
<td></td>
<td></td>
<td>IN INDUSTRIAL ENGINEERING V</td>
<td></td>
</tr>
<tr>
<td>2104828</td>
<td>DISSERTATION</td>
<td>6</td>
<td>2104828</td>
<td>DISSERTATION</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td><strong>THIRD SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104783</td>
<td>DOCTORAL SEMINAR</td>
<td>(1)*</td>
<td>2104786</td>
<td>DOCTORAL SEMINAR</td>
<td>(1)*</td>
</tr>
<tr>
<td></td>
<td>IN INDUSTRIAL ENGINEERING III</td>
<td></td>
<td></td>
<td>IN INDUSTRIAL ENGINEERING VI</td>
<td></td>
</tr>
<tr>
<td>2104828</td>
<td>DISSERTATION</td>
<td>9</td>
<td>2104828</td>
<td>DISSERTATION</td>
<td>9</td>
</tr>
<tr>
<td>2104897</td>
<td>QUALIFYING EXAM</td>
<td>0</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL CREDITS FOR GRADUATION = 48</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: (*1) Credits for this course are not assessed towards the degree program

(*3) Credits for this course are not assessed towards the degree program
COURSE DESCRIPTIONS IN INDUSTRIAL ENGINEERING (B.ENG.)

2104204 General Manufacturing Process Lab 1(0-3-0)
Basic measuring equipment and general manufacturing process; drawing and reading designs for work operation; use of tools in designing and work operation and use of machine for manufacturing; turning machine, milling machine, drilling machine; designing and manufacturing parts and conclusion of work operation in the manufacturing process.

2104251 Introduction to Manufacturing Systems 2(2-0-4)
Manufacturing systems overview; systematic problem solving; modeling in IE and performance measurement; basic IE tools and techniques; management concepts in manufacturing systems; push and pull manufacturing concepts; logistics and supply chain management.

2104252 Operations Management 2(2-0-4)
Condition: Prerequisite 2104251 or Consent of Faculty
Operations strategies, inventory and distribution management, capacity management, aggregate planning, master production scheduling, material requirements planning, operation scheduling, project management.

2104253 Engineering Statistics I 3(3-0-6)
Basis Engineering in Descriptive statistics; probability; discrete probability distributions; continuous probability distributions; joint probability distributions; point estimation; interval estimation; hypothesis and statistical inference for one population; engineering applications.

2104254 Engineering Statistics II 3(3-0-6)
Condition: Prerequisite 2104253 or Consent of Faculty
Basis Engineering in Hypothesis and statistical inference for two populations; analysis of variance; randomized blocks; latin square design; goodness of fit test; non-parametric statistics; linear regression analysis; time-series analysis; engineering applications.

2104255 Application Developing for Industrial Engineering 3(2-3-4)
Condition: Prerequisite 2110101 or Consent of Faculty
Application Developing for Industrial Engineering; object-oriented programming; event-driven programming; application developing from data structure and algorithm; application design.

2104256 Quality Management 2(2-0-4)
Quality philosophy; quality management strategies: total quality management (TQM), Six Sigma; quality system management: ISO, Thailand Quality Award (TQA); problem solving tools; team building techniques; organizing for quality.

2104257 Manufacturing Processes 3(3-0-6)
Introduction to manufacturing industry; economic principles of manufacturing processes; mechanical characterization of materials; casting; metal forming; rolling, metal drawing, extrusion, forging, cold forming; machining; turning, shaping and planning, milling, grinding; non-traditional machining; metal cutting; tool shape, forces and power requirement in metal cutting; tool’s life equations; power metallurgy and cutting tool material; welding technology and welding inspection; CNC technology.

2104258 Manufacturing Processes Laboratory 1(0-3-0)
Practice in manufacturing processes; machining and hand tools, heat treatment, welding and casting.

2104259 Operations Research 3(3-0-6)
Deterministic operations research in industrial engineering problem solving with emphasis on the use of mathematical models; linear programming; transportation model; and game theory.

2104351 Work Design 3(2-3-4)
Fundamentals of method, work and process analysis; line balancing; collection of operational data, process improvement through the use of flow process chart; operation process chart (assembly process chart), Gantt chart, multi-activity chart, motion Study (micro motion study), introduction to anthropometry, work physiology and biomechanics, macro and temporal ergonomics, guidelines for design and organization of work stations, guidelines for manual material handling and hand tools, guidelines for controls and displays, principles of motion economy, proposed method implementation, learning curves, stopwatch time study, performance rating and allowances, standard data and formulas, predetermined time systems, work sampling, indirect and expense labor standards.

2104352 Facility Design 3(3-0-6)
Condition: Prerequisite 2104351 or Consent of Faculty
Introduction to facility design; importance and process of facility design; preliminary analysis of facility design: layout and related factors: products, processes, material handing, machine, man, selection of facility location.

2104353 Engineering Economy 3(3-0-6)
Interest formulation; time value of money; equivalent value and rate of return; project analysis and evaluation; breakeven point; sensitivity analysis; risk and uncertainty analysis; asset replacement decision; depreciation and tax.

2104354 Industrial Cost Analysis and Budgeting 3(3-0-6)
Condition: Prerequisite 2104353 or Consent of Faculty
Fundamentals of financial reports; cost analysis for planning process; capital expenditure; cost control and opportunity loss management; capital rationing; profitability analysis and decision making for investment in challenging projects under uncertainty and risk.
2104355 Computer and Information Technology for Industrial Engineering 2(1-3-2)
Condition: Prerequisite 2104351 or Consent of Faculty
Database system; network systems; information communication technology; network application development

2104356 Quality Control 2(2-0-4)
Condition: Prerequisite 2104253 and 2104254 or Consent of Faculty
Quality control philosophy; methods of statistical quality control; control charts, process capability analysis, measurement system analysis, acceptance sampling; product reliability.

2104357 Engineering Experimental Design 3(3-0-6)
Condition: Prerequisite 2104254 or Consent of Faculty
Factorial design; 2^k factorial design; blocking and confound; fractional factorial design; factorial experiments with random factors; nested and split-plot design; non-linear regression analysis; response surface analysis.

2104358 Safety Engineering 3(3-0-6)
Safety principles and safety standards; basic human anatomy; study of the following hazards: noise, chemicals, electricity, fire, radiation, machine tools and pressure vessels, work in hot environment; hazard prevention method; accident investigation techniques; safety law; principle of safety management; introduction to industrial psychology; laboratory and field trips.

2104359 Simulation Programming 3(3-0-6)
Condition: Prerequisite 2104253, 2104254 or Consent of Faculty
Probabilistic operations research in industrial engineering problem solving with emphasis on the use of simulation; queueing theory; and inventory model.

2104361 Industrial Engineering Laboratory 1(0-3-0)
Laboratory work related to design, assign, control, and evaluation of work considering productivity and quality aspects.

2104362 Industrial Engineering Laboratory II 1(0-3-0)
Laboratory work related to design, assign, control, and evaluation of work considering productivity, safety and cost aspects.

2104391 Materials Technology I 3(2-3-4)
Condition: Prerequisite 2104257 or Consent of Faculty
Various production techniques of material powders, manufacturing techniques of metal and ceramic components from powders, powder characterization techniques, mechanical properties of components in relation to micro-structure production and physical properties of inorganic glasses.

2104401 Co-operative Education 6(0-36-0)
Full-time job training in a real-life industrial environment; working as an organization’s employee in the discipline associated with each student’s curriculum and career goals.

2104408 Energy management in Industry 3(3-0-6)
Types of energy in industrial processes; laws related to energy consumption; energy saving measures; instruments and energy auditing; economic analysis and work standard for efficient energy usage.

2104409 Industrial Business Management 3(3-0-6)
Basic knowledge about Organization-Business-Industry-Supply Chain; changed directions of the world and industry and adaptation; strategic Management; innovation management; operations management; management and utilization of data / information / knowledge / information technology; project development and project management; leadership; change management; human resource management; good governance and risk management; virtue; ethics; code of conduct; social responsibility; business management according to the philosophy of Sufficiency Economy

2104414 CNC Turning Technology 3(3-0-6)
Introduction to CNC Turning, CNC Lathe Cutting Fundamentals, CNC Lathe Control and Operation, CNC Lathe Technical Data, CNC Lathe Rapid and Feed Moves, CNC Lathe Circular interpolation, Tool Nose Radius Compensation and Command of CNC lathe by CNC Lathe Fixed Cycles G70-G94 and others.

2104415 CNC Machining Technology 3(3-0-6)
Introduction to CNC turning centres, CNC turning fundamentals, CNC turning centre cutting fundamentals, CNC turning centre control and operation, CNC turning centre technical data, CNC turning centre rapid and feed moves, CNC turning centre circular interpolation, CNC cutter diameter compensation, CNC canned cycles and CNC canned cycles G84, G86, and G76.

2104424 Applied Ergonomics 3(2-3-4)
Science of motion; biomechanics; 2-D analysis; problems of neck, shoulder, wrist, elbow, lower back, using a goniometer and EMG; psychophysics principles; fatigue and motivation; factory survey; work design; doing term projects, and presentation.

2104425 Maintenance Engineering 3(3-0-6)
Maintenance concepts; terrorotechnology; preventive maintenance; corrective maintenance; maintenance organization planning and control of maintenance activities; materials and spare part management; reliability and failure statistics; application of waiting line theory to maintenance problem; critical part scheduling, measurement and evaluation maintenance performance; depreciation causes; machine and equipment inspection.

2104426 Co-operative Education 3(0-18-0)
Full-time job training in a real-life industrial environment; working as an organization’s employee in the discipline associated with each student’s curriculum and career goals.

2104429 Applications of Operations Research 3(3-0-6)
Condition: Prerequisite 2104259 and 2104359 or Consent of Faculty
2104431 Automation 3(2-3-4)
Basic concepts of automation systems in manufacturing industry; equipment in automation systems: pneumatics, hydraulics, sensor; logical control; industrial robot technology; control theory.

2104432 Introduction to Cognitive Ergonomics 3(2-3-4)
Specialty the inter-discipline of design and system development that are involved with humans to make the systems more effective and more robust, focusing on amplifying human capability in performing cognitive work by integrating technical functions with human cognitive processes to create efficient and reliable systems.

2104456 Ergonomics 3(2-3-4)
Introduction to Ergonomics; human body as a working system (i.e. bones, joints, muscles, metabolism); anthropometry; work demand evaluation and factory inspection using biomechanics and physiology method; displays and controls; introduction to human information processing.

2104459 Value Engineering 3(3-0-6)
Introduction to value engineering methodology; application for value engineering technique to product design; procurement and manufacturing in order to reduce cost without loss of quality.

2104463 Project Feasibility Study 3(3-0-6)
Condition: Prerequisite 2104353 or Consent of Faculty
Study key factors crucial to decision making in industrial investment.

2104491 Industrial Engineering Pre-Project 1(0-2-1)
Problem framework; guidelines for problem solving and solutions to the problems in an industrial engineering project.

2104493 Special Problems in Industrial Engineering III 3(2-3-4)
Study or investigation of special problems assigned by the instructor with the consent of the head of the departmental.

2104494 Advanced Topics in Industrial Engineering III 3(3-0-6)
Study of current interesting topics and new development in industrial engineering.

2104495 Advanced Topics in Industrial Engineering I 3(3-0-6)
Study of current interesting topics and new development in industrial engineering.

2104496 Advanced Topics in Industrial Engineering II 3(3-0-6)
Study of current interesting topics and new development in industrial engineering.

2104497 Special Problems in Industrial Engineering I 3(2-3-4)
Study or investigation of special problems assigned by the instructor with the consent of the head of the department.

2104498 Special Problems in Industrial Engineering II 3(2-3-4)
Study or investigation of special problems assigned by of the instructor with the consent of the head of the department.

2104499 Industrial Engineering Project 3(3-0-6)
Practical interesting project or problems in various fields of industrial engineering assigned by the instructor.

2104505 Machinery and Instrument Appraisal 3(3-0-9)
Importance of appraisal for machines; equipment and instruments; life cycle of machinery; conditions and efficiency of machinery; factor effects to appraisal; step of appraisal; engineering economy; reporting case studies.

2104506 Engineering Project Management 3(3-0-9)
Project management models; project initiation; project planning, organization, scheduling and control; resource and cost management; risk management; project termination; project management information system; case study.

2104507 Logistics and Supply Chain Management 3(3-0-9)
Definition of logistics and supply chain management; distribution network design; distribution strategies production-inventory models; transportation design; coordination and information technology; international issues.

2104509 Warehouse and Warehousing Management 3(3-0-9)
Condition: Prerequisite 2104252 and 2104524 Consent of Faculty
The role of the warehouse; warehousing decisions; warehousing operations; materials handling and packaging.

2104511 Introduction to Virtual Environments 3(3-0-9)
Theory, development, and applications of virtual reality (VR) technology for the generation of the virtual environments (VE); human-computer interaction based on the 5 basic senses of human perception; use of 3D software and some scripting language to generate models in the CAVE system; application of VR technology in product and production design and others.

2104512 Production and Operations Management Information Systems 3(3-0-9)
Condition: Prerequisite 2104252 or 2104524 or Consent of Faculty
Information strategy, business information systems, ERP, system analysis and design, database for production and operations management, information
systems for production and operations management and control; systems implementation; systems operation and support, case studies.

2104513 Industrial Engineering Integration 3(3-0-9)
Condition: Prerequisite 2104252 or Consent of Faculty
Work in the manufacturing systems, servicing system and business system; Components of the management and control systems, core processes and supporting systems; design of organization structure, products, facilities, transformation process, supporting system and detail operation; operation and monitoring, evaluation, reviews and improvement.

2104515 Responsible Care 3(3-0-9)
Importance of Responsible Care (RC), A history of RC principles, laws, rules and standards, cooperation among organizations: producers, distributors, users, transportors, disposers, RC organizational structure, necessary internal activities for RC, emergency response, data managing and reporting concerning environment, health and safety.

2104516 Quality Improvement 3(3-0-9)
Condition: Prerequisite 2104254 or 2104690 or Consent of Faculty
Quality improvement based on Six Sigma approach; improvement project selection; steps for quality improvement; tools for quality improvement; appraisal of return on quality investment in quality improvement project.

2104518 Quality System 3(3-0-9)
Concept of quality system; several types of quality system, design and application of quality system in manufacturing or service industry; evaluation; analysis and improvement of quality system.

2104520 Visual Factory 3(3-0-9)
Meaning and principles of visual factory; need for communication in a factory; traditional methods for communication in a factory; key elements of a visual factory: work place organization and standardization; visual displays; visual controls; good visual communication; visual production control; visual quality control; process indications; and implementing visual communication.

2104521 Computer Programming for Industrial Engineering 3(3-0-9)
Practical Computer programming including database implementation, graphic user interface (GUI), network programming.

2104523 Introduction to Stochastic Models 3(3-0-9)
Condition: Prerequisite 2104253 or 2104690 or Consent of Faculty
Unconditional and conditional probability; discrete models; evaluation of complexity of problems; partitioning problems; use of statistics in decision making; systematic approach for problem solving.

2104524 Production and Service Management 3(3-0-0-9)
Work study; production time improvement; flow process chart; Therblig symbol; work measurement; time study; skill and effort rating; standard time; man machine chart; motion and time study; Gang process chart; human factor integration and cognitive science; reengineering.

2104525 Work Process Design and Improvement 3(3-0-0-9)
Condition: Consent of Faculty

2104548 Strategic Planning for Engineers 3(3-0-9)
Strategic planning process; analytical techniques used in formulating plans; concepts of manufacturing strategy.

2104555 System Safety 3(3-0-0-9)
Human Error; System Safety Design Requirements; Hazard Identification; Analysis and Resolution; Hazard Resolution Matrix; Preliminary Hazard Analysis (PHA); Failure Modes and Effects Analysis (FMEA); Event Trees; Fault Trees; Fault Classification; Fault-Tree Construction; Direct Evaluation of Fault Tree; Fault Trees Evaluation by Cut Sets.

2104559 Risk Management for Industry 3(3-0-0-9)
Introduction to Risk Management; types and classification of Risk from both internal and external factor with cover production industry and service industry; tools and techniques for Systems/Process Analysis and Internal Control System Setting in order to reduce and prevent failure of the designed System supported by ICT as a monitoring tool.

2104601 Engineering Economic Analysis 3(3-0-0-9)
Condition: Prerequisite 2104353 or Consent of Faculty
Theoretical foundations and advanced topics in engineering economic analysis; investment project evaluation in industrial and engineering works under conditions of uncertainty; analysis of capital budgeting decisions.

2104602 Analysis of Business System 3(3-0-0-9)
Business enterprises; business area; business components; product/services; business plan; concepts of business system strategies: marketing, production, and financial strategies; strategic management; performance measurement by Key Performance Indicator (KPI) and the Balanced Scorecard approach; improvement tools; improvement methods and process; quality systems and quality award.

2104603 Advanced Quality Control 3(3-0-0-9)
Principles practice of quality control in industry; administrative and engineering aspects of quality control program.

2104604 Advanced Quality Management 3(3-0-9)  
Theory, principles, concepts of quality system development including Quality Control, Quality Inspection, Quality Assurance, Quality Improvement, Quality Management, Quality Enhancement and Innovation; analysis and design of quality problem solving approach.

2104606 Advanced Industrial Organization and Management 3(3-0-9)  
Management science; information systems for executive; strategic management; job and organization design; managerial decision making process; leadership in organization and organization communication; financial analysis; case analysis; production control.

2104609 Reliability Theory in Engineering 3(3-0-9)  
Condition: Prerequisite 2104690 or Consent of Faculty  
Reliability analysis with emphasis on the exponential, weibull, gamma, log normal and extreme value distributions; reliability of systems; redundancy; maintainability and availability.

2104611 Inventory Analysis 3(3-0-9)  
Condition: Prerequisite 2104690 or Consent of Faculty  
Development of models of deterministic and stochastic inventory systems; derivation of optimal decision rules for the timing and size of replenishment orders; application of dynamic programming and markov chains in the modeling of dynamic systems.

2104612 Computer Simulation Techniques 3(3-0-9)  
Condition: Prerequisites 2104690 or Consent of Faculty  
Application of simulation techniques to optimization of large scale operations; construction of simulation models; validation of simulation models; limitations of simulation techniques; programming with simulation languages.

2104613 Principle of Optimization 3(3-0-9)  
Linear programming; the simplex method: big M and two-phase method; sensitivity and duality; integer linear programming and branch and bound method; goal programming; non-linear programming: convex and concave functions, one variable, unconstrained with several variables, steepest ascent, Lagrange multipliers, Khun -Tucker conditions; intro to heuristic search.

2104615 Engineering Experimental Design 3(3-0-9)  
Applications of experimental design to engineering problems. Emphasis on the methods of experimental set up, data collection, and data analysis.

2104616 Activity Scheduling 3(3-0-9)  
Principle of activity scheduling selection and application of appropriate models to deal with scheduling problems.

2104617 Industrial Scheduling 3(3-0-9)  
Condition: Prerequisite 2104616 or Consent of Faculty  
Concepts of industrial scheduling; single machine scheduling with both types of performance measures: tardiness based and utilization based measures; flow shop scheduling; parallel machine scheduling and batch sequencing; network based scheduling; job shop scheduling and open shop scheduling

2104624 Factory and Production Management 3(3-0-9)  
Emphasis on small industrial management; project management; plant site, layout and tool selection; types of production processes and their control; use of budgets for decision making and integrating the roles of various units.

2104625 Computerized Statistical Data Analysis 3(3-0-9)  
Condition: Prerequisite 2104690 or Consent of Faculty  
Use of computer for research design, data collection planning, data preparation, data analysis.

2104626 Materials and Processing 3(3-0-9)  
Types and characteristics of materials; manufacturing processes; mechanical, physical, and chemical analyses of materials.

2104627 Product and Production Design 3(3-0-9)  
Condition: Prerequisite 2104626 or Consent of Faculty  
The design of product for optimal production cost under specified tolerance; analysis of factors of production and processes.

2104637 Coordination and Communication 3(3-0-9)  
Relationships among communication, coordination and contradiction in organization; negotiation; public speaking; communication in business ethics of industrial entrepreneurs.

2104640 Decision Analysis in Engineering 3(3-0-9)  
Analysis of decisions in engineering and industry under uncertainty; decision tree analysis, expected monetary value and expected utility; expected value of perfect information and sampling information; basis for expected utility theory; rating and ranking of alternatives using multiple criteria; case studies.

2104642 Decision Support Systems 3(3-0-9)  
Taxonomy of decision support systems (DSSs); a framework of the development of DSSs; multi-criteria decision methodology; components of an architecture for DSS; an approach for an integrated DSS for strategic planning; executive information and support systems; group decision support system; intelligent DSS; using DSSs in various situations.
2104644 Advanced Maintenance Management 3(3-0-9)
Framework of maintenance management (MM); maintenance philosophies; interaction between production management and maintenance philosophies; maintenance management decision making; balancing between preventive and corrective maintenance; performance evaluation; computerized maintenance management system; ISO9000 and ISO14000 compliance.

2104645 Applied Biomechanics 3(2-3-7)
Applying biomechanics in order to design and develop work tasks, work places and tools based on ergonomics, which considers human strength as the first priority.

2104646 Work Physiology 3(2-3-7)
Applying physiology in order to design and develop work tasks, work places, tools and working environments or exhaustion based on ergonomics which considers human endurance as the first priority.

2104647 Hazardous Material and Fire Protection Engineering 3(3-0-9)
Evaluation; design, develop mint of a work place under a risk of fire and hazardous material based on engineering rules, which covers a protection and stop the hazardous events with consideration of safety management and safety engineering usage.

2104648 Strategic Planning for Engineers 3(3-0-9)
Strategic planning process; analytical techniques used in formulating plans; concepts of manufacturing strategy.

2104649 Cognitive Ergonomics 3(2-3-7)
Specialty inter-discipline of design and system development that are involved with containing humans to make the systems more effective and more robust, focusing on amplifying human capability in performing cognitive work by integrating technical functions with human cognitive processes to create efficient and reliable systems.

2104650 Project Management Concepts 3(3-0-9)
Introduction to engineering project management including overview and concepts of project management, planning successful projects, implementing, executing and closeout.

2104660 Stochastic Models for Financial Engineering 2(2-0-6)
Probability; random variables; probability distributions; discrete-time Markov chain; Poisson process; normal distribution; continuous-time Markov chain; Martingale; random walk; Brownian motion.

2104661 Statistical Methods for Financial Engineering 2(2-0-6)
Random sample; estimation and forecasting; confidence intervals; hypothesis testing; goodness of fit test; maximum likelihood estimators; general method of moments; volatility estimation; linear regression analysis.

2104662 Optimization for Financial Engineering 2(2-0-6)
Local and global optimality; linear programming; simplex algorithm; linear duality; sensitivity; nonlinear programming; Newton's method; Kuhn-Tucker conditions; saddle point conditions; convergence of algorithms; portfolio optimization.

2104663 Time-Series Analysis for Financial Engineering 2(2-0-6)
ARMA, ARIMA, ARCH, GARCH processes for univariate and multivariate variables; unit root and cointegration; vector autoregression.

2104664 Statistics for Financial Engineering 3 (3-0-3)
Asymptotic properties of estimators; sampling statistics; hypothesis testing; linear regression; weighted linear regression; endogeneity problems and instrumental variable estimation; maximum likelihood estimators; nonlinear regression; Wald test; likelihood ratio test; general method of moments; information criteria.

2104671 Advanced Work Design 3(2-3-7)
An advanced study of work design and methods of improving human work; factors affecting work such as fatigue, learning and physical capacity.

2104677 Seminar in Safety Engineering 3(2-3-7)
Intensive study of safety programs in industrial organization; critical discussion and review of existing working conditions in industry; case studies and factory tours used as means to recognize safety problems; analysis and discussion of solutions to the problems required as well as reports.

2104684 TECH INNO MGT 3 (3-0-3)
Key issues and core concept of technology and innovation management, develop a framework for innovation strategy, in search of innovation, technology and innovation selection, techniques and tools for effective implementation of innovation, the management of operations, execution of innovation, manufacturing and commercializing science and technology based ideas.

2104688 Research Methodology in Industrial Engineering and Operations Management 3(3-0-9)
Research philosophy; epistemology; ontology; qualitative and quantitative research methodology in IE&OM; research proposal; literature review; research topic; research design; bibliography; research presentation.

2104690 Quantitative Data Analysis for Industrial Engineering 3(3-0-9)
Probability theory and statistical inference used in engineering applications; random variables and distributions; probability models, jointly distributed random variables, parameter estimation and sampling distribution, confidence intervals, hypothesis testing, simple and multiple linear regression models, analysis of variance for design of experiments, non-parametric statistics.
Research problems in Industrial Engineering I (OR Technics) 3(3-0-9)
Interesting problems in industry (OR techniques); current knowledge that helps solve the problems, searching for and sharing of knowledge that helps solve the problems.

Research problems in Industrial Engineering II (Production Technics) 3(3-0-9)
Condition: Consent of Faculty
Interesting problems in industry (Production techniques); current knowledge that helps solve the problems, searching for and sharing of knowledge that helps solve the problems.

Research problems in Industrial Engineering III (Management Technics) 3(3-0-9)
Condition: Consent of Faculty
Interesting problems in industry (Management techniques); current knowledge that helps solve the problems, searching for and sharing of knowledge that helps solve the problems.

Research problems in Industrial Engineering IV (Safety Technics) 3(3-0-9)
Condition: Consent of Faculty
Interesting problems in industry (Safety techniques); current knowledge that helps solve the problems, searching for and sharing of knowledge that helps solve the problems.

Advanced Manufacturing Engineering 3(2-3-7)
Recent advances in engineering materials and processing; cost and value engineering as related to material and processing system selection and specification; computer controls of machines and processes in manufacturing systems; industrial robotics and flexible assembly; laboratory assignments.

Artificial Intelligence for Industrial Engineering 3(3-0-9)
Application of artificial intelligence techniques to industrial engineering problems, with emphasis on expert systems, neural networks, fuzzy logic, genetic algorithm, simulated annealing, and their hybrid forms.

Comparative Engineering Management 3(3-0-9)
Analysis and comparison of western and eastern practices in engineering management in the areas of manufacturing, marketing and technology strategy; effects of differences in national and organizational cultures; case studies.

Doctoral Seminar in Industrial Engineering I 1(1-0-3)
Literature survey and discussion of academic development and recent applications in industrial engineering.

Doctoral Seminar in Industrial Engineering II 1(1-0-3)
Literature survey and discussion of academic development and recent applications in industrial engineering.

Doctoral Seminar in Industrial Engineering III 1(1-0-3)
Literature survey and discussion of academic development and recent applications in industrial engineering.

Doctoral Seminar in Industrial Engineering IV 1(1-0-3)
Literature survey and discussion of academic development and recent applications in industrial engineering.

Doctoral Seminar in Industrial Engineering V 1(1-0-3)
Literature survey and discussion of academic development and recent applications in industrial engineering.

Doctoral Seminar in Industrial Engineering VI 1(1-0-3)
Literature survey and discussion of academic development and recent applications in industrial engineering.

Thesis 12 credits
Research and report of research results in industrial engineering.

Dissertation 48 credits

Doctoral Dissertation Seminar 0(0-0-0)

Qualifying Examination 0(0-0-0)
The Department of Chemical Engineering offers a Bachelor of Engineering degree, a Master of Engineering degree, and a Doctor of Engineering degree in Chemical Engineering. The department currently accepts a sophomore class of about 70 students for Bachelor’s program, 100 students for Master program (50-60 for M.Eng program, 30-40 for weekend M.Eng program) and 5-10 students for Doctoral program.

The Bachelor of Engineering’s degree program offers a complete set of basic courses in Chemical Engineering. The curriculum also allows the students to choose several elective courses. This special feature broadens the student’s knowledge to meet his or her interest and the demands of the industries. The senior project introduces the students to the integration of knowledge and gives them hands-on experiences in solving the engineering and technological problems. The curriculum additionally stresses the training of the student to think and present oneself logically and independently.

The department of Chemical Engineering offers two graduate programs leading to the degree of Master of Engineering and the degree of Doctor of Engineering. Students entering graduate study in the Department normally have a bachelor’s degree in Chemical Engineering. The Department also admits exceptional students who majored in another branch of engineering, or science at the undergraduate level. Depending on their background, these students have to take undergraduate chemical engineering courses as necessary, while simultaneously taking graduate level subjects for which they have adequate preparation.

The applicant for a doctoral degree must hold either a Bachelor’s degree in Chemical Engineering with Second Class Honors or equivalent or a master’s degree in Chemical Engineering.

The research activities at the department are grouped into 10 areas of interest, namely, biochemical engineering, catalysts and catalytic reaction engineering, control and system engineering, environmental chemical engineering and safety, life cycle engineering, oleochemical, particle technology and material processing, polymer science and polymer engineering, process systems engineering, and separation technology. Each student can choose to do his or her research in any one of these research areas.

The collaboration between the department and top universities in several countries such as Japan, Canada, England, Australia and China will strengthen graduate program of the department.

The above curriculum and research activities together with strong interaction between faculties and students in all levels have produced the graduates who can meet the demands and needs of the chemical, petrochemical, and related industries as well as various governmental organizations. Additionally, these have paved the way for the Department of Chemical Engineering to establish herself as an active partner in the advancement of Chemical Engineering discipline in Thailand.

HEAD:

Paisan Kittisupakorn, Ph.D. (London)

PROFESSORS:

Paisan Kittisupakorn, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Piyasan Prasentham, B.Eng. (Chula), M.Sc., (P.I.N.Y.), Dr. Ing. (I.N.S.A.) (Toulouse)
Suttichai Assabumrungrat, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)

ASSOCIATE PROFESSORS:

Artiwan Shotipruk, Ph.D. (Michigan, Ann Arbor)
Anongnat Somwangthanarom, Ph.D. (Michigan)
Bunjerd Jongsmolit, Ph.D. (Pittsburgh)
Deacha Chaisiriwetch, B.Eng. (Chula), D.I.C., Ph.D. (London)
Joongjai Panpranot, Ph.D. (Clemson)
Kasidit Nootong, Ph.D. (Pennsylvania)
Prasert Pavasant, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Sarawut Rimduisit, B.Eng. (Chula), M.S., Ph.D. (CWRU)
Seerong Prichanont, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Siriporn Damrongsukkul, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Soorathep kheawhom, Ph.D. (Tokyo)
Thawatchai Charinpanitkul, B.Eng. (Chula) M.Eng., D.Eng. (Tokyo)
Tharathon Mongkhonsi, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Soraphon Phisalaphong, B.Sc. (Kasetsart), M.Eng. (Chula), M.Sc. (Lehigh), Ph.D. (Colorado State)
Varong Pavarajarn, Ph.D. (Oregon State)
Ura Pancharoen, B.S. (Newark), M.Sc., D.Eng.Sc. (NJIT)

ASSISTANT PROFESSORS:

Amornchai Arpornwichanop, D.Eng. (Chula)
Apinan Soottitantawat, B.Eng.(Chula)
Nattaporn Tonanon, B.Sc., D.Eng. (Tottori)
Sorada Kanokpanont, Ph.D. (Drexel)
Suphot Phatanasri, B.Sc. (Chiengmai), M.Eng. (Chula), D.Eng. (Kyoto)

LECTURERS:

Akawat Sirisuk, Ph.D. (Wisconsin)
Chutimon Sattrapaphatkul, D.Eng (Tokyo Tech)
Jirdsak Tscheikuna, Ph.D. (OklahomaState)
Sirisarathana Covavisaruch, Ph.D. (Michigan, Ann Arbor)
Siritkanya Singcuna, M.S. (Waterloo)
Varun Taepaisiphongse, Ph.D. (UCLA)
Pimprern Ponpesh Ph.D. (California)
### CHEMICAL ENGINEERING CURRICULUM
#### FIRST YEAR CURRICULUM
**COMMON TO ALL ENGINEERING STUDENTS**

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>ENG MECHANICS I</td>
<td>3</td>
</tr>
<tr>
<td>2105220</td>
<td>CHEM</td>
<td>3</td>
</tr>
<tr>
<td>2105221</td>
<td>CHE CHEM LAB</td>
<td>1</td>
</tr>
<tr>
<td>2105222</td>
<td>CHE THERMO I</td>
<td>3</td>
</tr>
<tr>
<td>2105261</td>
<td>CHEM PROD IND</td>
<td>3</td>
</tr>
<tr>
<td>2105262</td>
<td>CHE PRIN</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL FOR SEMESTER</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2106231</td>
<td>MECH OF MAT I</td>
<td>3</td>
</tr>
<tr>
<td>2106233</td>
<td>CHE THERMO II</td>
<td>3</td>
</tr>
<tr>
<td>2106230</td>
<td>CHE MATH I</td>
<td>3</td>
</tr>
<tr>
<td>2106261</td>
<td>UNIT OP I</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL FOR SEMESTER</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2106331</td>
<td>CHE MATH II</td>
<td>3</td>
</tr>
<tr>
<td>2106332</td>
<td>CHE STAT</td>
<td>3</td>
</tr>
<tr>
<td>2106361</td>
<td>UNIT OP II</td>
<td>3</td>
</tr>
<tr>
<td>2106373</td>
<td>CHEM ENG KIN REACT</td>
<td>3</td>
</tr>
<tr>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL FOR SEMESTER</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107301</td>
<td>ENG PRACTICE</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107351</td>
<td>UNIT OP LAB III</td>
<td>1</td>
</tr>
<tr>
<td>2107352</td>
<td>CHEM PROC DSGN</td>
<td>3</td>
</tr>
<tr>
<td>2107353</td>
<td>PROC DY CONTROL</td>
<td>3</td>
</tr>
<tr>
<td>2107354</td>
<td>SAFETY IN CHEM OPER</td>
<td>3</td>
</tr>
<tr>
<td>2107355</td>
<td>CHE PROJ I</td>
<td>1</td>
</tr>
<tr>
<td>2107356</td>
<td>ELECTIVE COURSE</td>
<td>3</td>
</tr>
<tr>
<td>2107357</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL FOR SUMMER</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2108301</td>
<td>CHE SEM II</td>
<td>1</td>
</tr>
<tr>
<td>2108355</td>
<td>CHEM PLANT DSGN</td>
<td>3</td>
</tr>
<tr>
<td>2108352</td>
<td>ENV CHEM ENG</td>
<td>3</td>
</tr>
<tr>
<td>2108358</td>
<td>CHE PROJ II</td>
<td>1</td>
</tr>
<tr>
<td>OR 210099</td>
<td>ENGINEERING PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2108354</td>
<td>ELECTIVE COURSE</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL FOR SEMESTER</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION = 146**
NAME OF THE DEGREE
: Master of Engineering
: M.Eng.

PROFESSORS :
Paisan Kittisupakorn, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Piyasan Praserthdam, B.Eng. (Chula), M.Sc. (P.I.N.Y.), Dr.Ing. (I.N.S.A.) (Toulouse)
Suttichai Assabumrungrat, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)

ASSOCIATE PROFESSORS :
Artiwan Shotipruk, Ph.D. (Michigan, Ann Arbor)
Anongnat Somwangthanaroj, Ph.D. (Michigan)
Bunjerd Jongsomjit, Ph.D. (Pittsburgh)
Deacha Chatsiriruech, B.Eng. (Chula), D.I.C., Ph.D. (London)
Joongjai Panpranot, Ph.D. (Clemson)
Kasidit Noottong, Ph.D. (Pennsylvania)
Prasert Pavanat, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Sarawut Rimdusit, B.Eng. (Chula), M.S., Ph.D. (CWRU)
Seeroong Prichanont, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Siriporn Damrongnukul, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Soorathep Kheawhom, Ph.D. (Tokyo)
Tawatchai Charinpanitkul, B.Eng. (Chula) M.Eng., D.Eng. (Tokyo)
Tharajon Mongkhonsi, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Muenduen Phisalaphong, B.Sc. (Kasetsart), M.Eng. (Chula), M.Sc. (Lehigh), Ph.D. (Colorado State)
Varong Pavarajarn, B.S. (Newark), M.Sc., D.Eng.Sc. (NJIT)
Ura Pancharoen, B.Sc. (Kasetsart), M.Eng. (Chula), M.Sc. (Drexel)

ASSISTANT PROFESSORS :
Amornchai Arpornwichanop, D.Eng. (Chula)
Apinan Soottitantawat, B.Eng.(Chula), M.Sc., D.Eng. (Tottori)
Nattaporn Tonanon, D.Eng. (Kyoto)
Sorada Kanokpanont, Ph.D. (Drexel)
Suphot Phatanasri, B.Sc. (Chiangmai), M.Eng. (Chula), D.Eng. (Kyoto)

LECTURERS :
Akawat Sirisuk, Ph.D. (Wisconsin)
Chutimon Sirapatipatkul, D.Eng (Tokyo Tech)
Jirsak Tscheikuna, Ph.D. (Oklahoma State)
Sirjutjaratana Covavisoruch, Ph.D. (Michigan, Ann Arbor)
Sirikanya Singcuma, M.S. (Waterloo)
Varun Taepaisitphongs, Ph.D. (UCLA)
Pimmond Ponpesh, Ph.D. (California)

ADMISSION
An applicant must hold a Bachelor's Degree in Chemical Engineering or equivalent and also meets the requirements of the Graduate School.

DEGREE REQUIREMENTS
(for bachelor degree of chemical engineering graduated)
Students with bachelor degree of chemical engineering are required to complete 24 credits of courses and a thesis of 12 credits. The course consists of 9 credits of required courses in 1, not less than 6 credits of approved elective course from the same group in 2, and 9 credits of free elective courses in 3 or from another groups in 2. Chemical engineering seminar I and II are no credit required courses (S/U) and not counted to fulfill the program.

COURSE REQUIREMENTS
1. Required Courses 2 credits from
   2105605 Seminar I 1(1-0-3)
   2105606 Seminar II 1(1-0-3)

2) Core Course 15 credits from
   - Group I
     2105602 Advanced Transport Phenomena 3(3-0-9)
     2105685 Selected Topics in Transport Phenomena 3(3-0-9)
   - Group II
     2105603 Advanced Chemical Engineering Thermodynamics 3(3-0-9)
     2105686 Selected Topics in Chemical Engineering Thermodynamics 3(3-0-9)
   - Group III
     2105604 Advanced Chemical Engineering Kinetics and Chemical Reactor Design 3(3-0-9)
     2105687 Advanced Chemical Kinetics and Catalysis 3(3-0-9)
     2105688 Selected Topics in Chemical Engineering Kinetics 3(3-0-9)
   - Group IV
     2105601 Advance Engineering Mathematics for Chemical Engineers 3(3-0-9)
     2105607 Chemical Engineering Process Scale-up 3(3-0-9)
     2105612 Chemical Engineering Process and Product Development 3(3-0-9)
     2105617 Research Methodology and Statistical Analysis 3(3-0-9)
     2105618 Characterization and Instrumental
Analysis 3(3-0-9)
2105676 Instrumentation in Chemical Process 3(3-0-9)
2105671 Process Dynamics 3(3-0-9)
2105623 Optimization of Chemical Processes 3(3-0-9)
2105689 Safe Process Operation and Design 3(3-0-9)
2105699 Multifunctional Reactor 3(3-0-9)

3) Elective Courses 9 credits from
- Chemical Engineering Fundamental Division
  2105526 Total Productive Management for Chemical Process Industry 3(3-0-9)
  2105608 Adsorption Process 3(3-0-9)
  2105610 Membrane Technology 3(3-0-9)
  2105611 Separation Technology Via Liquid Membrane And Application 3(3-0-9)
  2105613 Mass Transfer Operation 3(3-0-9)
  2105626 Advanced Heat Transfer 3(3-0-9)
  2105663 Heat Transfer Operation 3(3-0-9)
  2105682 Surface Technology 3(3-0-9)
  2105684 Chemical Analysis for Chemical Process Control I 3(3-0-9)
  2105690 Independent Study I 3(3-0-9)
  2105691 Independent Study II 3(3-0-9)
  2105692 Independent Study III 3(3-0-9)

- Process Control and System Engineering Division
  2105522 Dynamic Process Simulation 3(3-0-9)
  2105599 Batch Chemical Processes 3(3-0-9)
  2105619 Advanced Automatic Process Control 3(3-0-9)
  2105693 Special Problems in Process Control Engineering 3(3-0-9)

- Petrochemical Engineering Division
  2105630 Heterogeneous Catalytic Reactor Modeling 3(3-0-9)
  2105631 Advanced Catalysts for Polymers 3(3-0-9)
  2105632 Petrochemical Technology 3(3-0-9)
  2105634 Catalysis 3(3-0-9)
  2105635 Heterogeneous Catalysis 3(3-0-9)
  2105637 Design of Industrial Catalysis 3(3-0-9)
  2105681 Catalysis Deactivation 3(3-0-9)
  2105694 Special Problems in Petrochemical Engineering 3(3-0-9)

- Polymer Engineering Division
  2105527 Polymer Characterization and Fracture 3(3-0-9)
  2105638 Advanced Polymer Engineering 3(3-0-9)
  2105643 Polymer Processing 3(3-0-9)
  2105649 Polymer Blends and Composites 3(3-0-9)
  2105675 Polymer Chemistry for Engineers 3(3-0-9)
  2105695 Special Problems in Polymer Engineering 3(3-0-9)

- Biochemical Engineering Division
  2105641 Biodegradable Material Engineering 3(3-0-9)
  2105650 Biochemical Engineering 3(3-0-9)
  2105652 Bioreactor Analysis and Control Design 3(3-0-9)
  2105654 Biosensors 3(3-0-9)
  2105655 Bioprocess Plant Design 3(3-0-9)
  2105659 Biochemical Separation Technology 3(3-0-9)

  2105679 Bioactive Compounds 3(3-0-9)
  2105683 Bioenergy Technology 3(3-0-9)
  2105696 Special Problems in Biochemical Engineering 3(3-0-9)

- Cleaner Production Engineering Division
  2105666 Source Control of Particulate Emission 3(3-0-9)
  2105667 Loss Prevention in Chemical Operations 3(3-0-9)
  2105697 Special Problems in Cleaner Production Engineering 3(3-0-9)

- Particle Technology Division
  2105572 Encapsulation Process 3(3-0-9)
  2105609 Advanced Particulate Technology 3(3-0-9)
  2105616 Fluid and Particle Mechanics 3(3-0-9)
  2105672 Simulation of Particulate and Material Processing 3(3-0-9)
  2105678 Introduction to Nanotechnology 3(3-0-9)
  2105698 Special Problems in Particle Technology 3(3-0-9)

4) THESIS
  2105811 THESIS 12 credits
  2105816 THESIS 36 credits

Master of Chemical Engineering Program

First Year

First Semester
  2105602 ADV TRANS PHENOM 3
  2105603 ADV CHE THERMO 3
  2105604 ADV CHE KINETICS 3
  21056xx/5xx Free Elective 3

  12

Second Semester
  21056xx/5xx Approved Elective 3
  21056xx/5xx Approved Elective 3
  21056xx/5xx Free Elective 3
  21056xx/5xx Free Elective 3
  2105811 Thesis 2

  15

Second Year

First Semester
  2105606 Seminar II 1
  2105811 Thesis 6
  21056xx/5xx Free Elective(Option) 3

  7,10

Second Semester
  2105811 Thesis 4
  21056xx/5xx Free Elective(Option) 3

  4,7

74
DEGREE REQUIREMENTS
(for non-bachelor degree of chemical engineering graduated)

Students with non-bachelor degree of chemical engineering are required to complete 30 credits of engineering and chemical engineering fundamental courses, 24 credits of courses and a thesis of 12 credits. The fundamental courses of 30 credits are listed in 5. The course consists of 9 credits of required courses in 1, not less than 6 credits of approved elective course from the same group in 2, and 9 credits of free elective courses in 3 or from another groups in 2. The fundamental, chemical Engineering Seminar I and II are non credit required courses (S/U) and not counted for in order to fulfill the program.

Master of Chemical Engineering Program

First Year

First Semester

2105373 Chemical Engineering Kinetics and Reactor Design 3
2105331 Chemical Engineering Mathematics II 3
2103106 Engineering Drawing 3
2105603 ADV CHE THERMO 3
21056xx/5xx Free Elective 3

Second Semester

2105333 Transport Phenomena 3
2105251 Unit Operations I 3
21056xx Approved Elective 3
21056xx/5xx Free Elective 3
2105605 Seminar I 1

Second Year

First Semester

2105352 Unit Operations II 3
2105356 Unit Operations Laboratory I 1
2105602 ADV TRANS PHOM 3
2105604 ADV CHE KINETICS 3
2105606 Seminar II 1

Second Semester

2105353 Unit Operations III 3
2105357 Unit Operations Laboratory II 1
21056xx Approved Elective 3
21056xx/5xx Free Elective 3
2105811 Thesis 2

Third Year

First Semester

2105464 Chemical Process Design 3
2105472 Process Dynamics and Control 3
2105458 Unit Operations Laboratory III 1
2105811 Thesis 4
21056xx/5xx Free Elective (Option) 3

Second Semester

2105811 Thesis 6
21056xx/5xx Free Elective (Option) 3

COURSE REQUIREMENTS

1) Fundamental Courses

2103106 Engineering Drawing 3(1-4-4)
2105251 Unit Operations I 3(3-0-6)
2105331 Chemical Engineering Mathematics II 3(3-0-6)
2105333 Transport Phenomena 3(3-0-6)
2105352 Unit Operations II 3(3-0-6)
2105353 Unit Operations III 3(3-0-6)
2105356 Unit Operations Laboratory I 1(0-3-0)
2105357 Unit Operations Laboratory II 1(0-3-0)
2105373 Chemical Engineering Kinetics and Reactor Design 3(3-0-6)
2105458 Unit Operations Laboratory III 1(0-3-0)
2105464 Chemical Process Design 3(2-3-4)
2105472 Process Dynamics and Control 3(3-0-6)

2) Required Courses 9 credits

2105602 Advanced Transport Phenomena 3(3-0-9)
2105603 Advanced Chemical Engineering Thermodynamics 3(3-0-9)
2105604 Advanced Chemical Engineering Kinetics and Chemical Reactor Design 3(3-0-9)
2105605 Chemical Engineering Seminar I 1(1-0-3)
2105606 Chemical Engineering Seminar II 1(1-0-3)

3) Approved Elective 6 credits

2105601 Advanced Engineering Mathematics for Chemical Engineers 3(3-0-9)
2105607 Chemical Engineering Process Scale-up 3(3-0-9)
2105612 Chemical Engineering process and Product Development 3(3-0-9)
2105617 Research Methodology and Statistical Analysis 3(3-0-9)
2105618 Characterization and Instrumental Analysis 3(3-0-9)
2105622 Chemical Process Simulation and Optimization 3(3-0-9)
2105676 Instrumentation in Chemical Process 3(3-0-9)

4) Elective Courses 9 credits

Group 1: Chemical Engineering Fundamental Division

2105526 Total Productive Management for Chemical Process Industry 3(3-0-9)
2105608 Adsorption Process 3(3-0-9)
2105610 Membrane Technology 3(3-0-9)
2105611 Separation Technology via Liquid Membrane and Application 3(3-0-9)
2105613 Mass Transfer Operations 3(3-0-9)
2105626 Advanced Heat Transfer 3(3-0-9)
2105661 Special Problems in Chemical Engineering 3(3-0-9)
2105662 Selected Topics in Chemical Engineering 3(3-0-9)
2105663 Heat Transfer Operation 3(3-0-9)
2105665 Cryogenic Engineering 3(3-0-9)
Group 2: Process Control and Systems Engineering Division
2105522 Dynamic Process Simulation 3(3-0-9)
2105599 Batch Chemical Process 3(3-0-9)
2105619 Advanced Automatic Process Control 3(3-0-9)
2105621 Multivariable Process Control 3(3-0-9)
2105623 Optimization of Chemical Processes 3(3-0-9)
2105624 Computer Process Control 3(2-3-7)
2105625 Process Control and Management 3(3-0-9)
2105628 Process Control Instrumentation 3(3-0-9)
2105629 Process Identification and Data Analysis 3(3-0-9)
2105671 Process Dynamics 3(3-0-9)
2105674 Computer-Aided Process and Product Engineering 3(3-0-9)

Group 3: Petrochemical Engineering Division
2105630 Heterogeneous Catalytic Reactor Modelling 3(3-0-9)
2105631 Advanced Catalysts for Polymers 3(3-0-9)
2105632 Petrochemical Technology 3(3-0-9)
2105634 Catalysis 3(3-0-9)
2105636 Heterogeneous Catalysis 3(3-0-9)
2105637 Design of Industrial Catalysts 3(3-0-9)
2105681 Catalyst Deactivation 3(3-0-9)

Group 4: Polymer Engineering Division
2105527 Polymer Characterization and Fracture 3(3-0-9)
2105638 Advanced Polymer Engineering 3(3-0-9)
2105643 Polymer Processing 3(3-0-9)
2105649 Polymer Blends and Composites 3(3-0-9)
2105675 Polymer Chemistry for Engineers 3(3-0-9)

Group 5: Biochemical Engineering Division
2105641 Biodegradable Material Engineering 3(3-0-9)
2105650 Biochemical Engineering 3(3-0-9)
2105652 Bioreactor Design Analysis and Control 3(3-0-9)
2105654 Biosensors 3(3-0-9)
2105655 Bioprocess Plant Design 3(3-0-9)
2105656 Bioremediation Engineering 3(3-0-9)
2105659 Biochemical Separation Technology 3(3-0-9)
2105679 Bioactive Compounds 3(3-0-9)
2105683 Bioenergy Technology 3(3-0-9)

Group 6: Cleaner Production Engineering Division
2105666 Source Control of Particulate Emissions 3(3-0-9)
2105667 Loss Prevention in Chemical Operations 3(3-0-9)
2105668 Energy Conservation in Chemical Processes 3(3-0-9)
2105669 Cleaner Technology 3(3-0-9)

Group 7: Particle Technology Division
2105571 Aerosol Engineering 3(3-0-9)
2105572 Encapsulation Process 3(3-0-9)
2105609 Advanced Particulate Technology 3(3-0-9)
2105616 Fluid and Particle Mechanics 3(3-0-9)
2105672 Simulation of Particulate and Material Processing 3(3-0-9)
2105678 Introduction to Nanotechnology 3(3-0-9)

4) Thesis

2105811 Thesis 12 Credits

NAME OF THE DEGREE:

PROFESSORS:
Paisan Kitiisupakorn, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Piyasan Praserthdam, B.Eng. (Chula), M.Sc., (P.I.N.Y.), Dr.Ing. (I.N.S.A.) (Toulouse)
Suttichai Assabumrungrat, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)

ASSOCIATE PROFESSORS:
Artiwan Shotipruk, Ph.D. (Michigan, Ann Arbor)
Anongnat Somwangthanaroj, Ph.D. (Michigan)
Bunjerd Jongsomjit, Ph.D. (Pittsburgh)
Deacha Chatsinwech, B.Eng. (Chula), D.I.C., Ph.D. (London)
Joongjai Panpranot, Ph.D. (Clemson)
Kasidit Nootong, Ph.D. (Pennsylvania)
Prasert Pavasant, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Sarawut Rimdusit, B.Eng. (Chula), M.S., Ph.D. (CWRU)
Seeroong Prichantawong, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Siritorn Dumrongsupkul, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Soorathep Kawphrom, B.Eng. (Chula) M.Eng., Eng. (Tokyo)
Tawatchai Chanthanitkul, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Muenduen Phisalaphong, B.Eng. (Chula), M.Sc. (Lehigh), Ph.D. (Colorado State)
Siriporn Damrongsupkul, B.Eng. (Chula), M.Sc., D.I.C., Ph.D. (London)
Varong Pavarajarn, B.S. (Newark), M.Sc., D.Eng.Sc. (NJIT)

ASSISTANT PROFESSORS:
Amomchai Ar pornwichanop, D.Eng. (Chula)
Apinan Soottitantawat, B.Eng.(Chula), M.Sc., D.eng. (Tottori)
The applicant must hold either a Bachelor's Degree in Chemical Engineering or equivalent with Second Class Honors, or a Master's Degree in Chemical Engineering, which is required for Pattern II. The additional requirement for Pattern I is the minimum grade point average of 3.5 on Master's Degree in Chemical Engineering.

### COURSE REQUIREMENTS

1) **Required Courses for Pattern II (1)**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Engineering Mathematics for Chemical Engineers</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Transport Phenomena</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Chemical Engineering Thermodynamics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Chemical Engineering Kinetics and Chemical Reactor Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Seminar in Chemical Engineering III</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>Seminar in Chemical Engineering IV</td>
<td>1(1-0-3)</td>
</tr>
</tbody>
</table>

2) **Elective Courses for Pattern II (2)**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymer Extrusion Process and Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Process System Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Advanced Separation Technology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Optimal Process Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Special Projects in Chemical Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>Air Engineering and Control of Gaseous Air Pollutants</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

Students may select other courses offered by the Graduate School, Chulalongkorn University, with approval from their academic advisor or Chemical Engineering Department.

### DEGREE REQUIREMENTS

There are two patterns of study as follows:

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Master's Degree Holder</th>
<th>Bachelor's Degree Holder</th>
<th>Master's Degree Holder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>0</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Seminar in Chem Eng.</td>
<td>2*</td>
<td>2*</td>
<td>2*</td>
</tr>
<tr>
<td>Dissertation</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>Total course requirements</td>
<td>48</td>
<td>72</td>
<td>60</td>
</tr>
</tbody>
</table>

* Seminar in Chemical Engineering III and IV are non credit required courses (s/u) and not counted for in order to fulfill the program.
Pattern I for Master's degree holder

**First Semester**
- 2105717 Seminar in Chemical Engineering III: 1
- 2105829 Dissertation: 10

**Second Semester**
- 2105718 Seminar in Chemical Engineering IV: 1
- 2105829 Dissertation: 10

**Third Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105829 Dissertation: 10

**Fourth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105829 Dissertation: 10

**Fifth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105829 Dissertation: 10

**Sixth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105829 Dissertation: 10

Pattern II (1) for Bachelor's degree holder

**First Semester**
- 2105717 Seminar in Chemical Engineering III: 1
- 2105830 Dissertation: 9

**Second Semester**
- 2105718 Seminar in Chemical Engineering IV: 1
- 2105830 Dissertation: 9

**Third Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105830 Dissertation: 9

**Fourth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105830 Dissertation: 9

**Fifth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105830 Dissertation: 9

**Sixth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105830 Dissertation: 9

**Seventh Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105830 Dissertation: 9

**Eighth Semester**
- 2105894 Doctoral Dissertation Seminar: 0
- 2105830 Dissertation: 9
### Pattern II (2) for Master’s degree holder

**First Semester**
- 21056xx Elective in CHE 3
- 21056xx Elective in CHE 3
- 2105717 Seminar in Chemical Engineering III 1  
  (s/u)** 4  
  **10**
- 2105828 Dissertation 4

**Second Semester**
- 2105602 Advanced Transport Phenomena 3
- 2105603 Advanced CHE ENG Transport Phenomena 3
- 2105604 Advanced CHE ENG Kinetics and CHE Reactor Design 3
- 21056xx Elective in CHE 3
- 2105717 Seminar in Chemical Engineering III 1  
  (s/u)** 1  
  **12**
- 2105828 Dissertation 8

**Third Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Fourth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Fifth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Sixth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Seventh Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **8**
- 2105828 Dissertation 8

**Eighth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **8**
- 2105828 Dissertation 8

### Pattern II (2) for Bachelor’s degree holder

**First Semester**
- 21056xx Elective in CHE 3
- 21056xx Elective in CHE 3
- 2105718 Seminar in Chemical Engineering IV 1  
  (s/u)** 4  
  **10**
- 2105828 Dissertation 4

**Second Semester**
- 21056xx Approve Elective in CHE 3
- 21056xx Approve Elective in CHE 3
- 21056xx Elective in CHE 3
- 21056xx Elective in CHE 3
- 2105718 Seminar in Chemical Engineering IV 1  
  (s/u)** 1  
  **12**
- 2105828 Dissertation 8

**Third Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Fourth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Fifth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Sixth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **10**
- 2105828 Dissertation 8

**Seventh Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **8**
- 2105828 Dissertation 8

**Eighth Semester**
- 2105894 Doctoral Dissertation Seminar 0  
  (s/u)** 0  
  **8**
- 2105828 Dissertation 8
IN CHEMICAL ENGINEERING (B.ENG.)

2105220  Chemical Engineering Chemistry 3(3-0-6)
Principles of chemical analysis for chemical engineers for quality control, process control, and researches, utilization of quantitative analysis and interpretation, techniques of chemical analysis, using traditional methods, and use of analysis instruments, principles of organic chemistry to be applied in chemical industries and bio-engineering, properties and reactions of basic functional groups: hydrocarbons, hydroxyl, ether, carbonyl, carboxylic, and organic complexes.

2105221  Chemistry for Chemical Engineering Laboratory 1(0-3-0)
Practice in chemical analysis using various techniques for quality control, process control, and research.

2105222  Chemical Engineering Thermodynamics I 3(3-0-6)
Prediction of thermodynamic properties of single components, ideal gas law, equation of states of gas and liquid, gaseous and liquid mixtures, thermodynamic laws, relationships of thermodynamic properties, phase equilibrium of single components, refrigeration cycle.

2105223  Chemical Engineering Thermodynamics II 3(3-0-6)

2105230  Chemical Engineering Mathematics I 3(3-0-6)
Fundamental of line integration and surface integration, polar co-ordinates, calculus of real value multivariable functions and application, analysis principles for solving chemical engineering problems.

2105251  Unit Operations I 3(3-0-6)
Units for transporting liquid and gas, fluidized systems, pneumatic system for transport particles, unit operations for separating particles from gaseous and liquid system with centrifugal forces, filtration, and diffusion.

2105261  Chemical Production Industries 3(3-0-6)
Industrial standard, law related to chemical industries, components of chemical plants, responsibilities of engineers.

2105262  Chemical Engineering Principles 3(3-0-6)
Principles of chemical engineering, relationship of mass with chemical reactions, conservation of mass and energy, use of phase equilibrium and thermodynamic properties.

2105301  Chemical Engineering Seminar I 1(0-3-0)
Softskill improvement for quality chemical engineer. Discussion of various topics relevant for recent chemical engineering development.

2105331  Chemical Engineering Mathematics II 3(3-0-6)
Numerical techniques for solving chemical engineering problems, application of computer for solving chemical engineering problems.

2105332  Chemical Engineering Statistics 3(3-0-6)
Elementary principles of statistics and probability, random variables and probability distributions, experimental data analysis, chemical process parameter estimation, linear regression and correlation, multiple regression, design and analysis of chemical experiments with single factor and with several factors, chemical process modeling with stochastic approach.

2105333  Transport Phenomena 3(3-0-6)
Viscosity, mathematical models of momentum transports in isothermal fluid systems, thermal conduction and convection, mathematical models of energy transports in solids and in fluids for isothermal systems and non-isothermal systems, diffusion in binary mixtures, mathematical models of mass transports in isothermal mixtures without chemical reactions and with chemical reactions, simultaneous mass and energy transports in fluid mixtures.

2105352  Unit Operations II 3(3-0-6)
Unit Operations for separating gaseous and liquid mixtures with distillation, absorption, extraction, adsorption and crystallization.

2105353  Unit Operations III 3(3-0-6)
Unit operations for exchanging heat, boilers, evaporators, condensers, dryers, and cooling water systems.

2105356  Unit Operations Laboratory I 1(0-3-0)
Condition: Prerequisite 2105251
Practice unit operations for momentum transports.

2105357  Unit Operations Laboratory II 1(0-3-0)
Condition: Prerequisite 2105352
Practice unit operations for mass transport and reaction kinetics.

2105362  Chemical Process Economic Assessment 3(3-0-6)
Cost components of chemical industries, chemical industrial cost indexes, capital cost components, capital investment estimates, purchase costs of process equipments, manufacturing cost components, manufacturing cost estimates, chemical process depreciation estimates, feasibility analysis, alternative investments and replacements.

2105373  Chemical Engineering Kinetics and Reactor Design 3(3-0-6)
Fundamental principles of chemical kinetics; diffusion and catalysis; concepts of reactor design; the effect of reactor geometry, operating conditions, and flow characteristics on mass and energy conservation equations; single and multiple reactor systems.

2105385  Recycling of Agricultural and Agro-Industrial Waste 3(2-3-4)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2105402</td>
<td>Chemical Engineering Seminar II</td>
<td>1</td>
<td>Soft skill improvement for quality chemical engineer. Discussion of various topics relevant for recent chemical engineering development.</td>
</tr>
<tr>
<td>2105403</td>
<td>Special Topics in Chemical Engineering I</td>
<td>3</td>
<td>Special topics in Chemical Engineering including new technology.</td>
</tr>
<tr>
<td>2105404</td>
<td>Special Topics in Chemical Engineering II</td>
<td>3</td>
<td>Special topics in Chemical Engineering including new technology.</td>
</tr>
<tr>
<td>2105405</td>
<td>Study Abroad I</td>
<td>2</td>
<td>Knowledge in chemical engineering obtains during the study abroad.</td>
</tr>
<tr>
<td>2105406</td>
<td>Study Abroad II</td>
<td>2</td>
<td>Knowledge in chemical engineering obtains during the study abroad.</td>
</tr>
<tr>
<td>2105407</td>
<td>Study Abroad III</td>
<td>2</td>
<td>Knowledge in chemical engineering obtains during the study abroad.</td>
</tr>
<tr>
<td>2105409</td>
<td>Study Abroad IV</td>
<td>3</td>
<td>Knowledge in chemical engineering obtains during the study abroad.</td>
</tr>
<tr>
<td>2105410</td>
<td>Study Abroad V</td>
<td>3</td>
<td>Knowledge in chemical engineering obtains during the study abroad.</td>
</tr>
<tr>
<td>2105430</td>
<td>Particle Technology</td>
<td>3</td>
<td>Particle characterization, transport of powder, selection of transport equipment (screw conveyor, belt conveyor, bucket elevator, pneumatic conveyor, air slide, etc.), storage of powder (hopper and silo design), powder feeding and discharging systems, classification of particles, granulation and agglomeration, commination (size reduction), mixing and agitation of powder, kneading filter press (expression), extrusion.</td>
</tr>
<tr>
<td>2105445</td>
<td>Catalyst Reaction Engineering Fundamentals</td>
<td>3</td>
<td>Catalyst structures and functions; fundamentals of catalyst manufacturing processes and catalyst reaction engineering; applications of catalysts in petrochemical and chemical engineering processes; catalyst reactor design.</td>
</tr>
<tr>
<td>2105452</td>
<td>Fermentation Processes</td>
<td>3</td>
<td>Detailed study of the processes, operations, technology involved in selected industrial fermentation processes directed towards the production of pharmaceuticals and industrial chemicals.</td>
</tr>
<tr>
<td>2105453</td>
<td>Introduction to Biochemical Engineering</td>
<td>3</td>
<td>Importance of biochemical reactions in the industries, health &amp; medicine, and daily life. A review of biochemical reaction kinetics for enzymes and cells including introduction to bioreactor design and downstream processing of the desire products. Separation of natural derived bioactive agents or cell components. Processes in pharmaceutical industry. Principles and instrumentation of the related techniques. Application of naturally derived biomaterial for various industries, especially for medical products, cosmetics, foods, agriculture. Molecular genetics, proteins, and metabolic engineering. Entrepreneurship and trends of technology related to biological engineering.</td>
</tr>
<tr>
<td>2105456</td>
<td>Introduction to Polymer Science</td>
<td>3</td>
<td>Polymer structures and physical properties, technology and mechanical properties of polymers, applications of polymers, polymer processing, plastic technology, fibre technology and elastomer technology.</td>
</tr>
<tr>
<td>2105463</td>
<td>Chemical Engineering Processes</td>
<td>3</td>
<td>Development of industrial chemical processes, relationship of unit operations, with raw materials, products, and energy for production, process energy, by-products and wastes managements.</td>
</tr>
<tr>
<td>2105464</td>
<td>Chemical Process Design</td>
<td>3</td>
<td>Design principles of reaction sections, selection of reactors, design principles of separation sections, development principles of process simulation model with commercial process simulator.</td>
</tr>
<tr>
<td>2105465</td>
<td>Chemical Plant Design</td>
<td>3</td>
<td>Design principles of heat exchanger network, process energy recovery principles, estimate equipment dimensions, selection principles of process equipment materials, and plant layout design.</td>
</tr>
<tr>
<td>2105466</td>
<td>Natural Gas and Petroleum Oil Conditioning</td>
<td>3</td>
<td>Water content estimate, hydrate formation estimate, prevention of hydrate formation, dehydration methods, methods of acid gas removals, liquefaction of natural gas, petroleum oil refinery, reforming petroleum oil products, sulfur compound removals.</td>
</tr>
<tr>
<td>2105472</td>
<td>Process Dynamics and Control</td>
<td>3</td>
<td>Mathematical modeling of chemical engineering systems; solution techniques and dynamics of these systems; introduction to automatic control; feedback control concept; stability analysis; frequency response and control system designs; introduction to measurement and control instrument characteristics.</td>
</tr>
</tbody>
</table>
2105475  Total Productive Management for Chemical Process  3(3-0-6)  
Related to Total Productive Management in Chemical Process Industries, Calculation of Key Management Index, Application of Chemical Engineering, such as Thermodynamics, Energy and Mass Transfer, and Statistics including Distribution Diagram, Control Chart.

2105477  Computer Application in Chemical Engineering  3(3-0-6)  
Computer software application for calculating and design related to chemical engineering.

2105478  Petrochemical Engineering Processes  3(3-0-6)  
Natural Gas Utilization Plan of Thailand; natural gas liquefaction plant; methanol plant; ethylene plant; gas separation plant; ammonia, urea, and phosphate plants; polypropylene plant; vinyl chloride monomer plant; polyvinyl chloride plant; polyethylene plant; ethylene oxide plant; polyester plant; polyethylene plant.

2105479  Polymer Engineering  3(3-0-6)  
Definitions and concepts; crystalline and glassy polymers; molecular architecture: structure, steric factors, conformation and morphology; polymer synthesis: step and chain polymerization; transition phenomena, mechanical properties affected by the transition phenomena; elastomer, theory of rubber elasticity; Polymer rheology: types of mechanical deformations, simple rheological responses, viscoelastic properties of polymer, linear viscoelastic models; yielding and theories on yielding of glassy polymer.

2105480  Safety in Chemical Operations  3(3-0-6)  
Condition: Senior Standing  

2105482  Environmental Chemical Engineering  3(3-0-6)  
Effects of pollutants on environments standard environmental qualities, sources and industrial wastewater characteristics and treatment methods, sources of air pollutants, control of particles and gaseous, compositions of solid wastes and hazardous wastes, method of treatments.

2105485  Modern Techniques in Process Control  3(3-0-6)  
Condition: Corequisite 2105472  
Principle and practice of modern control techniques in chemical processing; distributed control systems; computer integrated processing.

2105487  Digital Process Control Laboratory  3(1-4-2)  
Condition: Prerequisite 2105472 or Consent of Faculty  
Application of direct digital control principles of laboratory exercises supported by microcomputers; real time programming; data acquisition and control using simple and advanced control strategies; experiments in temperature, liquid level, pH controls; sequence control; term project.

2105491  Chemical Engineering Project I  1(0-2-1)  
Data collection and assessment of suitable chemical industrial problems for chemical engineering projects.

2105492  Chemical Engineering Project II  2(0-4-2)  
Condition: Prerequisite 2105491  
A research on chemical engineering projects related to chemical industrial problems or innovations.

COURSES DESCRIPTIONS IN CHEMICAL ENGINEERING (M.ENG, D.ENG.)

2105522  Dynamic Process Simulation  3(3-0-9)  
Fundamental of dynamic model development, lumped parameter systems, solution strategies for lumped parameter systems, distributed parameter systems, Solution strategies for distributed system, parameter system empirical model development, computer aided process modeling, static and dynamic simulation of chemical processes.

2105526  Total Productive Management for Chemical Process Industry  3(3-0-9)  
Total Productive Management, usage of Key Management Index, Key Performance Index, Key Activity Index, cascading of organizational responsibility autonomous management, productive maintenance, focused improvement, expansion based on knowledge transfer, quality management, initial phase management, management of safety, health and environment, management of social responsibility.

2105527  Polymer Characterization and Fracture  3(3-0-9)  
Structures-Properties-Performance relationship of polymers, the petrochemical and the plastic processing industrial approaches to polymer characterization, modification of polymers by compounding, blending & alloying and composites and their influences on fracture, transitions in polymers, thermal degradation of polymers, deformation in semi-crystalline and glassy polymers, shear yielding and crazing, fracture of polymers, modes of crack growth, brittle and ductile fracture of polymers, fracture morphology and fractography of polymers.

2105572  Encapsulation Process  3(3-0-9)  
Encapsulation process, use of encapsulation process in chemical industry and related industry, main techniques and methods in encapsulation process, the selection of wall materials, the selection of appropriate technique for core materials, the application of encapsulation process in industries and their products.
Batch mixing, batch extraction.

2105601 Advanced Engineering Mathematics for Chemical Engineers 3(3-0-9)

2105602 Advanced Transport Phenomena 3(3-0-9)

2105603 Advanced Chemical Engineering Thermodynamics 3(3-0-9)
Introduction to molecular thermodynamics, equations of state, equations for activity coefficients, thermodynamic property determination, multicomponent phase equilibrium, process analysis.

2105604 Advanced Chemical Engineering Kinetics and Chemical Reactor Design 3(3-0-9)
Review of fundamental principles. Order of reactions and rate equations. Theory of rate processes; diffusion, types of reactors, catalysis, mechanical arrangement of reactors for agitation, heat and mass transfer. Methods of designing chemical reactors with emphasis on continuous processing.

2105605 Chemical Engineering Seminar I 1(1-0-3)
Seminar and discussions on current research in chemical engineering for first year students.

2105606 Chemical Engineering Seminar II 1(1-0-3)
Seminar and discussions on current research in chemical engineering for second year students in the first semester.

2105607 Chemical Engineering Process Scale-up 3(3-0-9)
This course examines the technical issues associated with transforming a chemical process from small scale (e.g. laboratory) to commercial operation. The concepts underlying chemical principles, unit operations and transport phenomena are integrated to give students an understanding of the methodology involved in converting a laboratory experiment into a process with commercial potential. Specific topics include the effects of scale on the relative rates of mass, heat and momentum transfer, mixing effects, utility of various reactor operating modes (e.g. batch, semi-batch, continuous).

2105608 Adsorption process 3(3-0-9)
Adsorption phenomena, adsorption equilibrium, kinetics of mass transfers in porous particles, adsorption processes with steady-state and periodic operations, mathematical models of adsorption processes, chromatographic separation and gas separation with pressure swing adsorption.

2105609 Advanced Particulate Technology 3(3-0-9)
Particle characterization and measurement of physical and chemical properties of powder; transport phenomena and related topics; advanced powder handling operations in the industry; detonation and dust explosion.

2105610 Membrane Technology 3(3-0-9)
Membrane structure and function; Production of membrane; characterization, selection and use of membrane system; Applications for membrane separations in various chemical and biochemical processes.

2105611 Separation Technology Via Liquid Membrane And Application 3(3-0-9)
Variety of separation process via liquid membrane; selection of single/multiple extractant systems; design of a particular metal ion separation froms mixture; the applications of hollow fiber supported liquid membrane in separation of toxic metals, precious metals, rare earth metals and radioactive metals.

2105612 Chemical Engineering Process and product Development 3(3-0-9)
Strategies for chemical product design: Needs, Ideas, Selection, Manufacture, Strategies for chemical process design: Process synthesis, Process simulation, selection and design of reactors, synthesis of separation system, energy recovery, environmental protection.

2105613 Mass Transfer operation 3(3-0-9)

2105616 Fluid and Particle Mechanics 3(3-0-9)

2105617 Research Methodology and Statistical Analysis 3(3-0-9)
Steps employed in planning research and conducting research; Steps employed in writing a thesis or a research paper; Plagiarism; Presentation of the research; Test of statistical hypothesis; Analysis of variance; Design and analysis of experiments, Full and fractional factorial designs; Simple linear regression.
analysis; Multiple linear regression analysis; Basic nonlinear regression analysis.

2105618 Characterization and Instrumental Analysis 3(3-0-9)

Basic concepts of characterization and instrumental analysis: Thermal analysis, Crystallography, Surface analysis, Microscopy, FTIR, Raman spectroscopy, Chromatography, Mechanical testing.

2105619 Advanced Automatic Process Control 3(3-0-9)


2105621 Multivariable Process Control 3(3-0-9)

Introduction to multivariable control, uncertainty and robustness for multivariable control system, controller design and control structure design.

2105622 Chemical Process Simulation and Optimization 3(3-0-9)

Process analysis and simulation; concept of model synthesis, model characterization based on behavioral principles and on mathematical properties, subsystems and systems analysis. To give a broad coverage of the field of computer applications to chemical engineering, with emphasis on steady-state flowsheeting and process simulation.

2105623 Optimization of Chemical processes 3(3-0-9)


2105624 Computer Process Control 3(3-0-9)

Computer hardware, interfacing, control algorithms and their implementation, distributed control system, predictive control techniques, automatic tuning.

2105625 Process Control and Management 3(3-0-9)

Generalization concepts of process control; hierarchy in process concess control; planning and scheduling; manufacturing execution systems, plant information systems; process plan business function.

2105626 Advanced Heat Transfer 3(3-0-9)

Radiative heat transfer, radiative properties of real materials, radiation exchange between black surfaces and between diffuse gray surfaces, special radiative problems. Forced convection heat transfer, convection processes, similarity theory, correlations of heat transfer coefficients, effect of viscous dissipation, non-continuum effect. Analytical methods in conduction heat transfer. Bessel equation, the method of separation of variables, Laplace transforms, finite differences and finite elements. Heat transfer with vapourisation, condensation and natural convection.

2105628 Process Control Instrumentation 3(3-0-9)

Sensors and actuators used in process industries; signal conditioning and transmission; analog and digital controllers; interfacing and communication; programmable logic controllers; distributed process control systems; safety in process automation.

2105629 Process Identification and Data Analysis 3(3-0-9)

Methods for modeling the dynamic behaviour of a process and its disturbances using data collected from the process; transfer function and time series modeling theory and techniques; statistical methods for structure determination parameter estimation, model validation, experiment design, and closed-loop data analysis, analysis and control, multivariate statistical methods including Principal Component Analysis (PCA), and Partial Least Squares (PLS) used for the efficient extraction of information from large databases typically collected by on-line process computer; analysis of process problems and on-line process improvement by using these model.

2105630 Heterogeneous Catalytic Reactor Modelling 3(3-0-9)

Introduction to catalytic reactor modelling; criteria for selection a suitable model; mathematical models of different types of catalytic reactor; catalyst activity model; steady and transient state model.

2105631 Advanced catalysts for polymers 3(3-0-9)

Catalyst preparation and characterization of polymers: ziegler-natta catalysts, metallocene catalysts, and late transition metal complex catalysts the application of these catalysts in polymer production.

2105632 Petrochemical Technology 3(3-0-9)

The position today, the chemistry, the economics and where possible, the solid implications. The basis for petrochemicals: catalysts, economic and engineering Chemical components, or elements recovered from petroleum or natural gas. Petrochemical processes with emphasis on the chemical reactions and their kinetics.

2105634 Catalysis 3(3-0-9)

Adsorption and kinetics of surface reactions; poisoning, selectivity; and empirical activity patterns in catalysis; surface chemistry, catalytic mechanisms and modern experimental techniques in catalytic research; descriptive examples of industrial catalytic system.

2105636 Heterogeneous Catalysis 3(3-0-9)


2105637 Design of Industrial Catalysis 3(3-0-9)

The overall design of catalysts, design of the primary and secondary constituents of the catalyst,
choice of support materials, experimental testing, summary of some useful general information for catalyst designers, specific example of catalyst design.

2105638 Advanced Polymer Engineering 3(3-0-9)

2105641 Biodegradable Material Engineering 3(3-0-9)
Types of biodegradable materials: synthetic and natural materials, sources and production, properties biocompatibility, biodegradation mechanism, test methods for biodegradable plastics; polysaccharides, biopolymer protein (collagen, gelatin), biodegradable polymers for tissue engineering and controlled release.

2105643 Polymer Processing 3(3-0-9)
Application of heat transfer, fluid mechanics and thermodynamics to the design and control of polymer processing equipment. Detailed consideration of extrusion, calendering, rotational molding, stamping and injection molding.

2105649 Polymer Blends and Composites 3(3-0-9)
Terms and Definitions in multicomponent Polymer Systems, Advantages, Interfaces, Polymer Blends, Thermodynamics of Polymer Blends, Phase Separation, Miscibility, Block Copolymers, Polymer Composites Including Filled Polymers and Reinforced Polymers, Processing and Rheology of Multicomponent Systems, Coatings.


2105650 Biochemical Engineering 3(3-0-9)

2105652 Bioreactor Design Analysis and Control 3(3-0-9)
Analysis of microbial kinetics for bioreactor design; Design and analysis of batch, continuous, and multiphase bioreactors; Advanced control strategies of bioreactors.

2105654 Bioreactor Design Analysis and Control 3(3-0-9)
Analysis of microbial kinetics for bioreactor design; Design and analysis of batch, continuous, and multiphase bioreactors; Advanced control strategies of bioreactors,

2105655 Bioprocess Plant Design 3(3-0-9)
Design and cost analysis of equipment and plant for bioprocess industries; process waste treatments; Case study of bioprocess design.

2105656 Bioremediation Engineering 3(3-0-9)
Concept of bioremediation engineering, use of microorganisms for pollution control; biodegradation kinetics, bioreaction design and in situ bioremediation.

2105659 Biochemical Separation Technology 3(3-0-9)

2105661 Special Problems in Chemical Engineering 3(3-0-9)
Study of investigation of special problems in chemical engineering assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105662 Selected Topics in Chemical Engineering 3(3-0-9)
Study of specialized topics of interest in chemical engineering assigned by the lecturer with the consent of the head of the department. Written report and oral examination are required.

2105663 Heat Transfer Operation 3(3-0-9)
Heat transfer phenomena in Chemical Process Equipment, Conduction, Convection, Radiation, Overall heat transfer coefficient, mean temperature different, heat exchanger in chemical process, design of double pipe heat exchanger, design of shell and tube heat exchanger, boiling and condensing heat transfer, industrial furnace, heat recovery in chemical process, rating of heat exchanger.

2105665 Cryogenic Engineering 3(3-0-9)
Basic principles involved in the production at low temperature and the separation of gases. Physical properties of cryogenic fluids and recent developments in their engineering applications.

2105666 Source Control of Particulate Emissions 3(3-0-9)
Contents of controlling air pollution emissions. Control of particulate emissions—mechanical collectors, filters, electrostatic precipitators, scrubbers, Modeling, design, equipment selection and cost.

2105667 Loss Prevention in Chemical Operation 3(3-0-9)
210568 Energy Conservation in Chemical Processes 3(3-0-9)
Basic considerations and objective of energy conservation in chemical industry; Fundamentals of energy integration for chemical engineers; Synthesis, and optimization of heat exchanger networks in chemical processes; Other energy recovery techniques; Alternative sources of energy.

210569 Cleaner Technology 3(3-0-9)
Fundamental of clean technology; Pollution prevention in industrial processes: principles, approaches, application in process and equipment design; waste minimization: industrial waste reduction techniques; Life cycle analysis: concept, methods, application of pollution prevention.

210571 Process Dynamics 3(3-0-9)
Dynamic modeling of chemical engineering processes; control system design for chemical engineering process dynamic simulation of controlled manufacturing process.

210572 Simulation of Particulate and Material Processes 3(3-0-9)
Various approaches to mathematical modeling; modeling and simulation of industrial processes involved with particulate material; such as aerosol filtration with fibrous filters, capturing of suspended dust particles using liquid spraying, pneumatic conveying drying, spray drying, fluidization phenomena as well as multi-phase flow of particles using discrete simulation technique.

210573 Design and Analysis of Experiments in Chemical Engineering 3(3-0-9)
Simple comparative experiments; experiments with a single factor; analysis of variance; randomized blocks and Latin squares designs; Factorial design, Tow-level factorial design; Three-level and mixed-level factorial design; Robustness experiments with random factors.

210574 Computer-aided Process and Product Engineering 3(3-0-9)
Computer-aided modeling and simulation; Computer-aided process and product design; Computer-aided process operation; Modeling in the process life cycle.

210575 Polymer Chemistry for Engineers 3(3-0-9)
Basic concepts and knowledge of polymer chemistry for engineers and their applications; mechanism of polymerizations, kinetics model of polymerization, chemical and physical characterization methods in polymer chemistry to understand polymerization from engineering basis.

2105688 Instrumentation in Chemical Process 3(3-0-9)
The types and fundamental concepts of instrumentation in chemical process and related industry such as temperature, pressure, flow rate, concentration and level. Sensors and actuators used in process industries; signal conditioning and transmission analog and digital controllers; interfacing and communication; programmable logic controllers; distributed process control systems; safety in process automation.

2105678 Introduction to Nanotechnology 3(3-0-9)
Fundamentals of nanotechnology, instrumentation in nanotechnology, nanopowders and nanomaterials, natural nanomaterials, nanobiometrics, preparation of nanomaterials, properties of nanomaterials, applications of nanomaterials mainly in materials technology mediums, energy, electronics and chemical engineering, preparation of carbon nanomaterials and its applications.

2105679 Bioactive Compounds 3(3-0-9)
Physical, chemical and biological properties of bioactive compounds from plants, animals and microorganisms with significant biological activity and important uses in pharmaceuticals, agriculture, cosmetic industries, including synthesis, extraction techniques and development of bioactive properties by bio/chemical/genetic engineering treatment.

2105680 Multifunctional Reactor 3(3-0-9)
Basic concepts and knowledge of different multifunctional reactors and their applications; mathematical modelling and simulation to understand effects of various operating parameters on the multifunctional reactors performance.

2105681 Catalyst Deactivation 3(3-0-9)
Physical and chemical knowledge of catalyst deactivation by fouling, poisoning and sintering, regeneration of fixed beds.

2105682 Surface Technology 3(3-0-9)
Basic concepts and surface chemistry; and inorganic chemistry, absorption and various techniques for surface analysis.

2105683 Bioenergy Technology 3(3-0-9)
Fundamental concepts for biofuel/bioenergy technology, Renewable feedstocks, availability and attributes for biofuel/bioenergy production, Thermochemical conversion of biomass to heat, power, and fuel. Thermal gasification of biomass, Biochemical engineering for conversion of biomass to fuel; ethanol, butanol, methane, hydrogen and biodiesel production, environmental impacts of biofuel production; value-added processing of biofuel residues; case studies on biofuel production.

2105684 Chemical Analysis for Chemical Process Control I 3(3-0-9)
Principles of chromatograph (gas and liquid) and spectroscopy, signal characteristic, factors affecting signal interpretation, application in real-time process control.

2105685 Selected Topics in Transport Phenomena 3(3-0-9)
Study of specialized topics of interest in transport phenomena assigned by the lecturer with the consent of the head of the department. Written report and oral examination are required.

2105686 Selected Topics in Chemical Engineering Thermodynamics 3(3-0-9)
Study of specialized topics of interest in chemical engineering thermodynamics assigned by the lecturer with the consent of the head of the department. Written report and oral examination are required.
2105687 Advanced Chemical Kinetics and Catalysis 3(3-0-9)
Thermodynamics of chemical reaction; determination of rate expressions; reaction mechanisms; molecular theories of chemical kinetics; chemical systems involving multiple reactions; elements of heterogeneous catalysis; liquid phase reactions and homogeneous catalysis; mass and heat transport process in porous catalysts.

2105688 Selected Topics in Chemical Engineering Kinetics 3(3-0-9)
Study of specialized topics of interest in chemical engineering kinetics assigned by the lecturer with the consent of the head of the department. Written report and oral examination are required.

2105689 Safe Process Operation and Design 3(3-0-9)

2105690 Independent study I 3(3-0-9)
Independent studies course provides the platform for students to be involved in a research or industrial project. Students will need to work closely with a faculty member with the consent of the head of the department and external mentor who can guide them through the process of conducting a research study.

2105691 Independent study II 3(3-0-9)
Independent studies course provides the platform for students to be involved in a research or industrial project. Students will need to work closely with a faculty member with the consent of the head of the department and external mentor who can guide them through the process of conducting a research study.

2105692 Independent study III 3(3-0-9)
Independent studies course provides the platform for students to be involved in a research or industrial project. Students will need to work closely with a faculty member with the consent of the head of the department and external mentor who can guide them through the process of conducting a research study.

2105693 Special Problems in process control Engineering 3(3-0-9)
Study of investigation of special problems in process control engineering assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105694 Special Problems in Petrochemical Engineering 3(3-0-9)
Study of investigation of special problems in petrochemical engineering assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105695 Special Problems in Polymer Engineering 3(3-0-9)
Study of investigation of special problems in polymer engineering assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105696 Special Problems in Biochemical Engineering 3(3-0-9)
Study of investigation of special problems in biochemical engineering assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105697 Special Problems in Cleaner Production Engineering 3(3-0-9)
Study of investigation of special problems in cleaner production engineering assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105698 Special Problems in Particle Technology 3(3-0-9)
Study of investigation of special problems in particle technology assigned by the instructor with the consent of the head of department. The work must be completed within one semester and an examination taken.

2105699 Multifunctional Reactor 3(3-0-9)
Basic concepts and knowledge of different multifunctional reactors and their applications; mathematical modeling and simulation to understand effects of various operating parameters on the multifunctional reactors performance.

2105717 Seminar in Chemical Engineering III 3(3-0-9)
Review and presentation of specialized topic of modern progress in Chemical Engineering assigned by program committee. Written report presentation and oral examination are required.

2105718 Seminar in Chemical Engineering IV 3(3-0-9)
Study and discussion of specialized topics of modern progress in Chemical Engineering assigned by program committee. Written report, presentation and oral examination are required.

2105897 Qualifying Examination 0(0-0-0)

2105811 Thesis 12 Credits
2105816 Thesis 36 Credits

2105828 Dissertation 48 Credits
2105829 * Dissertation 60 Credits
2105830* Dissertation 72 Credits

2105894 Doctoral Dissertation Seminar 0(0-0-0)
Study and discussion of dissertation and present the progress of doctoral dissertation.
DEPARTMENT OF MINING AND PETROLEUM ENGINEERING

The Department of Mining and Petroleum Engineering currently offers two undergraduate programs namely Georesources Engineering and Petroleum Engineering. Mining Engineering program is replaced by Georesources Engineering Program where two majors mining, and resources engineering are conducted. These two existing programs are designed to prepare graduates for mining, resources, petroleum, and related industries both in Thailand and abroad. These programs also facilitate graduates to carry on to higher education.

Courses are designed to give students basic knowledge in both sciences and engineering fundamentals as well as professional subjects of the fields. Optional courses are also offered as electives to accommodate special interest of students or special need of the industry. Practical training are compulsory to familiarize students with industry. English, humanities, and social sciences courses are also requirement of the programs so that students have opportunity to broaden their views as well as English skill.

Georesources Engineering
The undergraduate georesources engineering program provides foundation knowledge in all aspects of georesources development. After having broad background in sciences and basic engineering during the first and the second year, students will receive a thorough background in georesources engineering in the first semester of the third year, which will support advance georesources engineering courses in the third and fourth year. A broad interdisciplinary coverage of georesources development principles including mining geology, mineral exploration, ore reserve estimation, mine development, mining methods of both surface and underground operations, rock mechanics, geostatistics, georesources economics and management, mineral processing and utilization and environmental aspects of mining operation and recycling will be provided for junior and senior level.

Petroleum Engineering Program
The Petroleum Engineering curriculum for undergraduate study provides core courses in all aspects of petroleum engineering including rock and fluid properties, reservoir engineering, well logging, drilling engineering, production engineering, production operations, natural gas processing, and petroleum economics. The Department also offers a master's degree program in petroleum engineering. The program is specially designed for Thai and foreign students using English as a program language. It is designed for students who graduate with B.Eng. or B.Sc. in petroleum engineering or other related disciplines.

Due to the rapid progress in engineering and trend toward interdisciplinary environment in industries, the department also emphasizes on learning and communication skills of students. In addition, awareness in environmental problems related to engineering work is also an important element in the programs.

HEAD:
Thitisak Boonpromote, Ph.D. (Colorado school at Mines)

ASSOCIATE PROFESSORS:
Dawan Wiwattanadate, Ph.D. (Osaka)
Somsak Saisinchai, M.Eng. (Chula)

ASSISTANT PROFESSORS:
Jirawat Chewaroungroaj, Ph.D. (Texas at Austin)
Sunthorn Pumjan, Ph.D. (Michigan Tech)
Suwat Athichanagom, Ph.D. (Stanford)
Kreangkrai Maheeintr, Ph.D. (Regina)

LECTURERS:
Pipat Laowattanabandit, Ph.D.(Colorado School of Mines)
Falan Srisuriyachai, Ph.D. (Bologna)
Apisit Numprasanthai, Ph.D. (Griffith)
Raphael Bissen, Dr.rer.nat (Freiburg)
# Georesources Engineering Undergraduate Curriculum

**First Year Curriculum**

## Common to all Engineering Students

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>Eng Mechanics I</td>
<td>3</td>
<td>2103393</td>
<td>Eng Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>Calculus III</td>
<td>3</td>
<td>2108302</td>
<td>Field Practice I</td>
<td>1</td>
</tr>
<tr>
<td>2106251</td>
<td>General Geology</td>
<td>3</td>
<td>2106441</td>
<td>Geotech</td>
<td>3</td>
</tr>
<tr>
<td>2106422</td>
<td>Fund GE</td>
<td>1</td>
<td>2106432</td>
<td>Separation Technology</td>
<td>3</td>
</tr>
<tr>
<td>2106222</td>
<td>Chem Mat Lab</td>
<td>1</td>
<td>2106412</td>
<td>Res Econ Mgt</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>Com Pres Skil</td>
<td>3</td>
<td>2106333</td>
<td>Res Proc Lab II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
<td>5500308</td>
<td>Tech Writ Eng</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Third Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101202</td>
<td>Mech Mat I</td>
<td>3</td>
<td>2100301</td>
<td>Eng Practice</td>
<td>2</td>
</tr>
<tr>
<td>2108298</td>
<td>Surveying I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2106458</td>
<td>Mining Geology</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2106316</td>
<td>Sur Min</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104253</td>
<td>Eng Stat I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Fourth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>Eng Mechanics I</td>
<td>3</td>
<td>2103393</td>
<td>Eng Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>Calculus III</td>
<td>3</td>
<td>2108302</td>
<td>Field Practice I</td>
<td>1</td>
</tr>
<tr>
<td>2106251</td>
<td>General Geology</td>
<td>3</td>
<td>2106441</td>
<td>Geotech</td>
<td>3</td>
</tr>
<tr>
<td>2106422</td>
<td>Fund GE</td>
<td>1</td>
<td>2106432</td>
<td>Separation Technology</td>
<td>3</td>
</tr>
<tr>
<td>2106222</td>
<td>Chem Mat Lab</td>
<td>1</td>
<td>2106412</td>
<td>Res Econ Mgt</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>Com Pres Skil</td>
<td>3</td>
<td>2106333</td>
<td>Res Proc Lab II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
<td>5500308</td>
<td>Tech Writ Eng</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Fifth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100311</td>
<td>Eng Essentials</td>
<td>3</td>
<td>2106446</td>
<td>Min Plan Dsgn</td>
<td>3</td>
</tr>
<tr>
<td>2112346</td>
<td>Hydraulics I</td>
<td>3</td>
<td>2106413</td>
<td>Res Env Poll Prvnt</td>
<td>3</td>
</tr>
<tr>
<td>2103295</td>
<td>Basic Therm</td>
<td>3</td>
<td>xxxxxxx</td>
<td>Elective Course</td>
<td>3</td>
</tr>
<tr>
<td>2106310</td>
<td>Mineral Process Eng</td>
<td>3</td>
<td>xxxxxxx</td>
<td>Elective Course</td>
<td>3</td>
</tr>
<tr>
<td>2106332</td>
<td>Res Proc Lab I</td>
<td>1</td>
<td>xxxxxxx</td>
<td>Elective Course</td>
<td>3</td>
</tr>
<tr>
<td>2106445</td>
<td>Underground Min</td>
<td>3</td>
<td>xxxxxxx</td>
<td>Elective Course</td>
<td>3</td>
</tr>
<tr>
<td>2106444</td>
<td>Eng Exp Rock Blast</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Sixth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>Eng Mechanics I</td>
<td>3</td>
<td>2103393</td>
<td>Eng Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>Calculus III</td>
<td>3</td>
<td>2108302</td>
<td>Field Practice I</td>
<td>1</td>
</tr>
<tr>
<td>2106251</td>
<td>General Geology</td>
<td>3</td>
<td>2106441</td>
<td>Geotech</td>
<td>3</td>
</tr>
<tr>
<td>2106422</td>
<td>Fund GE</td>
<td>1</td>
<td>2106432</td>
<td>Separation Technology</td>
<td>3</td>
</tr>
<tr>
<td>2106222</td>
<td>Chem Mat Lab</td>
<td>1</td>
<td>2106412</td>
<td>Res Econ Mgt</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>Com Pres Skil</td>
<td>3</td>
<td>2106333</td>
<td>Res Proc Lab II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
<td>5500308</td>
<td>Tech Writ Eng</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Summer Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>Eng Mechanics I</td>
<td>3</td>
<td>2103393</td>
<td>Eng Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>Calculus III</td>
<td>3</td>
<td>2108302</td>
<td>Field Practice I</td>
<td>1</td>
</tr>
<tr>
<td>2106251</td>
<td>General Geology</td>
<td>3</td>
<td>2106441</td>
<td>Geotech</td>
<td>3</td>
</tr>
<tr>
<td>2106422</td>
<td>Fund GE</td>
<td>1</td>
<td>2106432</td>
<td>Separation Technology</td>
<td>3</td>
</tr>
<tr>
<td>2106222</td>
<td>Chem Mat Lab</td>
<td>1</td>
<td>2106412</td>
<td>Res Econ Mgt</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>Com Pres Skil</td>
<td>3</td>
<td>2106333</td>
<td>Res Proc Lab II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
<td>5500308</td>
<td>Tech Writ Eng</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Seventh Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>Eng Mechanics I</td>
<td>3</td>
<td>2103393</td>
<td>Eng Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>Calculus III</td>
<td>3</td>
<td>2108302</td>
<td>Field Practice I</td>
<td>1</td>
</tr>
<tr>
<td>2106251</td>
<td>General Geology</td>
<td>3</td>
<td>2106441</td>
<td>Geotech</td>
<td>3</td>
</tr>
<tr>
<td>2106422</td>
<td>Fund GE</td>
<td>1</td>
<td>2106432</td>
<td>Separation Technology</td>
<td>3</td>
</tr>
<tr>
<td>2106222</td>
<td>Chem Mat Lab</td>
<td>1</td>
<td>2106412</td>
<td>Res Econ Mgt</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>Com Pres Skil</td>
<td>3</td>
<td>2106333</td>
<td>Res Proc Lab II</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
<td>5500308</td>
<td>Tech Writ Eng</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Eighth Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
<th>Course No.</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>Eng Mechanics I</td>
<td>3</td>
<td>2103393</td>
<td>Eng Lab Non ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>Calculus III</td>
<td>3</td>
<td>2108302</td>
<td>Field Practice I</td>
<td>1</td>
</tr>
<tr>
<td>2106251</td>
<td>General Geology</td>
<td>3</td>
<td>2106441</td>
<td>Geotech</td>
<td>3</td>
</tr>
<tr>
<td>2106422</td>
<td>Fund GE</td>
<td>1</td>
<td>2106432</td>
<td>Separation Technology</td>
<td>3</td>
</tr>
<tr>
<td>2106222</td>
<td>Chem Mat Lab</td>
<td>1</td>
<td>2106412</td>
<td>Res Econ Mgt</td>
<td>3</td>
</tr>
<tr>
<td>2106445</td>
<td>Underground Min</td>
<td>3</td>
<td>xxxxxxx</td>
<td>Elective Course</td>
<td>3</td>
</tr>
<tr>
<td>2106444</td>
<td>Eng Exp Rock Blast</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Credits for Graduation = 146
# PETROLEUM ENGINEERING UNDERGRADUATE CURRICULUM

## FIRST YEAR CURRICULUM

### COMMON TO ALL ENGINEERING STUDENTS

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>ENG MECHANICS I</td>
<td>3</td>
<td>2103393</td>
<td>ME LAB NON ME</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>CALCULUS III</td>
<td>3</td>
<td>2106361</td>
<td>WELL LOGGING</td>
<td>3</td>
</tr>
<tr>
<td>2103295</td>
<td>BASIC THERMO</td>
<td>3</td>
<td>2106368</td>
<td>RESERVOIR ENG II</td>
<td>3</td>
</tr>
<tr>
<td>2106261</td>
<td>PETROLEUM GEOLOGY</td>
<td>3</td>
<td>2106369</td>
<td>PROD TECH</td>
<td>3</td>
</tr>
<tr>
<td>2106263</td>
<td>FUND PE</td>
<td>3</td>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td>xxxxxxx</td>
<td>ELECTIVE COURSE</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>18</strong></td>
<td></td>
<td></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

### THIRD SEMESTER

### SIXTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103231</td>
<td>MECH OF MAT I</td>
<td>3</td>
<td>2100301</td>
<td>ENG PRACTICE</td>
<td>2</td>
</tr>
<tr>
<td>2103351</td>
<td>FLUID MECHANICS I</td>
<td>3</td>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2104253</td>
<td>ENG STAT I</td>
<td>3</td>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2106266</td>
<td>PETROPHYSICS</td>
<td>3</td>
<td>2106462</td>
<td>PET PROC ENG</td>
<td>3</td>
</tr>
<tr>
<td>2106267</td>
<td>PET FLUID PROP</td>
<td>3</td>
<td>2106465</td>
<td>PETROL ECONOMICS</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>3</td>
<td>xxxxxxx</td>
<td>ELECTIVE COURSE</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>18</strong></td>
<td></td>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

### FOURTH SEMESTER

### SUMMER SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100311</td>
<td>ENG ESSENTIALS</td>
<td>3</td>
<td>2106474</td>
<td>PETRO RES DEV</td>
<td>3</td>
</tr>
<tr>
<td>2106268</td>
<td>PET DRILL FLUID LAB</td>
<td>3</td>
<td>2106479</td>
<td>PETROLEUM PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2106362</td>
<td>DRILLING ENG</td>
<td>3</td>
<td>OR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2106367</td>
<td>RESERVOIR ENG I</td>
<td>3</td>
<td>2100499</td>
<td>ENG PROJ</td>
<td></td>
</tr>
<tr>
<td>2106464</td>
<td>PRODUCTION ENG</td>
<td>3</td>
<td>xxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>6</td>
</tr>
<tr>
<td>2301312</td>
<td>DIFF QUATIONS</td>
<td>1</td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td></td>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

### SEVENTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2106368</td>
<td>PETROLEUM PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2301312</td>
<td>DIFF QUATIONS</td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
</tbody>
</table>

### FIFTH SEMESTER

### EIGHTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100311</td>
<td>ENG ESSENTIALS</td>
<td>3</td>
</tr>
<tr>
<td>2106268</td>
<td>PET DRILL FLUID LAB</td>
<td>3</td>
</tr>
<tr>
<td>2106362</td>
<td>DRILLING ENG</td>
<td>3</td>
</tr>
<tr>
<td>2106367</td>
<td>RESERVOIR ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2106464</td>
<td>PRODUCTION ENG</td>
<td>3</td>
</tr>
<tr>
<td>2301312</td>
<td>DIFF QUATIONS</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
</tbody>
</table>

### TOTAL CREDITS FOR GRADUATION = 143
## Study Program for Master Degree in Georesources and Petroleum Engineering (Mining Engineering)

### First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186532</td>
<td>Geomechanics</td>
<td>3</td>
</tr>
<tr>
<td>2186608</td>
<td>Resources Environment and Life Cycle Pollution Prevention</td>
<td>3</td>
</tr>
<tr>
<td>2186670</td>
<td>Sustainable Mineral and Petroleum Resources Development</td>
<td>3</td>
</tr>
</tbody>
</table>

### Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186533</td>
<td>Mine Planning and Design</td>
<td>3</td>
</tr>
<tr>
<td>2186642</td>
<td>Resources Economics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>3</td>
</tr>
</tbody>
</table>

### Third Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186756</td>
<td>Research Seminar</td>
<td>S/U</td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>6</td>
</tr>
<tr>
<td>2186811</td>
<td>Thesis</td>
<td>3</td>
</tr>
</tbody>
</table>

### Fourth Semesters

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186811</td>
<td>Thesis</td>
<td>9</td>
</tr>
</tbody>
</table>

Graduate students with no mining engineering background must complete the following courses within the first year of study.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186524</td>
<td>Basic Georesources Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2186534</td>
<td>Basic Geology</td>
<td>3</td>
</tr>
</tbody>
</table>

85
## STUDY PROGRAM FOR MASTER DEGREE IN GEORESOURCES AND PETROLEUM ENGINEERING
(RESOURCES RECYCLING ENGINEERING)

### First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186509</td>
<td>Resources Process Technology and Utilization</td>
<td>3</td>
</tr>
<tr>
<td>2186608</td>
<td>Resources Environment and Life Cycle Pollution</td>
<td>3</td>
</tr>
<tr>
<td>2186670</td>
<td>Sustainable Mineral and Petroleum Resources Development</td>
<td>3</td>
</tr>
</tbody>
</table>

### Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186623</td>
<td>Process Separation for Resources Recovery</td>
<td>3</td>
</tr>
<tr>
<td>2186642</td>
<td>Resources Economics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>3</td>
</tr>
</tbody>
</table>

### Third Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186756</td>
<td>Research Seminar</td>
<td>S/U</td>
</tr>
<tr>
<td>2186811</td>
<td>Thesis</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>6</td>
</tr>
</tbody>
</table>

### Fourth Semesters

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186811</td>
<td>Thesis</td>
<td>9</td>
</tr>
</tbody>
</table>

Graduate students with no resources recycling engineering background must complete the following courses within the first year of study.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186524</td>
<td>Basic Georesources Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2186535</td>
<td>Basic Minerals and Rocks</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>2186651</td>
<td>Advanced Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2186667</td>
<td>Production System Analysis</td>
<td>3</td>
</tr>
<tr>
<td>2186670</td>
<td>Sustainable Mineral and Petroleum Resources</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Development</td>
<td>9</td>
</tr>
<tr>
<td>2186671</td>
<td>Advanced Natural Gas Engineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>6</td>
</tr>
</tbody>
</table>

**Second Semester**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2186756</td>
<td>Research Seminar</td>
<td>S/U</td>
</tr>
<tr>
<td>2186664</td>
<td>Petroleum Well Construction</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective Courses</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Thesis</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

**Third Semester**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2185655</td>
<td>Basic Petroleum Geology</td>
<td>3</td>
</tr>
<tr>
<td>2185666</td>
<td>Petrophysics</td>
<td>3</td>
</tr>
<tr>
<td>2185667</td>
<td>Basic Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2185668</td>
<td>Basic Drilling Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2185669</td>
<td>Basic Production Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

**Fourth Semester**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thesis</td>
<td>9</td>
</tr>
</tbody>
</table>

Graduate students with no petroleum engineering background must complete the following courses within the first year of study.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2185655</td>
<td>Basic Petroleum Geology</td>
<td>3</td>
</tr>
<tr>
<td>2185666</td>
<td>Petrophysics</td>
<td>3</td>
</tr>
<tr>
<td>2185667</td>
<td>Basic Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2185668</td>
<td>Basic Drilling Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2185669</td>
<td>Basic Production Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>
2106208 Chemical for Materials 3(3-0-6)
Condition: Concurrent 2106209
Phase equilibria and physical properties of matter; and heterogeneous mixture; colligative properties of solution; colloid and surface chemistry; surface chemistry and application in materials separation; electrochemistry and corrosion; ore sampling and dissolution for analysis; separation and analysis of metal ions in solution.

2106209 Chemical for Materials Lab 1(0-3-0)
Condition: Concurrent 2106208
Effects of temperature on liquid viscosity; effects of temperature and/or surfactant on liquid surface tension molecular weight determination via colligative properties of solution; preparation of standard solution and standardization; Ore dissolution and fusion; analysis of metal ion in solution by redox titration; potentiometric titration; and spectrometry.

2106222 Fundamental of Georesources Engineering 1(1-0-2)
Introduction to mining industry and georesources development; exploration, evaluation and mineral deposit development; Environment, health and safety considerations in mine operations.

2106251 General Geology 3(2-3-4)
Scope of geology; the universe and the earth; surface features of the earth's crust and the geological processes; deformation of the earth's crust; rock structures; problems of dip and strike, vein intersection, faulting and folding; geological maps and sections; field techniques in geological mapping; collection of field specimens; well logging and drill core; preparation of geological maps and reports.

2106252 Minerals and Rocks 3(2-3-4)
Basic knowledge of mineralogy; crystallography; crystal system; physical properties; identification of rock-forming economic minerals; origin of igneous; sedimentary and metamorphic rocks; geological and engineering classification rocks.

2106296 Engineering Geology 3(2-3-4)
Condition: Prerequisite 2103105 and 2108205 or 2108291
A general survey of geology with particular reference to civil engineering; common rock forming minerals; general characteristics and origins of rocks; features of the earth and geological processes; structural features of the earth's crust; geology of water supply, reservoirs and dam sites, erosion and flood control; river and harbour improvement; geological, factors affecting quarrying, tunnelling, landside, land subsidence, foundations, and building materials.

2106310 Mineral Processing Engineering 3(3-0-6)
Theory of Physical methods of mineral processing; Fundamental of mineral processing including sampling, comminution and liberation, screening, classification, size determination, gravity concentration, magnetic separation, electrostatic separation, introduction to flotation. Construction of simple flow sheets for mineral processing plants.

2106315 Mining Engineering Laboratory 1(0-3-0)
Condition: Consent of Faculty
Laboratory experiments in mining development and mining operation.

2106316 Surface Mining 3(3-0-6)
Exploration, evaluation and development of mineral deposits, classification and selection of various mining methods; mine planning and design concept; earth and rock excavation; drilling and bench blasting; mine loading and haulage; environmental protection; mine welfare and safety.

2106331 Mineral and Process Engineering 3(3-0-6)
Condition: Concurrent 2106332
Theory of Physical methods of mineral processing. Fundamental of mineral processing including sampling, comminution and liberation, screening, classification, size determination, gravity concentration, magnetic separation, electrostatic separation, introduction to flotation. Construction of simple flow sheets for mineral processing plants.

2106332 Resources Process Laboratory I 1(0-3-0)
Condition: Concurrent 2106331
Laboratory experiments in resources separation and recovery.

2106333 Resources Process Laboratory II 1(0-3-0)
Condition: Concurrent 2106331
Laboratory experiments in resources separation and recovery.

2106412 Resources Economics and Management 3(3-0-6)
Mineral demand and supply; mineral trade and markets; mineral market forecasting techniques; government regulations and taxation; resources evaluation; economics of resources development; project management.

2106413 Resources Environment and Pollution Prevention 3(3-0-6)
Major environmental problems from production and utilization of resources; environmental technology to manage and control the problems; waste minimization and waste disposal, environmental planning for the development and utilization of resources.

2106414 Resources Process Technology and Utilization 3(3-0-6)
Extraction, processing and utilization of resources; review of fundamental principles of process technology and utilization of resources; concepts of technology application; processes of extraction and improvement of material quality; review of principles of process design.

2106415 Resources Recovery and Recycling 3(3-0-6)
Recyclable resources; recycling of non-metal, recycling of ferrous and non-ferrous metals; principles of recycling; criteria for recovery and recycling; potential benefits of recycling; recycling technology; limitation of recycling; markets for recycle, factors affecting recycle rates; environmental aspects of recycling.
2106428 Geostatistics  3(3-0-6)
Introduction to geostatistics; spatial data and geostatistical approach; problems and geostatistical solution; structure of regionalized variable and its applications on sampling analysis and optimization; kriging system and characteristic features; estimator and estimation variance; and use of computer codes.

2106432 Separation Technology  3(3-0-6)
Condition: Concurrent 2106333
General description of separation and classification efficiency; hydrocyclones, screens, electrostatic precipitators; mixing, granulation, crystallisation; comminution matrix description of size reduction, milling circuit simulation, size enlargement and agglomeration; motion of particles in fluids; flow of fluids through granular beds; incompressible and compressible cake filtration; gravity sedimentation and clarification; pneumatic and hydraulic transport of solids; surface chemistry and thermodynamics of particles-bubbles attachment; mechanisms of mineral flotation; kinetics of mineral flotation and mechanics; flotation processes of minerals and materials.

2106433 Material Characterization  3(3-0-6)
Theories and use of techniques in material analysis including mineralogy, microscopic techniques, differential thermal analysis, thermogravimetric analysis, x-ray refraction, x-ray fluorescence, atomic absorption spectrometry, inductively coupled electron analysis and chemical analysis.

2106434 Material Handling Engineering  3(3-0-6)
Theories and design of material handling processes; belt conveyor, chain, and bucket elevator; bin and bunker design; stock piling; blending and homogenizing; feed control of bulk solids; slurry pipeline transportation, tailing disposal.

2106438 Clean Coal Technologies  3(3-0-6)
Coal utilization; coal reserve; coal gasification; coal dust explosion; coal storage; combustion; pollution management; carbon capture and storage.

2106439 Particle Technologies for Georesources Engineering  3(3-0-6)
Particle characterization, grinding; powder separation; mixing; agglomeration; transport of powder; storage of powder; safety in operation; dust explosion; dust collection.

2106441 Geotechniques  3(3-0-6)

2106442 Geotechniques Laboratory  1(0-3-0)
Laboratory experiments in rock properties.

2106443 Rock Engineering  3(3-0-6)
Basic: rock mechanics; discontinuities; rock and rock mass; strength and failure criteria; in-situ stress; site investigation; rock mass classification; rock testing, in-situ testing; rock mechanics and engineering works; rock slope stability; rock excavation; geotechnical instrumentation and monitoring.

2106444 Engineering Explosives and Rock Blasting  3(3-0-6)
Concepts of rock fragmentation, drilling and blasting; type of explosives and accessories; characteristics and properties of explosives; safety in the transportation, storage, and handling of explosives; rock blasting practices, delay blasting; bench blasting design; controlled blasting techniques; the control of ground vibration, air blast, fly rock, drilling and blasting cost evaluation.

2106445 Underground Mining  3(3-0-6)
Basic soil and rock mechanics; discontinuities; geological factors for underground excavation Site investigation for underground excavation; underground excavation in mining and civil engineering; underground mining methods, underground monitoring, explosive and blasting in underground excavation, rock support and rock reinforcement; underground mine planning and design, equipment and machine used in underground mining; basic mine ventilation, underground mine safety.

2106446 Mine Planning and Design  3(3-0-6)
Concepts of mine planning and design; application of relevant knowledge in mining on mine design; computer application and simulation in mine planning design; selection of heavy equipment; case studies on mine planning and design.

2106458 Mining Geology  3(3-0-6)
Condition: Prerequisite 2106252
Origin and Occurrence of mineral deposits; mineral associations, alterations and classification, geologic factors controlling characteristics of ore-body; surface and underground geological mapping principles and application of geological, geochemical and geophysical prospecting; planning for exploration drilling, sampling techniques; ore reserve estimation; grade control; and fundamental of geostatistics.

2106481 Advanced Topics in Geo-Resources Engineering I  3(3-0-6)
Topics of current interest and/or new development in various fields of Geo-Resources Engineering.

2106482 Advanced Topics in Geo-Resources Engineering II  3(3-0-6)
Condition: Consent of Faculty
Topics of current interest and/or new development in various fields of Geo-Resources Engineering.

2106483 Special Problems in Geo-Resources Engineering I  3(2-3-4)
Condition: Consent of Faculty
Special problems in Geo-Resources Engineering and their solutions.

2106484 Special Problems in Geo-Resources Engineering II  3(2-3-4)
Condition: Consent of Faculty
Special problems in Geo-Resources Engineering and their solutions.

2106488 Practical Education for Resources Engineering  3(2-3-4)
Practical interesting projects/topics for resources and petroleum engineering.
2106489 Geo-Resources Engineering Project
Condition: Consent of Faculty
Practical interesting projects of problems in various fields of Geo-Resource Engineering.

COURSES DESCRIPTIONS IN PETROLEUM ENGINEERING (B.ENG.)

2106261 Petroleum Geology 3(3-0-6)
Fundamental principles of petroleum regarding its origin, migration, and accumulation; chemical composition of petroleum; nature of source rocks, reservoirs, and traps; sedimentary environment and facies; geological field methods; characteristics of natural gas and oil fields of Thailand.

2106263 Fundamental of Petroleum Engineering 3(3-0-6)
Introduction to petroleum industry; economics and structure of petroleum industry; petroleum prospecting; drilling operation; petroleum production system; reservoir performance; oil and gas separation; oil and gas transportation; utilization of oil and natural gas.

2106266 Petrophysics 3(3-0-6)

2106267 Petroleum Fluid Properties 3(3-0-6)
Phase behavior; equations of state; and PVT properties and determination.

2106268 Petroleum and Drilling Fluid Laboratory 3(3-0-8)
Viscosity; specific gravity; composition analysis; pressure, volume, and temperature (PVT) analysis of petroleum fluids; physical and chemical properties of drilling fluids.

2106361 Well Logging 3(3-0-6)
Condition: Prerequisite 2106265
Principles, applications, and interpretation of openhole logs as used in petroleum exploration and reservoir evaluation.

2106362 Drilling Engineering 3(3-0-6)
Drilling fluids, drilling hydraulics; drilling bit and drill string; directional drilling; casing and cementing, and drilling well control.

2106367 Reservoir Engineering I 3(3-0-6)
Condition: Prerequisite 2106265
Petroleum reserves; reservoir drive mechanism; volumetric calculation; material balance; decline curve analysis; fluid flow in porous media; well performance; water and gas coning; and water influx.

2106368 Reservoir Engineering II 3(3-0-6)
Condition: Prerequisite 2106367
Oil and gas well tests; and numerical reservoir simulation.

2106369 Production Technology 3(3-0-6)
Condition: Prerequisite 2106362
Well completion; wireline and coiled tubing operation; perforating; formation damage mechanism and migration; sand production and its control; well stimulation; well surveillance and workover.

2106462 Petroleum Process Engineering 3(3-0-6)
Prerequisite: 2106267
Handling, separating of oil, natural gas and water from petroleum production; acid gas treating; gas dehydration; LNG, transmission and natural gas.

2106464 Production Engineering 3(3-0-6)
Condition: Prerequisite 2106265
Multiphase flow in pipe; inflow performance; restricted flow into a wellbore; artificial lift; and oil and gas production system and facilities.

2106465 Petroleum Economics 3(3-0-6)
Economic evaluation of petroleum projects, generating forecasts of key technical and economic parameters for the discounted cash flow (DCF) model of petroleum development projects, world oil markets and price mechanisms, petroleum fiscal system analysis; expected value and decision tree analysis for petroleum exploration projects, Baysian analysis and value of information.

2106466 Improved Oil Recovery 3(3-0-6)
Condition: Prerequisite 2106367
Secondary recovery; mobility-control processes; miscible displacement; chemical flooding; and thermal recovery; microbial flooding; screening criteria for improved oil recovery.

2106472 Well Design and Operations Planning 3(3-0-6)
Condition: Prerequisite 2106362
Petroleum well design and construction; drilling procedures and well completion practices; well cost estimation; drilling program; wellsites operation and logistics; well operation planning and reporting.

2106473 Reservoir Management 3(3-0-6)
Condition: Prerequisite 2106367
Numerical reservoir simulation; enhanced oil recovery techniques; field development planning; reservoir management procedures.

2106474 Petroleum Resources Development 3(2-3-4)
Condition: Prerequisite 2106361, 2106367, 2106464
Integrated approaches to petroleum resources exploration and development; application of geological and petroleum engineering methods in designing petroleum production operation; injection wells with emphasis on teamwork.

2106475 Advanced Topics in Petroleum Engineering I 3(3-0-6)
Topics of current interest and/or new development in various fields of petroleum engineering.

2106477 Special Problems in Petroleum Engineering I 3(2-3-4)
Study or investigation of special problems in petroleum engineering.
2106479 Petroleum Engineering Project 3(0-6-3)
Practical interesting projects or problems in various fields of petroleum engineering.

2106488 Practical Education for Resources Engineering 3(2-3-4)
Practical interesting projects/topics for resources and petroleum engineering.

2186509 Resources Process Technology and Utilization 3(3-0-9)
Extraction, separation and utilization of resources; review of fundamental principles of process technology and utilization of resources; concepts of technology application; processes of extraction and improvement of material quality; review of principles of process design.

2186510 Materials Handling 3(3-0-9)
Materials handling involving storage and stockpiling; theory of flow solids in bins and bankers; design of bins and bankers; conveyors and feeders; homogenization; hydraulic transport in pipe, pneumatic transport and waste sorting and disposal.

2186512 Chemical Process Separation 3(3-0-9)
Chemical separation of materials; solid state and solution chemistry; thermodynamics and kinetics; stability of compounds; oxidation and reduction; roasting; calcination and sintering; dissolution and mechanisms; effects of thermal treatment; leaching reactions, including halogenation and cyanidation; leaching process variables; recovery from solution and purification; ion exchange and solvent extraction applications; chemical process flowsheets and case studies.

2186522 Materials Characterization 3(3-0-9)
Theories and techniques in material analysis, including mineralogy, microscopy, differential thermal analysis, x-ray diffraction, x-ray fluorescence, spectrometry, electron microanalysis.

2186524 Basic Georesources Engineering 3(3-0-9)
Basic principles in mining industry and georesources development; exploration, evaluation of mineral deposits; mining method; mineral processing and recycling; development of mineral resources; environment, health and safety considerations in mine operation.

2186531 Advanced Geostatistics 3(3-0-9)
Geostatistics principle, non-linear geostatistics; cokriging and cross validation; indicator kriging; principle of stochastic simulation; simulation with Gaussian-related algorithms and indicator based approaches.

2186532 Geomechanics 3(3-0-9)
Engineering properties of rock; rock measurement and classification; stress - strain analysis; in-situ stresses; failure criteria; rock stability and well bore stability analysis; geomechanics application to rock excavation; hydraulic fracturing; geomechanical monitoring.

2186533 Mine Planning and Design 3(3-0-9)
Review of surface and underground mining methods; stages of mining activities; ore modeling and reserve estimation; concept of mine planning and design to maximize profit with less environmental impact; various elements in mine planning and design processes; planning and design by using a mining software.

2186534 Basic Geology 3(3-0-9)
The universe and the earth; surface feature of the earth’s crust and the geological processes; plate tectonic; structural geology, including problems of dip and strike, vein intersection, faulting and folding; minerals and rocks; geological maps and sections; hydrogeology and geophysical prospecting.

2186535 Basic Minerals and Rocks 3(3-0-9)
Basic knowledge in mineralogy; crystallography; crystal system; physical properties; identification of rock-forming and economic minerals; origin of igneous, sedimentary and metamorphic rocks; geological and engineering classification of rocks.

2186550 Numerical Methods for Georesources Engineer 3(3-0-9)
Cases of mathematical calculation and modeling in georesources engineering; error analysis; various approaches to numerical methods; application of finite element method (FEM), finite difference method (FDM), and boundary element method (BEM) to solve problems in geo-engineering works.

2186555 Basic Petroleum Geology 3(3-0-9)
Surface features of the earth’s crust and the geological processes; deformation of the earth’s crust; rock structures, dip and strike, faulting and folding, geological maps and sections; petroleum origin, migration, and accumulation; chemical composition of petroleum; stratigraphy; nature of source rocks; reservoirs and traps; geological field methods.

2186566 Petrophysics 3(3-0-9)
Rock mineralogy; porosity; permeability; rock-fluid properties; spontaneous potential logs; resistivity logs; gamma ray logs; porosity logs; porosity crossplots.

2186567 Basic Reservoir Engineering 3(2-3-7)
Reservoir drive mechanisms; classification of petroleum reserves; volumetric reserve calculation; material balance; decline curve analysis; fluid flow in porous media.

2186568 Basic Drilling Engineering 3(3-0-9)
Mechanics of rotary drilling; drilling fluids and their hydraulics; directional drilling; formation pore pressure and fracture resistance; casing and cementing design; well control.

2186569 Basic Production Engineering 3(3-0-9)
Well completion; subsurface and wellhead equipment; perforating; sand control; formation damages and production stimulation; surface production processes; production problems and remedies; well intervention and workover.
Environment and Pollution Prevention in the Life Cycle of Resources 3(3-0-9)

Major environmental problems from production and utilization of resources; technology in managing and controlling environmental effects; waste minimization, waste storage and disposal; environmental management planning for sustainable resource development and utilization; relevant environmental issues in the global arena.

Process Separation for Resources Recovery 3(3-0-9)

Review of fundamentals of separation processes; mass balance and mass balance adjustment; separation efficiency; separation by physical properties; comminution and classification; gravity separation; separation by magnetic and electrical properties; flocculation and coagulation; flotation. Introduction to chemical processing.

Industrial Minerals Technology 3(3-0-9)

Technology in industrial minerals; extraction, separation and utilization of some major industrial minerals and dimension stones and improvement of their quality to meet industrial requirements; discussion of advanced technology in industrial minerals and case studies.

Fuel Minerals Technology 3(3-0-9)

Technology in fuel minerals; mineral resource evaluation or assessment, mining processing and utilization of fuel minerals and their quality improvement to meet industrial requirements; discussion of advanced technology in industrial minerals and case studies.

Quarry Technology 3(3-0-9)

Quarry technology; rock resource evaluation, quarrying, size reduction to various industrial applications; economic aspects of the technology; quality improvement of products according to industrial requirements; discussion of advanced technology in quarry and case studies.

Advanced Geotechnique 3(3-0-9)

Review of soil and rock mechanics; investigation and data collection; application of soil mechanics theory to both mining and civil engineering works; grouting in engineering works; rock support and reinforcement; various analysis methods in geotechnique; case studies in either rock slope engineering or underground excavations.

Resources Recovery and Waste Recycling 3(3-0-9)

Classification of resources: renewable and non-renewable resources; resources utilization and recycling; waste utilization; waste-to-materials and waste-to-energy; life cycle and sustainable resource management; concepts and case studies of sustainable production and consumption.

Resources Economics 3(3-0-9)

Mineral demand and supply; mineral trade and markets minerals market model forecasting techniques; time series forecasting; government regulations and mineral taxation; specification of boundaries and distribution of earth resources; resources evaluation; utilization; cost-benefit analysis; optimal control of the development of earth resources.
development project; modeling of petroleum fiscal system; project evaluation criteria and basic risk assessment; probabilistic models of petroleum exploration projects; expected value; decision tree analysis; and value of information.

2186721 Advanced Resources Recovery and Recycling 3(3-0-9)

Principle of resource recovery and recycling; types of secondary resources; criteria for resource recovery and recycling; benefits and limitations of recycling; rate of recycling and resource depletion; energy conservation from recycling; review of separation processes including physical, chemical and bacterial processes; recycling of ferrous and non ferrous metals, non metals, industrial waste, electrical and electronic equipment waste, end of life vehicles, packaging waste, construction and demolition waste, liquid and waste water from processes recovery in the form of energy, sub-marginal mineral deposit and low grade tailings; energy recovery from waste; unconventional resources; economic aspects in resource recovery and recycling; environmental considerations; current legislation and management for resource recovery and recycling in Thailand and international communities; trade and market for recycling; planning and design of separation for resource recovery project; feasibility case studies.

2186756 Research Seminar 1(1-0-3) (S/U)

Condition: - Consent of faculty
Presentation and discussion of the topics to the researched into or current interesting research topics.

2106811 Thesis 12 Credits
The aim of the Department of Environmental Engineering is to teach and train students to be engineers with a competent knowledge (theoretical and practical) of surveying, planning and design, consulting and operating in the following fields:

1. water supply and treatment
2. drainage system and wastewater treatment
3. environmental sanitation
4. industrial environment
5. air pollution control
6. water pollution control and management
7. urban and rural sanitation
8. solid waste management
9. hazardous wastes treatment
10. environmental management

Moreover, students are obliged to use their own creative idea and self-responsibility. They are also encouraged to take an interest in techniques, foresee problems in the future and develop a sustainability of man and nature.

HEAD:
Khemarath Osathaphan, Ph.D. (Oregon State)

ASSOCIATE PROFESSORS:
Chavalit Ratanatamskul, Ph.D. (Tokyo)
Chanathip Pharino, Ph.D. (MIT)
Orathai Chavalparit, Ph.D. (Chula)
Petchporn Chawakitchareon, Ph.D. (ENTPE-LYONI)
Pisut Painmanakul, Ph.D. (INSA-Toulouse)
Sutha Khaodhia, Ph.D. (Oregon State)
Srima Panyametheekul, Ph.D. (Imperial College)
Thares Srisatit, Ph.D. (Savoie)
Khemarath Osathaphan, Ph.D. (Oregon State)
Patpam Punyapalakul, Ph.D. (Tokyo)
Tawan Limpiyakorn, Ph.D. (Tokyo)
Wiboonluk Pungrasmi, Ph.D. (Tokyo)

ASSISTANT PROFESSORS:
Achariya Suriyawong, Ph.D. (Washington)
Benjaporn Suwannasilp, Ph.D. (Stanford)
Chaiyaporn Puprasert, Ph.D. (INSA-Toulouse)
Manaskorn Rachakornkij, Ph.D. (New Jersey)
Pichaya Rachdawong, Ph.D. (Wisconsin-Milwaukee)
Saru Tejasen, Ph.D. (Oregon State)
On - anong Lavpparisudthi, Ph.D. (Coventry)
Viboon Srirnarongchaikul, Ph.D. (Georgia Tech)

LECTURERS:
Dao Suwansang Jancharoen, Ph.D. (Illinois at Urbana-Champaign)
<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>ENG MECH I</td>
<td>3</td>
<td>2107542</td>
<td>PHYSICO-CHEMICAL TREATMENT</td>
<td>3</td>
</tr>
<tr>
<td>2107311</td>
<td>BIO ENV ENG</td>
<td>3</td>
<td>2107462</td>
<td>HAZ WASTE TREAT</td>
<td>3</td>
</tr>
<tr>
<td>2107214</td>
<td>AQUA CHEM ENV ENG</td>
<td>3</td>
<td>2107481</td>
<td>INT ENV IMP ASSESSMENT</td>
<td>3</td>
</tr>
<tr>
<td>2107346</td>
<td>HYDRAULICS I</td>
<td>3</td>
<td>2108302</td>
<td>FIELD PRACTICE I</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVE</td>
<td>2</td>
<td>2100311</td>
<td>ENGINEERING ESSENTIALS</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td>xxxxxxx</td>
<td>APPROVED ELECTIVE</td>
<td>2</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION = 147**
NAME OF THE DEGREE

: Master of Engineering
: M.Eng.

DEPARTMENT STAFFS

Khemarath Osathaphan, Ph.D. (Oregon State)

ASSOCIATE PROFESSORS:

Chavalit Ratamatnakul, Ph.D. (Tokyo)
Chanathip Pharino, Ph.D. (MIT)
Orathai Chavalparitskul, Ph.D. (Chula)
Petchpor Malackitkachareon, Ph.D. (ENTPE-LYONI)
Pisut Painnanakul, Ph.D. (INS-Toulouse)
Sutha Khaothiam, Ph.D. (Oregon State)
Sirima Panyametheekul, Ph.D. (Imperial College)
Thares Srisatit, Ph.D. (Savoie)
Khemarath Osathaphan, Ph.D. (Oregon State)
Puchalee Punyanatapakul, Ph.D. (Tokyo)
Tawan Limpiyakorn, Ph.D. (Tokyo)
Wiboonluk Phuangphasai, Ph.D. (Tokyo)

ASSISTANT PROFESSORS:

Achariya Suriyawong, Ph.D. (Washington)
Benjaporn Suwanwong, Ph.D. (Stanford)
Chaiyaporn Puprasert, Ph.D. (INS-Toulouse)
Manaskorn Rachakornkij, Ph.D. (New Jersey)
Pichaya Rachawong, Ph.D. (Wisconsin-Milwaukee)
Sarun Tejasen, Ph.D. (Oregon State)
On-anong Lavruuparaisuthdi, Ph.D. (Coventry)
Viboon Sricharoenchakul, Ph.D. (Georgia Tech)

LECTURERS:

Dao Suwansang Janchawoen, Ph.D. (Illinois at Urbana-Champaign)

ADMISSION

The applicant must hold either a Bachelor’s Degree in Engineering or related degrees and met the requirements of the Graduate School.

DEGREE REQUIREMENTS

This program consists of 24 credits of course work, of which 17 are required and 7 are electives.

A student must present an acceptable thesis and pass an oral examination in the field of specialization for a quantity of not less than 12 credits.

COURSE REQUIREMENTS

1) Prerequisite Courses

Students with bachelor’s degree other than environmental engineering degree must take and pass these following four prerequisite courses with S/U grade or obtain the exemption from the department.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107667</td>
<td>Fundamental Engineering for Environmental Engineering</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

All Students must take and pass the following prerequisite course with S/U grade:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107701</td>
<td>Seminar in Environmental Engineering I</td>
<td>1(1-0-3)</td>
</tr>
</tbody>
</table>

2) Required Courses 20 credits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107658</td>
<td>Theory and Design of Advanced Water Treatment Processes</td>
<td>4(3-3-10)</td>
</tr>
<tr>
<td>2107659</td>
<td>Theory and Design of Advanced Wastewater Treatment Processes</td>
<td>4(3-3-10)</td>
</tr>
<tr>
<td>2107670</td>
<td>Air Quality Management and Engineering</td>
<td>4(3-3-10)</td>
</tr>
<tr>
<td>2107671</td>
<td>Solid and Hazardous Waste Management</td>
<td>4(3-3-10)</td>
</tr>
<tr>
<td>2107673</td>
<td>Principles for Environmental Engineering Management</td>
<td>3(0-0-9)</td>
</tr>
</tbody>
</table>

3) Elective Courses 74 credits

Students must choose at least two elective courses from one particular field and at least another elective course from any fields with consent from the advisor.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107530</td>
<td>Advanced Techniques In Physical And Chemical Treatment</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107607</td>
<td>Environmental Analysis</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107608</td>
<td>Technology of Solid and Hazardous Waste Treatment</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107616</td>
<td>Air Quality Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107622</td>
<td>Environmental Control Planning</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>2107626</td>
<td>Stream Sanitation</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>2107627</td>
<td>Advanced Sanitary Engineering Laboratory</td>
<td>3(1-6-5)</td>
</tr>
<tr>
<td>2107628</td>
<td>Design of Water Retaining Structures</td>
<td>3(1-6-5)</td>
</tr>
<tr>
<td>2107630</td>
<td>Treatment and Disposal of Industrial Waste</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2107632</td>
<td>Environmental Impact Assessment</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>2107633</td>
<td>Water Quality and Agriculture Practice</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107634</td>
<td>Advances in Environmental Pollution Research</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>2107635</td>
<td>Reading in Environmental Engineering</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>2107638</td>
<td>Plumbing Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107639</td>
<td>Atmospheric Chemistry</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107641</td>
<td>Air Polluting Control Technology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107642</td>
<td>Engineering Practices for Solid Waste Disposal</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107644</td>
<td>Advanced Study in Environmental Engineering I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2107645</td>
<td>Advanced Study in Environmental Engineering II</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>
3(3-0-9)
2107615 Advanced Environmental Biology 3(1-3-4)
2107616 Air Quality Management 3(3-0-9)
2107618 Water and Wastewater Treatment Plant Operation 3(2-3-7)
2107622 Environmental Control Planning 2(2-0-6)
2107626 Stream Sanitation 2(2-0-6)
2107627 Advanced Sanitary Engineering Laboratory 3(1-6-5)

ASSISTANT PROFESSORS:

Benjakorn Suwannasilp, Ph.D. (Stanford)
Chaiyaporn Puprasert, Ph.D. (INSAT-INSAT)
Chanchit Phairin, Ph.D. (MIT)
Khemarat Osathaphan, Ph.D. (Oregon State)
Pichaya Rachdawong, Ph.D. (Wisconsin-Milwaukee)
Sarun Tejasen, Ph.D. (Oregon State)
Tawan Limpayakom, Ph.D. (Tokyo)
Wiboonluk Pungrasmi, Ph.D. (Tokyo)
Patiparn Punyapisakul, Ph.D. (Tokyo)
Manaskorn Rachakornkij, Ph.D. (New Jersey)
Viboon Sricharoenchaikul, Ph.D. (Georgia Tech)

LEcTUErS:
Achariya Suriyawong, Ph.D. (Washonton)
On-anong Lavprparisudthi, Ph.D. (Coventry)

ADMISSION:
1) The applicant must have a Bachelor's Degree in Engineering with a minimum of second class honors or
2) The applicant must have a Master's Degree in Environmental Engineering or Sanitary Engineering.

DEGREE REQUIREMENTS:

Pattern 1 for a Master's Degree student who has a grade point average minimum of 3.5
- require 48 credits of doctoral dissertation
Pattern 2(1) for a Bachelor's Degree student
- require 72 credits of which 24 credits are course work and 48 credits are doctoral dissertation
Pattern 2(2) for a Master's Degree student who has a grade point average less than 3.5
- require 60 credits of which 12 credits are course work and 48 credits are doctoral dissertation

COURSE REQUIREMENTS:

1) Required Courses 6 credits

2107607 Environmental Analysis 3(3-0-9)
2107608 Technology of Solid and Hazardous Waste Technology 3(3-0-9)
2107615 Advanced Environmental Biology 2(1-3-4)
2107616 Air Quality Management 3(3-0-9)
2107618 Water and Wastewater Treatment Plant Operation 3(2-3-7)
2107622 Environmental Control Planning 2(2-0-6)
2107626 Stream Sanitation 2(2-0-6)
2107627 Advanced Sanitary Engineering Laboratory 3(1-6-5)
2107630 Treatment and Disposal of Industrial Waste 3(2-3-7)
2107631 Environmental System Engineering 3(3-0-9)
2107633 Water Quality and Agriculture Practice 3(3-0-9)
2107634 Advances in Environmental Pollution Research 2(2-0-6)
2107635 Reading in Environmental Engineering 1(1-0-3)
2107636 Industrial Hygiene Practices 3(3-0-9)
2107637 Advanced Wastewater Technology 3(3-0-9)
2107638 Plumbing Design 3(3-0-9)
2107639 Atmospheric Chemistry 3(3-0-9)
2107641 Air Polluting Control Technology 3(3-0-9)
2107642 Engineering Practices for Solid Waste Disposal 3(3-0-9)
2107643 Public Health Engineering 3(3-0-9)
2107644 Advanced Study in Environmental Engineering I 3(3-0-9)
2107645 Advanced Study in Environmental Engineering II 3(3-0-9)
2107646 Chemistry for Water and Wastewater Treatment 3(3-0-9)
2107647 Process Chemistry of Water Treatment 3(3-0-9)
2107648 Industrial Water Conditioning 3(3-0-9)
2107649 Treatment Plant Hydraulics for Environmental Engineers 1(1-0-3)
2107650 Process Design for Nitrogen Control in Wastewater Treatment Plants 2(2-0-6)
2107652 Upgrading Wastewater Treatment Plants 2(2-0-6)
2107653 Modeling of Biochemical Reactors 3(3-0-9)
2107654 Sampling and Analysis of Air Pollutants 3(2-3-7)
2107655 Statistics for Environmental Engineers 3(3-0-9)
2107656 Thermal Processes for Waste Minimization and Utilization 3(3-0-9)
2107657 Energy and Environment 3(3-0-9)
2107658 Theory and Design of Advanced Water Treatment Processes 4(3-3-9)
2107659 Theory and Design of Advanced Wastewater Treatment Processes 4(3-3-9)
2107660 Industrial and Hazardous Waste Management 3(3-0-9)
2107669 Environmental Impact Assessment 3(3-0-9)
2107663 Industrial Waste Management 3(3-0-9)
3) Dissertation
2107828 Dissertation 48 credits
2107894 Doctoral Dissertation Seminar 0(0-0-0)
2107897 Qualifying Examination 0(0-0-0)

COURSE DESCRIPTIONS IN ENVIRONMENTAL ENGINEERING (B.ENG.)

2107211 Introduction to Environmental Sanitation and Engineering 3(3-0-6)
An introduction course to the field of Sanitary and Environmental Engineering for rural and urban development; topics include the communicable diseases and methods of communication, control of disease vectors, excreta disposal, refuse collection and disposal, building sanitation, industrial hygiene, air and noise pollution, sources of water supply and treatment, wastewater collection, treatment and disposal.

2107212 Chemistry for Environmental Engineering I 2(1-3-2)
Condition: Prerequisite 2302127, 2302163
Chemical and physical characteristics of water, general considerations, methods for determination and application of data to environmental engineering practice; instrumentation; laboratory analysis of water; interpretation of water analysis results as related to their treatment: neutralization, precipitation, coagulation, water softening, ion exchange, corrosion, adsorption, chlorination.

2107213 Chemistry for Environmental Engineering II 2(1-3-2)
Condition: Prerequisite 2302127, 2302163
Chemical and physical characteristics of wastewater, general considerations, methods for determination and application of data to Environmental Engineering practice; sample collection and preservation; determinations of solids, DO, BOD, COD, Nitrogen (in all forms related to Environmental Engineering practice), phosphorus and phosphates, grease and oil, volatile acids and sulfides; instrumentation for wastewater analysis.

2107214 Aquatic Chemistry for Environmental Engineering 3(2-3-4)
Chemical and physical characteristics of water, general considerations, methods for determination and application of data to environmental engineering practice; instrumentation; laboratory analysis of water; interpretation of water analysis results as related to their treatment; neutralization, precipitation, coagulation, water softening, ion exchange, corrosion, absorption, chlorination; basic principles of acid-base equilibria, solubility equilibria, oxidation-reduction equilibria, fundamentals of process kinetics, fundamental of surface and colloidal chemistry, water stabilization, water softening and neutralization.

2107215 Wastewater Chemistry for Environmental Engineering 2(1-3-2)
Chemical and physical characteristics of wastewater, general considerations, methods for determination and application of data to environmental engineering practice; sample collection and preservation; determinations of solids, DO, BOD, COD, nitrogen (in all forms related to environmental engineering practice), phosphorus and phosphates, grease and oil, volatile acids, sulfides and gas analysis; instrumentation for wastewater analysis.

2107219* Urban Environments Engineering 3(3-0-6)
Urban environments in general, pollution problems in urban area : wastewater, solid waste, noise pollution, air pollution, and hazardous waste : sources of pollution; destruction of the urban environment; especially solution to its urban problems in such scientific, especially engineering aspect; management of pollution, especially pollution control and treatment; improvement guidelines for urban development; regulations and laws related to buildings in urban area, participation of people living in urban are, and case studies.
(* Elective course for non Environmental Engineering Students)

2107220 Environments and Daily Life 3(3-0-6)
A learning process of environment in daily life; the un of case studies and social knowledge which are key information in analyzing the importance of in daily life; integrated ecological system; natural resources and related environment; integration the of outcome of the study with related disciplines in order to understand and realize the importance of environment and guidelines for participation for better environment.
2107221 Environmental Studies 3(3-0-6)
Basic knowledge and important perspectives on global environment with emphasis on case studies; ecosystem; biogeochemical cycles; population studies; energy; wetland; water pollution; air pollution; noise pollution; solid waste disposal; hazardous waste; waste treatment system design; environmental responsibility.

2107311 Biology for Environmental Engineering 3(2-3-7)
Cell and its structure, principles of bacteriology, population growth, roles of bacteria in public health, coliform bacteria, methods of collection and bacteriological examination of water & sewage, principles of immunization, disinfection and sterilization, actions of enzymes as related to stabilization of organic matter, biodegradation of organic compounds, fundamental concepts related to energy, food chain, productivity and limiting factors, positive and negative interactions among microbial populations, basic concept of ecology, habitat and ecological niche, Nitrogen, Carbon, Sulfur, Phosphorus cycles, freshwater ecology and biota, dynamics in wastewater treatment environments.

2107312 Unit Operations for Environmental Engineering 3(3-0-6)
An overview of unit processes and application of unit operations in water and waste treatment as well as air pollution control: aeration and gas transfer, mixing, sedimentation, aerosol separation, filtration, coagulation, precipitation, ion exchange, adsorption.

2107313 Unit Process for Environmental Engineering 3(2-3-4)
Reactor design, flow model, reaction kinetics, screening, sedimentation, filtration, coagulation-flocculation, absorption, stripping, sorption, stoichiometry of biological process, microbial growth kinetics, activated sludge system.

2107411 Water Supply Engineering and Design 4(3-3-6)
Condition : Prerequisite 2107212,2107312
Sources of public water supply, quality and quantity requirements: water standards, population prediction, water consumption and flow variation; design of water distribution systems; design of water treatment plant; planning.

2107412 Wastewater Engineering and Design 4(3-3-6)
Condition : Prerequisite 2107311, 2107312,
2107213
Wastewater flow rates and characteristics; collection, transportation and pumping; wastewater treatment objectives; methods and design fundamental of process analysis; facility design of physical, chemical and biological treatment for primary and secondary processes; land treatment and disposal.

2107441 Air Pollution Control 3(3-0-6)
Basic knowledge in air pollution: major pollutants, sources, effects on health and welfare, meteorological transport. Sampling and analysis, techniques for control of emissions of particulates and gas, air pollution control regulations and standards, air quality management, enforcement systems.

2107444 Building Sanitation 3(3-0-6)
Fundamentals of Building Sanitation; law & regulations, design of building water supply (hot, cold & drinking water), building drainage and vent systems; fire protection; site drainage; building wastewater and solid wastes disposal and treatment, swimming pool system design.

2107445 Air Pollution Control and Design 4(3-3-6)
Basic knowledge in air pollution: major pollutants, sources, effects on health and welfare, meteorological transport, sampling and analysis, techniques for control of emissions of particulates and gas, air pollution control regulations and standards, air quality management, enforcement systems.

2107446 Treatment of Industrial Wastewater 3(3-0-6)
Condition : Prerequisite 2107412
Industrial wastewater effluent standards; laws and regulations; industrial wastewater monitoring systems; sources, quantity and qualification characteristics of industrial wastewater; industrial wastewater treatment technology; water pollution control and management in major industries; case studies on wastewater reuse and product recovery.

2107448 Noise and Vibration Control 2(2-0-4)
Behavior of sound waves; instrumentation; practical measurements; environmental impact of noise and vibration; regulations and criteria for noise and vibration control in environmental systems; use of acoustic materials, noise and vibration barriers.

2107449 Industrial Safety Management 2(2-0-4)
Nature of accident in industry and need of accident prevention; planning for safety such as plant layout, machine guarding and maintenance, etc; safety in industry; management of safety program; safety training; case studies in accident analysis.

2107450 Environmental Systems and Management 3(3-0-6)
Basic interrelating effects on environmental in terms of environmental engineering aspects; the functions of government and other agencies in environmental management; an analysis for decision making in environmental protection programs; public policy and action; arrangement of organizations and institutes related to environmental management including their structures and roles; policy development; management approaches and program implementation; case studies of specific environmental protection.

2107451 Principles of Public Health 2(2-0-4)
Health aspects of environmental quality; some principles of epidemiology with special emphasis on community and occupational environment; environmental health standards and requirements; engineering control of some urban and rural pollution problems; other topics in application of engineering principles in environmental protection.
2107452 Physico-chemical Treatment 3(3-0-6)
Theoretical approach to physico-chemical treatment processes: Chemical reaction treatment, Oxidation-reduction treatment, Flocculation, Sedimentation, Precipitation, Separation units, Floatation, Adsorption, Membrane Processes.

2107453 Public Health Engineering 3(3-0-6)
Public health and safety in different environmental quality settings; principles of managing the environment and safety of working places; managing and promoting the safety during work; law and regulations related to public health; Implementation of engineering principles to manage and minimize environmental problems in working places, communities and metropolitan.

2107460 Introduction to Hazardous Waste Treatment 3(3-0-6)
An introduction course to hazardous waste treatment technology: topics include definition, classification, regulations, sources, impacts on environment, chemical, biological, thermal, stabilization/solidification treatment, and final disposal method.

2107462 Hazardous Waste Treatment 3(3-0-6)
Basic principles of management and treatment of both organic and inorganic hazardous waste; the treatment system includes physical, chemical, biological, or thermal process as well as final disposal method.

2107480 Sanitary System in Architecture 2(2-0-4)
Fundamentals of building sanitary engineering: conceptual design and installation of building water supply and hot water supply, wastewater collection, rain water drainage, wastewater treatment, fire protection, swimming pool water treatment, solid wastes collection and disposal.

2107481 Introduction to Environmental Impact Assessment 3(3-0-6)
Development of environmental impact study with emphasis on environment parameters including physical resources, ecological resources, human use values and quality of life values. Interrelationship between engineering aspects and environmental parameters and case studies.

2107482 Environmental Engineering Project I 1(0-3-1)
Practical interesting project on problems in various fields of Environmental Engineering.

2107483 Environmental Engineering Project II 2(0-3-2)
Practical interesting project on problems in various fields of Environmental Engineering.

2107484 Solid Waste Engineering 3(3-0-6)
Condition: Prerequisite 2107213
Quantity and composition of solid wastes; impacts to environment; disposal methods - alternatives and selection; leachate problem; volume and size reduction; transportation; components separation; landfilling; incineration; composting; integrated process and management.

2107491* General Water Supply Engineering 3(3-0-6)
Sources of Water supply; drinking water standards; quantity required, ground water collection; water transmission and distribution; water treatment technique: screening, coagulation and flocculation, sedimentation, filtration, disinfection, softening, iron removal, taste and odor removal.

2107494* Industrial Water Supply and Wastewater Treatment 3(3-0-6)
Sources of water supply; industrial water standards; water treatment techniques: screening, coagulation and flocculation, sedimentation, filtration, softening, demineralization and disinfection; industrial wastewater characterization; effluent standards; industrial wastewater treatment processes.

2107495 Advanced Topics in Environmental Engineering I 3(3-0-6)
Condition: Senior Standing
Study topics of current interest and new developments in various fields of environmental engineering.

2107496 Advanced Topics in Environmental Engineering II 3(3-0-6)
Condition: Senior Standing
Study topics of current interest and new developments in various fields of environmental engineering.

2107497 Special Problems in Environmental Engineering I 3(2-3-4)
Condition: Senior Standing
Study or investigation of special problems in Environmental Engineering.

2107498 Special Problems in Environmental Engineering II 3(2-3-4)
Condition: Senior Standing
Study or investigation of special problems in Environmental Engineering.

2107499 Environmental Engineering Project 3(0-6-3)
Condition: Senior Standing
Practical interesting project on problems in various fields of Environmental Engineering.

(* Elective course for non Environmental Engineering Students)
COURSE DESCRIPTIONS IN ENVIRONMENTAL ENGINEERING (M.ENG., PH.D.)

2107530 Advanced Techniques in Physical and Chemical Treatment 3(3-0-9)
Applications of theoretical approaches to the following physical and chemical treatment processes: absorption, adsorption, stripping, distillation, sedimentation, flotation, coagulation, flocculation, neutralization, gas / liquid transfer, heavy metal removal, membrane filtration.

2107551 Environmental Management System ISO 14000 3(3-0-6)
Environmental management system and ISO 14000 series; ISO 14001 criteria and requirements; environmental situation review; search for environmental aspect, policy and action plans; environmental management system auditing and management review.

2107607 Environmental Analysis 3(3-0-9)
Procedures and details of environmental sample analysis; methods of sample collection, sample handling; analytical method selection; details of analysis and data presentation.

2107608 Technology of Solid and Hazardous Waste Treatment 3(3-0-9)
Basic principles of solid and hazardous materials; atom structure and chemical reaction; combustion mechanisms of reactive materials; laws governing gas temperature, pressure and volume; behavior of compressed and cryogenic gases; explosive mechanism; shock waves; toxicity, corrosive and radiation; hazardous waste treatment technologies, physical chemical and biological treatments; precipitation, sedimentation, chemical oxidation, neutralization, extraction, incineration, landfill, land treatment, ocean disposal; sources, types and composition of waste to be treated and utilized; advantages and disadvantages in recycling waste; processes of basic technologies; processes of utilizing; organic and inorganic waste.

2107611 Advanced Water Treatment Processes 3(3-0-9)
Condition : Prerequisite 2107212 or Consent of Faculty

2107612 Advanced Wastewater Treatment Processes 3(3-0-9)
Condition : Prerequisite 2107213, 2107311 or Consent of Faculty
Development in wastewater technology; wastewater collection and transportation, design of sewers and appurtenances, advanced wastewater treatment, treatment by microbial and biological control techniques, laws relating to effluent disposal, wastewater treatment plant organization and management.

2107613 Design of Water Treatment Plant and Distribution System 3(1-8-5)
Condition : Prerequisite 2107611 or Consent of Faculty
Development of design criteria for water sources, pipe lines distribution and storage facilities, water treatment and softening, engineering design of water distribution system, functional and hydraulic design of complete water treatment plant.

2107614 Design of Wastewater Treatment Plant and Collection System 3(1-6-5)
Condition : Prerequisite 2107612 or Consent of Faculty
Combined and separate system: pumping stations, functional and hydraulic design of complete wastewater treatment plant.

2107616 Air Quality Management 3(3-0-9)
Interaction among air, water and land pollutants, effects of air pollutants, standards and regulations, technical aspects of air pollution control programs, the organization and management of control programs in governmental and private sectors.

2107617 Solid Wastes and Hazardous Wastes Management 3(3-0-9)
Quantity and composition of solid wastes and hazardous wastes; impacts to environment; legislation; collection and transportation system; disposal technique; choice of disposal site; planning and management; case study.

2107622 Environmental Control Planning 2(2-0-6)
Fundamental of comprehensive environmental planning; planning for environmental health : program planning process; rural and urban development; ecosystem concepts; energy; toxicology; environmental health standards; economic principles of pollution control; social cost and pollution damage functions and their economic, social and health implication; problems associated with environmental management.

2107626 Stream Sanitation 2(2-0-6)
Patterns of pollution and natural purifications; bacterial self purification; deoxygenation rate; reoxygenation rate; DO sag curve; detection and measurement of pollution; pollution of tidal & coastal waters; BOD loading of receiving waters.

2107627 Advanced Sanitary Engineering Laboratory 3(1-8-5)
Laboratory and pilot plant techniques used to obtain design data, to control plant operation, and to investigate processes for the treatment of water, sewage and wastes.

2107628 Design of Water Retaining Structures 3(1-6-5)
General design principles of water retaining structures; cylindrical and rectangular tanks; open and covered reservoirs; tanks with conical and pyramidal bottoms; swimming pools and tanks with sloping floors; water tower storage; some special design problems

2107630 Treatment and Disposal of Industrial Wastes 3(2-3-7)
Industrial waste problems; categories of waste; nature and characteristics of liquid waste; effect of waste on environment; laws for disposal of waste in Thailand and other countries; method of treatment of various kinds of waste; preventive measures.
2107632 Environmental Impact Assessment 2(2-0-6)
Environmental changes and its impact on communities; assessment methodology; environmental planning and decision making; case studies.

2107633 Water Quality and Agriculture Practice 3(3-0-9)
Water pollution from agricultural practices; sediment, plant nutrients, pesticides, and animal waste; implications of agricultural pollution; control policy and methods.

2107634 Advances in Environmental Pollution Research 2(2-0-6)
Selected research topics in water and wastewater treatment, air pollution control and abatement, and solid waste disposal and management.

2107635 Reading in Environmental Engineering 1(1-0-3)
Selected topics in environmental engineering issues and discussion.

2107638 Plumbing Design 3(3-0-9)
Plumbing systems, materials, and flow in pipes. Design of water supply systems, hot water supply systems, sanitary drainage and vent systems, storm drainage, fire protection system, public swimming pools, valves, pumps. Installation and testing a system.

2107639 Atmospheric Chemistry 3(3-0-9)
Photochemistry of small quantity gas; surface reaction and adsorption phenomena; physical and chemical of aerosol; origin; coagulation and precipitation of dust in ambient and reaction with gas.

2107641 Air Pollution Control Technology 3(3-0-9)
Overview of air pollution control methods. Control of particulates and gaseous emissions by settling chambers, cyclones, scrubbers, filters and electrostatic precipitators. Design of equipment, maintenance and evaluation of control efficiency.

2107642 Engineering Practices for Solid Waste Disposal 3(3-0-9)

2107644 Advanced Study in Environmental Engineering I 3(3-0-9)
Study of recent topic and technology development in various fields of environmental engineering.

2107645 Advanced Study in Environmental Engineering II 3(3-0-9)
Study of recent topic and technology development in various fields of environmental engineering.

2107646 Chemistry for Water and Wastewater Treatment 3(3-0-9)
Basic principles, acid-base equilibria, solubility equilibria, oxidation - reduction equilibria, fundamentals of process kinetics fundamental of surface and colloidal chemistry, coagulation in water treatment, water stabilization, water softening and neutralization, ion exchange, carbon adsorption.

2107647 Process Chemistry of Water Treatment 3(3-0-9)

2107654 Sampling and Analysis of Air Pollutants 3(2-3-7)
Sampling of particulate and gaseous pollutants from source and atmosphere, flow measuring devices and their calibration techniques of pollutant identification and analysis, particle measurement, use of techniques in performance test of air control equipment.

2107655 Statistics for Environmental Engineers 3(3-0-9)
Review of basic statistics; sampling methods for quantitative and qualitative data collection, sample size determination; statistics for data quality control in laboratory; design of experiments, and basic model building techniques.

2107656 Thermal Processes for Waste Minimization and Utilization 3(3-0-9)
Introduction to potential agricultural and industrial wastes for thermal conversion processes; kinetics in thermal pyrolysis and gasification; innovative heat source systems including plasma and microwave; low and high temperature processes; short and long residence time processes; potential pollution problems and amendment; design considerations of different types of thermal conversion reactors; treatment and conversion of immediate products into useful chemicals and fuel; ash and tar formation and their remediation.

2107657 Energy and Environment 3(3-0-9)
Energy resources and utilization in the global context and a case studies in Thailand; fossil-based energy, environmental impact of mining and fuel processing; air pollution, greenhouse gas, and global warming from fuel utilization; energy conservation and renewable energy technologies; hydro energy harnessing and its environmental impact and mitigation; other non-fossil fuel options: biomass, solar, and wind energy; synthetic fuel conversion technology including pyrolysis and gasification; biogas from fermentation; prospect of hydrogen economy.

2107658 Theory and Design of Advanced Water Treatment Processes 4(3-3-10)
Condition: Prerequisite: 2107661 or C.F.
Water sources; water chemistry and quality, aeration, coagulation, sedimentation, filtration, ion exchange, membrane processes, disinfection absorption, neutralization and stabilization; water conditioning for boiler and cooling system; design criteria for water sources, lines distribution and storage.
facilities, water treatment and softening, engineering design of water distribution system, functional and hydraulic design of complete water treatment.

2107659 Theory and Design of Advanced Wastewater Treatment Processes 4(3-3-10)
Condition : Prerequisite: 2107311, 2107661 or C.F.
Development of wastewater technology; wastewater collection and transportation; design of sewers and appurtenances; advanced wastewater treatment by microbial and biological control techniques, law related to effluent disposal; wastewater law relating to effluent disposal, wastewater treatment plant organization and management; combined and separate system pumping stations; functional and hydraulic design of complete wastewater treatment system.

2107660 Industrial and Hazardous Waste Management 3(3-9)
Terms and definitions, types and sources of waste, law, regulations, disposal and management standards, related organizations; reduction of waste and case studies, unit operations for waste management; reuse and recycle of industrial waste and case studies; treatment of industrial waste; sample collection and characterization of waste; physical and chemical treatment of industrial waste, stabilization and solidification; disposal of industrial waste and monitoring, disposal guidelines; design of industrial waste landfill, monitoring and checking of the landfill; international industrial waste management, transport of hazardous waste across international borders, case studies, Basel accord.

2107661 Fundamental Chemistry for Environmental Engineering 3(2-3-7)
Chemical and physical characteristics of water and wastewater, general considerations, methods for determination and application of data to environmental engineering practice; instrumentation; sample collection and preservation; laboratory analysis of water; interpretation of water analysis results as related to their treatment; neutralization, precipitation, coagulation, water softening, ion exchange, corrosion, absorption, chlorination; determinations of solids, DO, BOD, COD, nitrogen (in all forms related to environmental engineering practice), phosphorus and phosphates, grease and oil, volatile acids, sulfides and gas analysis.

2107662 Unit Processes for Environmental Engineering 3(3-9)
An overview of unit processes and application of unit operations in water and waste treatment by physical, chemical and biological processes as well as air pollution control processes.

2107663 Industrial Waste Management 3(3-9)
Analysis of material and energy flow in industrial system to enhance eco-efficiency; relationships between industrial production and economic development; waste minimization, pollution prevention, prevention, design for environment, life cycle analysis (LCA) and waste exchange; linkage of Industrial activity with environmental and social sciences; integration of environmental management and environmental ethics; environmental policies and laws.

2107664 Anaerobic Wastewater Treatment Technology 3(3-9)
Types of biological wastewater treatment; Theory and basic mechanism of anaerobic wastewater treatment; microbiology and biochemistry of anaerobic fermentation; Kinetics of anaerobic treatment system; various types of anaerobic wastewater treatment system; design and operation of anaerobic treatment processes; current status of anaerobic technology; consideration and selection of anaerobic process in industrial, municipal and agricultural wastewater treatment.

2107665 Mass Transfer and Separation Processes in Environmental Engineering 3(3-9)
Theory of molecular diffusion and mass transfer; fundamental of phase equilibrium; mass transfer operation and separation process; interface mass transfer; adsorption and ion exchange; distillation; physical separation process; membrane separation process; finishing process.

2107666 Fundamental Biology for Environmental Engineering 3(2-3-7)
Cell and its structure, principles of bacteriology, population growth, roles of bacteria in public health, coliform bacteria, methods of collection and bacteriological examination of water and sewage, principles of immunization, disinfection and sterilization, actions of enzymes as related to stabilization of organic matter, biodegradation of organic compounds, fundamental concepts related to energy, food chain, productivity and limiting factors, positive and negative interactions among microbial populations, basic concept of ecology, habitat and ecological niche; nitrogen, carbon, sulphur, phosphorus cycles; freshwater ecology and its inhabitants, lake stratification, river pollution, roles of inhabitants and biota dynamics in wastewater treatment environments.

2107667 Fundamental Engineering for Environmental Engineering 3(3-9)
Basic principles of mathematics, statistics, calculus, ordinary differential equation, mechanic, hydraulics and hydrology required for environmental engineering.

2107668 Clean-up of Contaminated Sites by Biological Processes 3(3-9)

2107669 Environmental Impact Assessment 3(3-9)
Selection of feasible projects by engineering, socio-economic and environment; environmental changes and its on communities, assessment methodology, environmental planning and decision making; risk assessment caused by chemical of hazardous waste; case studies.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2107670</td>
<td>Air Quality Management and Engineering</td>
<td>4(3-1-10)</td>
</tr>
<tr>
<td></td>
<td>Effects of air pollutants, standards, law and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>regulations, the organization and management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of mitigation programs, emission source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>inventory, pollutant dispersion and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mathematical modeling, principles and design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of air pollution control system, measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and monitoring system.</td>
<td></td>
</tr>
<tr>
<td>2107671</td>
<td>Solid and Hazardous Waste Management</td>
<td>4(3-1-10)</td>
</tr>
<tr>
<td></td>
<td>Overview of management schemes, sources and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>generation of solid and hazardous wastes,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>important physical, chemical, and biological</td>
<td></td>
</tr>
<tr>
<td></td>
<td>characteristics of wastes, regulations,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>international laws and standards,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>collection and transfer, transport of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>hazardous wastes and code of practices,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>resource recovery of solid wastes, treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>procedures and stabilization of hazardous</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wastes, thermal processes, various disposal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>means of solid and hazardous wastes including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>landfill.</td>
<td></td>
</tr>
<tr>
<td>2107672</td>
<td>Adsorption for Water and Wastewater Treatment</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Adsorption theory in aqueous phase; type of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>adsorbents; characterization adsorbsents of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>physico-chemical adsorption phenomena;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>adsorption kinetics; adsorption isotherm;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>effects of water and wastewater</td>
<td></td>
</tr>
<tr>
<td></td>
<td>characteristics on adsorption efficiency;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>adsorption processes design for water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>production and wastewater treatment;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>adsorbent regeneration; case studies on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>adsorption phenomena of pollutants in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>aqueous phase.</td>
<td></td>
</tr>
<tr>
<td>2107673</td>
<td>Principles for Environmental Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Principles of planning and setting policies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for environmental management; example of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>policy application in working; principles of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>using economic instruments in setting policies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for natural resource conservation and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>environmental protection; methods of cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>survey and estimation; effectiveness and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>advantages of policies for environmental</td>
<td></td>
</tr>
<tr>
<td></td>
<td>management; comparision of advantages and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>disadvantages of each type of policies in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>order to achieve the objective as planned;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>analysis and comparison of current guidelines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and policies for environmental management by</td>
<td></td>
</tr>
<tr>
<td></td>
<td>using case studies in Thailand and abroad;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>related projects.</td>
<td></td>
</tr>
<tr>
<td>2107674</td>
<td>Treatment of Wastewater Contaminated with Oil</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>and Small Particles in Environmental Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil and small particles; overview of treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and separation processes; fundamental knowledge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of separation process; oil skimmer; gravity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>separation (decantation); coalescer;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>flotation; hydrocyclone; membrane processes;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>thermal processes; chemical treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>processes; electro-chemical processes; hybrid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>treatment processes; finishing process.</td>
<td></td>
</tr>
<tr>
<td>2107701</td>
<td>Seminar in Environment Engineering I</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td></td>
<td>A once a week seminar series on work done in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sanitary engineering points of view. Invited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>speakers from government industry and various</td>
<td></td>
</tr>
<tr>
<td></td>
<td>professionals will present these seminar.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Every student is expected to present paper on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>his own research.</td>
<td></td>
</tr>
</tbody>
</table>

2107702 Seminar in Environment Engineering II 1(1-0-3)
A once a week seminar series on work done in sanitary engineering points of view. Invited speakers from government industry and various professionals will present these seminar. Every student is expected to present paper on his own research.

2107791 Advanced Seminar in Environmental Engineering I 1(1-0-3)
Seminar on recent and interesting topics in the field of environmental engineering, and report presentation.

2107792 Advanced Seminar in Environmental Engineering II 1(1-0-3)
Seminar on recent and interesting topics in the field of environmental engineering, and report presentation.

2107793 Advanced Seminar in Environmental Engineering III 1(1-0-3)
Seminar on recent and interesting topics in the field of environmental engineering, and report presentation.

2107794 Advanced Seminar in Environmental Engineering IV 1(1-0-3)
Seminar on recent and interesting topics in the field of environmental engineering, and report presentation.

2107795 Advanced Seminar in Environmental Engineering V 1(1-0-3)
Seminar on recent and interesting topics in the field of environmental engineering, and report presentation.

2107796 Advanced Seminar in Environmental Engineering VI 1(1-0-3)
Seminar on recent and interesting topics in the field of environmental engineering, and report presentation.

2107811 Thesis 12 Credits
2107816 Thesis 36 Credits
2107826 Dissertation 36 Credits
2107828 Dissertation 48 Credits
2107830 Dissertation 72 Credits
2107894 Doctorial Dissertation Seminar 0(0-0-0)
2107897 Qualifying Examination 0(0-0-0)
The objective of the department is aimed at providing theoretical principles and practical techniques on surveying and mapping necessary for various engineering and development projects. Courses offering in the department both at undergraduate and graduate levels cover broad fields of surveying, photogrammetry and remote sensing, cartography, geodesy, and spatial information technology.

The department currently have three curriculums:
1. The bachelor degree in survey engineering
2. The master of engineering program in survey engineering
3. The doctor of philosophy program in geomatic engineering

The bachelor degree curriculum which is four years is designed such that the student will have basic knowledge in engineering in general and a more intensive knowledge of survey engineering in particular. The curriculum is blended with theories and practices. Students will have experiences on various surveying instruments and computer programming, confidence and competence to solve practical problems in the domain of survey engineering is strengthened through field practices and on the job training. A more insight to the subject is possible, upon the department's approval, through senior project, special study, and seminars on topics of the student's interest. It is expected that the program would enable the students to
1. understand the structures and requirements of surveying and mapping;
2. apply the theories and techniques to general surveying tasks effectively, efficiently, and economically;
3. analyse the instrumental mechanics for evaluating the accuracy and precision attained;
4. follow new technology and development in the field of surveying and mapping and spatial information technology.

The master of engineering in survey engineering program (revised curriculume 1994) is a two-year program designed to respond social needs which keep changing according to technological advances. The program objectives are:
1. To allow more flexible curriculum structure in order to be more responsive to social needs and;
2. To produce graduates highly capable in both theory and practice;
3. To study and research in fields related to survey engineering and mapping, in order to improve the quality of the graduates.

The program of master of science in spatial information technology in engineering commenced in academic year 1999. The curriculum is designed to respond social needs of people highly capable in spatial information technology or geographic information system. The program objectives are:
1. To produce graduates who have a deep understanding of spatial information technology for engineering enterprises in both business and public sector;
2. To generate new body of knowledge in spatial information system for the research and development of the department and the university.

Ph.D. in survey engineering is a three-years program for full-time candidates with the possibility of two years extensions. Candidates undertake a research program which is supervised normally through a supervisory panel with one principle supervisor. The program objectives are:
1. To generate new body of knowledge in the specific field of survey engineering through a research work;
2. To produce graduates.

HEAD:
Chalermchon Satirapod, Ph.D. (New South Wales)

PROFESSORS:
Chalermchon Satirapod, Ph.D. (New South Wales)

ASSOCIATE PROFESSORS:
Banjerd Phalakarn, Ph.D. (Denis Diderot)
Itthi Trisirisatayawong, Ph.D. (Melbourne)
Chanin Tinnachote, D.Eng. (AIT)
Phisan Santitamnont, Dr.-Ing. (Leibniz Hannover)
Vichai Yiengveerachon, M.Eng. (Chula)

ASSISTANT PROFESSORS:
Sanphet Chunithipaisarn, Ph.D. (Newcastle upon Tyne)
Colonel Kanok Weerawong, Ph.D. (Purdue)
Somchai Kriengkraiwasin, M.Eng. (Chula)

LECTURERS:
Octavian Andrei, Ph.D (TUI, Romania)
Chaichoke Vaiphasa, Ph.D. (ITC)
Thonghit Chayakula, Ph.D. (London)
Teetat Charoenkalunyuta, Ph.D. (Chula)
Garavig Tanaksaranond, Ph.D. (London)
<table>
<thead>
<tr>
<th>COURSE</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2301207</td>
<td>CALCULUS III</td>
<td>3</td>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2</td>
</tr>
<tr>
<td>2103205</td>
<td>DESCRIPTIVE DRAWING</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103213</td>
<td>ENGINEERING MECHANICS I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2104253</td>
<td>ENGINEERING STATISTICS I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108234</td>
<td>NUMERICAL ANALYSIS IN GEOMATICS</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108415</td>
<td>GEODETIC SURVEYING</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVE ELECTIVES I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>APPROVE ELECTIVES II</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION III</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>FREE ELECTIVES I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2112343</td>
<td>HYDROLOGY FOR SURVEYING ENGINEERS</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108372</td>
<td>ADVANCED REMOTE SENSING</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108373</td>
<td>ADVANCED PHOTOGRAMMETRY</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108306</td>
<td>FIELD PRACTICE ON TOPOGRAPHIC SURVEYING</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108307</td>
<td>FIELD PRACTICE ON ROUTE SURVEYING</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108412</td>
<td>SATELLITE SURVEYING</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2108326</td>
<td>GEOSPATIAL INFORMATION ANALYSIS AND VISUALIZATION</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5500308</td>
<td>TECHNICAL WRITING FOR ENGINEERING</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NAME OF THE DEGREE  
: Master of Engineering  
: M.Eng.

PROFESSORS:
Chalermchon Satirapod, Ph.D. (New South Wales)

ASSOCIATE PROFESSORS:
Banjerd Phalakarn, Doctorat (Denis Diderot)
Itthi Trisirisatayawong, Ph.D. (Melbourne)
Chanin Tinnachote, D.Eng. (AIT)
Phisan Santitammont, Dr.-Ing. (Leibniz Hannover)
Vichai Yiengveerachon, M.Eng. (Chula)

ASSISTANT PROFESSORS:
Sanphet Chunithipaisarn, Ph.D. (Newcastle upon Tyne)
Colonel Kanok Weerawong, Ph.D. (Purdue)
Somchai Kriengkraiwasin, M.Eng. (Chula)

LECTURERS:
Octavian Andrei, Ph.D (TUI, Romania)
Chaichoke Vaiphasa, Ph.D. (ITC)
Thongthit Chayakula, Ph.D. (London)
Teetat Charoenkalunyuta, Ph.D. (Chula)
Garavig Tanaksaranond, Ph.D. (London)

ADMISSION
An applicant must hold a Bachelor's Degree in Survey Engineering or a Bachelor's Degree in other fields of study as approved by the Department. The applicant must also meet the requirements of the Graduate School.

DEGREE REQUIREMENTS
Students are required to fulfill the following specific requirements
A. A minimum of 24 credits of courses which consists of
1. 18 credits of the required courses.
2. At least 6 credits of elective course approved by the department.
B. An acceptable thesis of 12 credits
A student who fulfilled the requirements of the program with a cumulative grade point average not less than 3.00 with a period of study not less than 4 regular semesters and not more than 8 regular semesters will be awarded the Degree of Master of Engineering.

COURSE REQUIREMENTS
1) Required Courses (18 credits)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2108511</td>
<td>Numerical Techniques in Geomatics</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2108512</td>
<td>Adjustment Computation in Geomatics</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2108532</td>
<td>Satellite Surveying and Modern Techniques</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2108557</td>
<td>Spatial Data Structure and Models</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

2) Elective Courses (21 credits)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2108502</td>
<td>Fundamentals of Positioning and Mapping</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2108513</td>
<td>Geodesy and Geodetic Methods</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2108556</td>
<td>Online Spatial Information Technologies</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2108558</td>
<td>Spatial Data Handling and Analysis</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2108601</td>
<td>Advanced Adjustment Computation</td>
<td></td>
</tr>
</tbody>
</table>
2108202 Surveying Engineering 3(2-3-4)
Concepts of surveying and mapping; theory of measurements and errors; basic survey measurements: distance and angle measurements, theodolite and total station, traversing and computation, vertical distance measurements: leveling, reciprocal leveling and trigonometric leveling, contours, topographic mapping procedure: control and topographic surveying; map accuracy; specification, profile and cross section, areas and volumes.

2108205 Fundamental of Geomatics 3(3-0-6)
Roles of geospatial information in society; overview of geospatial data capturing, processing, and utilizing procedures; representing the Earth digitally; modeling reality into spatial database, geospatial data model: concept of coordinate system; mapping the Earth; Earth figure and its impact on position; map scale and accuracy of geospatial data; surveying and mapping techniques for geospatial data acquisition; applications of geospatial information technology.

2108234 Numerical Analysis in Geomatics 3(2-3-4)
Condition : Prerequisite 2108233
Numerical Techniques for Solving Set of Linear Equations; Algorithmic Solutions to Non-Linear System; Interpolation and Curve Fitting; 2-D and 3-D Coordinate Transformations; Purposes and Necessity of Coordinate Transformation, Affine Transformation, Polynomial and Rational Polynomial Transformation, Introduction to Spherical Trigonometry, Solving Direct Problem and Inverse Problem.

2108298 Surveying 3(2-3-4)
Introduction to surveying work; basic field works, leveling; principles and applications of theodolites and total stations; distance and direction measurements; errors in surveying, acceptable errors, data correction, triangulation; precise determination of azimuth; precise traverse; plane coordinate system, precise leveling; topographic survey; map plotting.

2108301 Surveying with Construction Applications 3(2-3-4)
Condition : Prerequisite 2108202
Alignment, grade and equipment for construction surveys, route location and design; horizontal curve; spiral curve; vertical curve; earth work, tunnel surveying, hydrographic surveying, survey project planning and management.

2108306 Field Practice on Topographic Surveying 1(field practice)
Condition : Prerequisite 2108202or 2108298
Field practices at surveying camp to complete fair drawing of planimetric and topographic maps of given areas; third order levelling and traverse; topographic detailing.

2108307 Field Practice on Route Surveying 1(field practice)
Condition : Prerequisite 2108301
Planning, scheduling, and carrying out a complete strip topographic map for feasibility study of route location; design and staking-out; earthwork computation.

2108311 Global Geodesy 3(3-0-6)
Condition : Prerequisite 2108234
Figure of the earth, geodic datums, gravity field of the earth, reference coordinate systems, astro-geodetic method, computation on the ellipsoid, gravimetric method, satellite method.

2108325 Geographic Information System and Applications 3(2-3-4)
Condition : Prerequisite 2108201
Definition, basic principles and components of Geographic Information System (GIS); geospatial data models: vector, raster, and surface (3D) data models; different types of data sources and data input techniques; basic geospatial data management and query; basic geospatial data analysis and manipulation; spatial analysis of discrete entities in space; spatial analysis using continuous fields; applications of Geo-Information Systems in various fields; introduction to web GIS and location-based services; quality and metadata of geospatial data; geospatial data standards.

2108326 Geospatial Information Analysis and Visualization 3(2-3-4)
Condition : Prerequisite 2108325
Geospatial data analysis functions; spatial interpolation and surface modeling; exploratory spatial data analysis; process modeling and simulation; cartographic fundamentals; principles of graphic design; scientific visualization; animation and virtual worlds; cognitive basis of visualization; cartographic communication; cartographic symbolization and map design; map annotation and name placement; geo-spatial data generalization; web cartography.

2108332 Adjustment Computation 3(2-3-6)
Condition : Prerequisite 2108233, 2108234
Statistical concepts; principle of propagation; least squares adjustment methods; post adjustment analysis.

2108342 Mathematical Cartography 3(2-3-6)
Condition : Prerequisite 2108311

2108371 Photogrammetry and Remote Sensing System 3(2-3-6)
Condition : Prerequisite 2108202
Concepts and basic principles of remote sensing, electromagnetic energy, sources and radiation.
principles, energy interaction with atmosphere and earth surface features, sensors and digital image characteristics, multispectral-thermal-hyperspectral sensing, radar imagery, Earth observation satellite, an ideal remote sensing system, characteristics of real remote sensing systems, elements of photographic systems, history of aerial photography, basic principles of photogrammetry, geometry of aerial photographs, monoscopic measurement, stereoscopic of photogrammetry, mapping with photogrammetry. 

2108372  Advanced Remote Sensing  3(2-3-6)  
Condition : Prerequisite 2108371  
Digital imagery, vector and raster data, Image rectification and restoration, image enhancement, contrast manipulation, multi-image manipulation, Image classification, fourier analysis for image processing, hyperspectral image analysis, radar image analysis, feature extraction, pattern recognition, colour systems, colour image processing.

2108373  Advanced Photogrammetry  3(2-3-6)  
Condition : Prerequisite 2108302  
Imaging air-borne and high-resolution sensor systems, geometry on single image frame, information from stereo images, aerial triangulation, sensor modeling and its orientation, mapping and other data products from photogrammetry, applications of photogrammetric products.

2108374  Close-range Photogrammetry  3(3-0-6)  
Introduction to close-range photogrammetry, calibration of cameras, geometric and non geometric factors of projects, accuracy and reliability, 3D models, visualization. applications of close-range photogrammetry in civil engineering, industry, architecture, archeology.

2108408  Computer Aided Surveying and Design  3(2-3-4)  
Condition : Prerequisite 2108302  
Survey automation system: field code system, triangulated irregular network, earth work; road design and civil works.

2108411  High Precision Surveying  2(1-3-2)  
Condition : Prerequisite 2108311, 2108332  
High precision Instruments:- calibration and testing, target, benchmark; Horizontal measurement methods, vertical measurement methods, 3D measurement methods, computation technique, modern surveying technology.

2108412  Satellite Surveying  3(2-3-6)  
Condition : Prerequisite 2108311  
Concept of satellite positioning, global positioning systems, NAVSTAR GPS concept, errors in GPS measurements, observables in GPS, survey planning, field methods, data processing, practical applications.

2108413  Field Practice on Precise Surveying  1(field practice)  
Condition : Prerequisite 2108411, 2108412  
Field practice on geodetic horizontal and vertical controls surveying, computation, photo control surveying.

2108414  Field Practice on Digital Mapping  1(field practice)  
Condition : Prerequisite 2108325, 2108371  
Rectification of Satellite and Aerial Images; Various Techniques for Detail Survey and Field Data Acquisition; Map Updating; GIS Database Construction.

2108415  Geodetic Surveying  3(2-3-4)  
Condition : Prerequisite 2108201, 2108301 and 2108311  
Introduction to physical geodesy, Height systems, Height from GNSS (GPS), High precision instruments:- calibration and testing, target, benchmark and geodetic control point; Datum transformation, Horizontal measurement methods, Vertical measurement methods, 3D measurement methods, computation technique on UTM.

2108421  Modern Integrated Surveying Technology  3(2-3-4)  
Condition : Senior Standing  
Concepts of integrating modern surveying technologies to speed up survey: robotic theodolite, laser ranging, laser scanner, GNSS receiver, inertial surveying system, digital camera and video.

2108436  Spatial Database  3(2-3-6)  
Condition : Prerequisite 2108326  
Introduction to Spatial Database; spatial concept and data model; spatial query language; simple feature for SQL, spatial storage and indexing; query processing and optimization; introduction to spatial data mining; trends in DBMS.

2108450  Advanced GIS Techniques  3(2-3-6)  
Condition : Prerequisite 2108326  
Overview of GIS and spatial data base management system; review of spatial data models; GIS data management functions; data analysis modeling and functions; output presentation functions; data applications in natural resources and environmental management; applications in disaster management; applications in socio-economic and business problems; GIS development processes; GIS development in Thailand; standard and data quality; trends of future GIS technology.

2108455  GIS Application Development  3(2-3-6)  
Condition : Prerequisite 2108326  
Types of GIS application; GIS application environment; software development technologies; VBA; Python; .NET; Web application development; opensource tools and software; Software customization, 

2108457  Seminar in Survey Engineering  1(1-0-2)  
Condition : Senior Standing  
Presentation and discussion on topics of interest in survey engineering.

2108495  Advanced Topics in Survey Engineering I  3(3-0-6)  
Condition : Senior Standing or Consent of Faculty
Topics of current interest and new developments in various fields of survey engineering.

2108496 Advanced Topics in Survey Engineering II 3(3-0-6)
Condition: Senior Standing or Consent of Faculty
Topics of current interest and new developments in various fields of survey engineering.

2108497 Special Problems in Survey Engineering I 3(2-3-7)
Condition: Senior Standing or Consent of Faculty
Study or investigation of special problems in survey engineering.

2108498 Special Problems in Survey Engineering II 3(2-3-7)
Condition: Senior Standing or Consent of Faculty
Study or investigation of special problems in survey engineering.

2108499 Survey Engineering Project 3(0-6-3)
Condition: Senior Standing or Consent of Faculty
Practice interesting project or problem in various fields of survey engineering.

COURSES DESCRIPTIONS IN SURVEY ENGINEERING (M.ENG., PH.D.)

2108502 Fundamentals of Positioning and Mapping 3 (2-3-7)
Figure of earth, geodetic datum, earth coordinate reference frame, map projection, general techniques of positioning, 2-D and 3-D coordinate transformation, measurement sampling and interpolation, position determination by modern ground-based instruments, mapping from digital satellite/aerial imagery.

2108511 Numerical Techniques in Geomatics 3 (2-3-7)
Overview of matrix and linear systems, solutions of non-linear systems, overdetermined system, functional and stochastic model, measurement error and error propagation, statistical analysis of observation and parameters.

2108512 Adjustment Computation in Geomatics 3 (2-3-7)
Review of statistical concepts and linear algebra; principle of covariance propagation; non-linearity, linearization and iteration procedure; math models for least-squares adjustment computation; unified least-squares adjustment; statistical analysis of adjustment results; reliability of networks; data snooping and blunder detection.

2108513 Geodesy and Geodetic Methods 3(3-0-9)
Earth’s gravity field; geoid, reference ellipsoid and geodetic datum; geodetic survey, astronomic observations; direction, distance and calculation on the ellipsoid; geodetic height and elevation; satellite orbit, positioning.

2108516 Engineering Geodesy 3 (2-3-7)
Condition: Senior Standing
The course build on student active participation by integration of theory and practice. The main objective is to demonstrate how four different geomatic technologies (Global Navigation Satellite System, Total Station, Digital Levelling and Terrestrial Laser Scanning) may be integrated to resemble the technical measurement design and precise positioning production in engineering projects. The course does not teach details of any of the above-mentioned technologies but rather how to use them in an integrated approach.

2108532 Satellite Surveying and Modern Techniques 3 (2-3-7)
Satellite datum, coordinate systems, concept of satellite positioning, global positioning system, observable in GPS, errors in GPS measurements, survey planning, field procedures, data processing, principle of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

2108533 Remote Sensing of Environment 3(3-0-6)
Condition: Senior Standing
Remote Sensing of Environment brings the student through recent publication on theory, science, applications and technology of remote sensing of earth resources and environment.

2108534 Microwave Remote Sensing 3(3-0-6)
Condition: Senior Standing
Fundamental of microwave, microwave and human health, microwave in remote sensing, SLAR, SAR, InSAR, Lidar, basic SAR data processing, basic Lidar processing, SAR and Lidar applications and case studies.

2108536 Spatial Database 3(3-0-6)
Condition: Senior Standing
Introduction to Spatial Database; spatial concept and data model; spatial query language; simple feature for SQL; spatial storage and spatial indexing; query processing and optimization; introduction to spatial data mining; trends in DBMS.

2108556 Online Spatial Information Technology 3 (2-3-7)
Condition: Senior Standing
Introduction to GIS, and internet GIS, fundamental of computer networking, client/server computing, technology evolution of web GIS, DHTML, standards for distributed geospatial services (ISO & OGC), XML, GML and SVG, mobile GIS, case studies and web GIS applications.

2108557 Spatial Data Structure and Models 3 (3-0-9)
Conceptual model of space: entities & fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadtrees, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; introduction to geo-
spatial relational database system, graph theory; optimal path.

2108558 Spatial Data Handling and Analysis 3 (2-3-7)
Data capture technique, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflation, feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring; linear referencing, mapping accuracy standard and determination method.

2108559 Geospatial Database and OpenGIS 3 (2-3-7)
Introduction to relational database management system (RDBMS), Data Model; Entity Relationship Model, Normalization of Database Tables, Introduction to Structured Query Language(SQL), Data Types, SQL Commands, Function and Operation, OGC/ISO Simple Feature (SF), OGC SF Object and Structure, Spatial Database and Table, Simple Feature Access using SQL/SP and SQL for Multimedia (SQL/MM), attribute and spatial querying, OpenGIS Functions, Procedural Language / Structure Query Language (PL/SQL), database optimization and spatial indexing, interface to geospatial RDBMS via web-based applications, Roles of geo-spatial RDBMS in information services and Open Geospatial Information System.

2108560 Advanced Map Design and Prototyping 3(2-3-7)
Condition : Senior Standing
Introduction to various types of maps focusing on user-centered design, including generating new ideas, system analysis, user requirement analysis, prototyping, evaluation and improving; interaction design principle; the effects of interactive functions to map design principle; map prototyping methods, including drawing and using software.

2108592 Seminar in Geoinformatic Technology 3(3-0-9)
Case studies in geoinformation technology, special lectures on advanced/emerging geoinformation technology, experimental design, research topic development.

2108601 Advanced Adjustment Computation 3 (2-3-7)
Sequential least-squares adjustment; Helmert-Wolf blocking; generalized inverse matrices; Kalman filter for geomatics; approximation, interpolation and prediction; least-squares collocation.

2108627 Geoinmage Processing 3 (2-3-7)
Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation; Stereo-photogrammetry; photogrammetric triangulation; orthorectification, mosaic, photo map production.

2108628 Radar Remote Sensing 3 (2-3-7)
ellipsoid; geodetic height and elevation; satellite orbit, positioning.

2108514 Mathematical Projections in Geodesy 3(3-0-9)
Use of analytic functions; representation of the ellipsoid on a sphere; geometry of the projected geodesic; mercator, transverse mercator, bolique mercator, conformal comic projections.

2108515 Introduction to Advance Geodetic Surveying 3(3-0-9)
Geometry of reference ellipsoid; triangulations and trilaterations, Traverses and levelling for major geodetic control; position determination of points by geometric, gravimetric and astronomical methods.

2108521 Aerial Triangulation 3(1-6-5)
Ground control points; aeropolygon aerial triangulation, graphical and numerical strip adjustment and independent model aerial triangulation.

2108522 Analytical Photogrammetry 3(2-3-7)
Comparator, measurement of plate coordinates; transformation of plate coordinates and corrections; relative and absolute orientations; computation of ground coordinates from plate coordinates.

2108523 Terrestrial and Close-Range Photogrammetry 2(1-3-4)
Introduction : terrestrial and closed-range cameras and their orientations; geometry of photographs ; control surveys ; graphical and analytical determination of horizontal and vertical positions of point; parallax equations; space coordinates of point by direction cosines.

2108532 Satellite Surveying and Modern Techniques 3 (2-3-7)
Satellite datum, coordinate systems, concept of satellite positioning, Global Positioning System (GPS), observable in GPS, errors in GPS measurements, survey planning, field procedures, data processing, principles of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

2108551 Spatial Data Structures and Algorithms 2(2-0-6)
n-depth examination of geographic information system components; representation of spatial data; storage and retrieval techniques; algorithms for spatial data manipulation and analysis ; aster/vector conversion algorithms; advanced spatial data models; user interface; knowledge-based system.

2108552 GIS Design and Evaluation 2(2-0-6)
Nature of design ; feasibility studies & requirements analysis ; software engineering techniques; detailed system design; program design & implementation; design of spatial database; system selection.

2108556 Online Spatial Information Technology 3(2-3-7)
Prerequisite : 2108352 or 2108453 or 2108460
Introduction to GIS; introduction to Internet GIS; fundamental of computer networking, client/survey computing, technology evolutions of web GIS; standards for distributed geospatial services (ISO & OGC), GML and SVG, Mobile GIS; case studies and web GIS applications.

2108557 Spatial Data Structure and Models 2(3-0-9)
Conceptual models of space: entities and fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadtrees, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; graph theory; optimal path.

2108558 Spatial Data Handling and Analysis 2(2-3-7)
Data capture techniques, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflation, feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring.

2108559 Geospatial Database and OpenGIS 3 (2-3-7)
Introduction to relational database management system (RDBMS), data model: Entity Relationship model, normalization of database tables, Structured Query Language (SQL), data types, SQL commands, function and operation, OGC/ISO Simple Feature (SF), OGC SF object and structure, spatial database and table, Simple Feature Access using SQL/SF and SQL for multimedia (SQL/MM), attribute and spatial querying, OpenGIS functions, Procedural Language / Structure Query Language (PL/SQL), database optimization and spatial indexing, interface to geospatial RDBMS via web-based applications, roles of geospatial RDBMS in information services and open geospatial information system

2108592 Seminar in Geoinformatic Technology 2(2-3-7)
Advanced and emerging geoinformation technology; case studies; experimental design, research topic development.

2108601 Advanced Adjustment
Photography

of surveys and for the presentation of collected data. Possibilities and limitations; interdisciplinary execution and working methods in related disciplines, their investigations for development planning; the concepts of digital image: air borne, space borne; specialized comparator techniques.

System Engineering and Management for Survey Engineer 3(3-0-9)

A study of methodologies and processes of system engineering. A discipline concerned with the planning, organization and management of programs for designing and operating systems. Application of systems engineering to surveying projects.

Development Planning Survey 3(3-0-9)

Function of surveyor in a multidisciplinary investigations for development planning; the concepts and working methods in related disciplines, their possibilities and limitations; interdisciplinary execution of surveys and for the presentation of collected data.

Analog Photogrammetry 3(2-3-7)

Theory of orientation, method and accuracy; review of various plotting instruments; testing of instrument; rectification and orthophotography.

Metric Photography 2(1-3-4)

Properties, design and calibration of various photogrammetric cameras; physical characteristics and quality control of photography; navigation and auxiliary devices; image evaluation.

Photogrammetry in Practice 3(3-0-9)

Prerequisite: 2108621 and 2108625

Photogrammetric planning; digital terrain model; applications to various fields, e.g. cadastral survey, highway planning and design, damsite study, architecture, museum and monument preservations, biostereometric and medicine, etc.

Advanced Analytical Photogrammetry 3(2-3-7)

Systematic errors, system calibration and self-calibration, analytical strip and block triangulation with and without auxiliary data, constraints, structure and solution of the normal matrix, Resseau photography and specialized comparator techniques.

Remote Sensing I 3(3-0-9)

A study on theory, instrumentation, and techniques employed in remote sensing.

Remote Sensing II 3(2-3-7)

Prerequisite: 2108625 and Consent of Faculty

Applications and interpretation of remote sensing data, in general and in particular. An indepth study of an application chosen by individual participant.

Geoinformation Processing 3 (2-3-7)

Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation; stereo-photogrammetry; photogrammetric triangulation; orthorectification.

Radar Remote Sensing 3 (2-3-7)

Characteristics of microwave, microwave interaction with atmosphere and target, radar equation and radar cross section, principles of imaging radar, measurable phase/amplitude/polarization in radar imagery, geometric and radiometric properties of radar imagery, synthetic aperture radar, airborne/spaceborne SAR systems, interferometric SAR, processing stages in interferogram generation, differential interferometric SAR, InSAR/DInSAR as measurement tools, geodetic and geophysical applications of InSAR/DInSAR, polarimetric SAR, classification/analysis of polarimetric SAR, landuse/landcover mapping applications using polarimetric SAR.

Advanced Geoinformation Processing 3(2-3-7)

Special problems to be carried out under staff direction. Digital photogrammetry, digital photogrammetric workstation and workflow, digital sensor types: line, area/frame and TDI/staggered CCD, sensor models and sensor orientation, airborne digital camera systems, mapping from space, digital elevation model (DEM), light detection and ranging (Lidar), high-resolution satellites imageries, high-resolution satellite imageries processing, relief displacement, orthorectification, geo-image compression, tile and pyramid image structure, oblique photogrammetry and 3-D geoinformation system, orthophoto service and mash-up mapping, tile-caching management service, acquisition of panorama view, data collection and information service.

Advanced GNSS Surveying 3(2-3-7)

GPS system, coordinate and reference systems, GPS observations and equations, GPS error mitigation techniques, computation of GPS satellite positions, principles of least-squares estimation, mathematical models for GPS positioning, standard format of GPS data, GPS data processing by least-squares method, interpretation of baseline results, GPS network adjustment, quality control for GPS surveying, GPS heighting, trends and applications of GNSS technology.

Special Studies 3(2-3-7)

Special problems to be carried out under staff direction.

Seminar in Geomatic Engineering I 3(0-9-3)

Review of and discussion on special topics related to problems and progress in Geomatic engineering.

Seminar in Geomatic Engineering II 3(0-9-3)

Condition: PREQ 2108790

Discussion on special topics related to progress in Geomatic engineering; analysis of related data, conclusion, data presentation and report of findings.

Seminar in Geomatic Engineering III 3(0-9-3)

Prerequisite: 2108791

Discussion on special topics related to progress in Geomatic engineering concerning research projects; analysis of related data, conclusion, data presentation and report of findings.

Thesis 12 credits
2108828 Dissertation 48(0-0-0) 
(S/U)/1/2548)

2108894 Doctoral Dissertation Seminar 0(0-0-0) 
(S/U)/1/2548)

COURSE DESCRIPTIONS IN SPATIAL INFORMATION SYSTEM (M.SC.)

2108501 Fundamentals of Surveying and Mapping 3(2-3-7)
Shape of earth; reference ellipsoids; positioning on earth surface; map projections; scale and distortion; 2-D and 3-D coordinate transformation; model of measurements; error and error propagation; Mapping and map updating techniques.

2108502 Fundamentals of Positioning and Mapping 3 (2-3-7)
Figure of earth, geodetic datum, earth coordinate reference frame, map projection, general techniques of positioning; 2-D and 3-D coordinate transformation, measurement sampling and interpolation, position determination by modern ground-based instruments, mapping from digital satellite/aerial imagery.

2108511 Numerical Techniques in Geomatics 3 (2-3-7)
Overview of matrix and linear systems, solutions of non-linear systems, overdetermined system, functional and stochastic model, measurement error and error propagation, statistical analysis of observation and parameters.

2108512 Adjustment Computation in Geomatics 3 (2-3-7)
Review of statistical concepts and linear algebra; principle of covariance propagation; non-linearity, linearization and iteration procedure; math models for least-squares adjustment computation; unified least-squares adjustment; statistical analysis of adjustment results; reliability of networks; data snooping and blunder detection.

2108513 Geodesy and Geodetic Methods 3 (3-0-9)
Earth's gravity field; geoid, reference ellipsoid and geodetic datum; geodetic survey, astronomic observations; direction, distance and calculation on the ellipsoid; geodetic height and elevation; satellite orbit, positioning.

2108524 Analysis of Aerial and Satellite Imagery 3(2-3-7)
Operations on image, point operations, local operations, geometric operations; image segmentation by clustering, thresholding, spectral classification, spatial classification, edge detection; iterative segmentation by probabilistic relaxation, fuzzy relaxation.

2108531 GPS Satellite Surveying 3(2-3-7)
Condition : PRER 2108501 or C.F.
Fundamental of satellite orbit motion; global positioning system; GPS observables and errors; surveying method; data processing; applications in Thailand.

2108541 Computer Assisted Cartography 3(2-3-7)
Condition : PRER 2108501 or C.F.
Development, production and application of computer-assisted mapmaking; survey of computer cartography terms, concepts and equipment; conceptual and development aspects of computer-produced maps; digitizing, coordinate data structures; spatial databases; computer map design; turnkey cartographic systems; computer map production.

2108553 Spatial Data Model 3(3-0-9)
Vector data model, vector data organization, spaghetti model, topological models; raster data model, representation of raster data, runs, binary trees, blocks, quadtrees, borders; comparisons of vector and raster data model; conversion between raster and vector data.

2108554 Spatial Data Handling 3(2-3-7)
Data capture techniques; coordinate systems; intersections of lines and curves; calculation of length and area; coordinate adjustment; rubber sheeting; edge matching; image warping; conflation; feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring.

2108532 Satellite Surveying and Modern Techniques 3 (2-3-7)
Satellite datum, coordinate systems, concept of satellite positioning, global positioning system, observable in GPS, errors in GPS measurements, survey planning, field procedures, data processing, principle of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

2108556 Online Spatial Information Technology 3 (2-3-7)

2108557 Spatial Data Structure and Models 3(3-0-9)
Conceptual model of space: entities & fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadtrees, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; introduction to geospatial relational database system, graph theory; optimal path.

2108558 Spatial Data Handling and Analysis 3(2-3-7)
Data capture technique, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflation, feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring; linear referencing, mapping accuracy standard and determination method.
2108559  Geospatial Database and OpenGIS 3(2-3-7)
Introduction to relational database management system (RDBMS), Data Model: Entity Relationship Model, Normalization of Database Tables, Introduction to Structured Query Language (SQL), Data Types, SQL Commands, Function and Operation, OGC/ISO Simple Feature (SF), OGC SF Object and Structure, Spatial Database and Table, Simple Feature Access using SQL/SF and SQL for Multimedia (SQL/MM), attribute and spatial querying, OpenGIS Functions, Procedural Language / Structure Query Language (PL/SQL), database optimization and spatial indexing, interface to geospatial RDBMS via web-based applications, Roles of geo-spatial RDBMS in information services and Open Geospatial Information System

2108562  Seminar in Geoinformatic Technology 3(3-0-9)
Case studies in geoinformation technology, special lectures on advanced/emerging geoinformation technology, experimental design, research topic development.

2108601  Advanced Adjustment Computation 3(2-3-7)
Sequential least-squares adjustment; Helmert-Wolf blocking; generalized inverse matrices; Kalman filter for geomatics; approximation, interpolation and prediction; least-squares collocation.

2108627  Geoinage Processing 3(2-3-7)
Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation; satellite triangulation; orthorectification, mosaic, photo map production.

2108628  Radar Remote Sensing 3(2-3-7)

2108629  Advanced Geoinage Processing and Applications 3 (2-2-3-7)
Digital photogrammetry, digital photogrammetric workstation and workflow, digital sensor types: line, area/frame and TDI/staggered CCD, sensor models and sensor orientation, airbone digital camera systems, mapping from space, Digital Elevation Model (DEM), light detection and ranging (Lidar), high-resolution satellites imagery, high-resolution satellite imagery processing, relief displacement, orthorectification, geo-image compression, tile and pyramid image structure, oblique photogrammetry and 3-D geoinformation system, orthophoto service and mash-up mapping, tile-caching management service, acquisition of panorama view and information service

2108632  Advanced GNSS Surveying 3 (2-3-7)
GPS system, coordinate and reference systems, GPS observations and equations, GPS error mitigation techniques, computation of GPS satellite positions, principles of least-squares estimation, mathematical models for GPS positioning, standard format of GPS data, GPS data processing by least-squares method, interpretation of baseline results, GPS network adjustment, quality control for GPS surveying, GPS heighting, trends and applications in GNSS technology.

2108555  Spatial Analysis 3(3-0-9)
Data quality; measures of dispersion; measures of arrangements; geometric searching; range searching; proximity searching; buffer generation; polygon overlays; spanning trees and graph traversal; shortest part routing.

2108591  Seminar in AM/FM/GIS 3(3-0-9)
Group discussion, special lectures on various topics, research paper, presentation of research paper, site visits.

2108623  Photogrammetry in Practice 3(3-0-9)
Photogrammetric planning; digital terrain model; applications to various fields, e.g. cadastral survey, highway planning and design, damsite study, architecture, museum and monument preservation, biostereometric and medicine, etc.

2108625  Remote Sensing I 3(3-0-9)
A study on theory, instrumentation, and techniques employed in remote sensing

2108626  Remote Sensing II 3(2-3-7)
Condition : PRER 2108625 or C.F.
Applications and interpretation of remote sensing data, in general and in particular. An indepth study of an application chosen by individual participant.

2108631  Advanced GPS Satellite Surveying 3(2-3-7)
Condition : Prerequisite : 2108531
GPS system; coordinate and reference systems, computation of GPS satellite position; GPS observations and equations; principles of least-squares estimation; mathematical models for GPS positioning; standard format of GPS data; GPS error mitigation techniques; GPS data processing by least-squares method; interpretation of baseline results; GPS network adjustment; quality control for GPS surveying; GPS heighting; trends and applications of GNSS technology.

2108651  Implementation of Spatial Information System 3(3-0-9)
Condition : Prerequisite 2108501 and 2108553 or C.F.
Components of a spatial information system; roles of spatial information system; development cycle of spatial information system; characteristics of GIS software; applications of spatial informations system; investment issues; data warehousing; data standard; copyright issues; trend and future of spatial technology.

2108671  Geoinformation Technologies for Infrastructure Development 3(3-0-9)
Overview of geoinformation technologies for infrastructure planning, construction, monitoring and maintenance; coordinate system and map projection; GPS and GNSS, mapping by remote sensing and photogrammetry techniques; GIS technologies for infrastructure project planning and management; emerging geoinformation technologies for infrastructure development.

2108691 Special Studies 3(2-3-7)
Special problems to be carried out under staff direction.

2108790 Seminar in Geomatic Engineering I 3(0-9-3)
Review of and discussion on special topics related to problems and progress in Geomatic engineering.

2108791 Seminar in Geomatic Engineering II 3(0-9-3)
Discussion on special topics related to progress in Geomatic engineering; analysis of related data, conclusion, data presentation and report of findings.

2108792 Seminar in Geomatic Engineering III 3(0-9-3)

2108828 Dissertation 48 Credits

2108894 Doctoral Dissertation Seminar

2108897 Qualifying Exam S/U

2108811 Thesis 12 Credits
DEPARTMENT OF METALLURGICAL ENGINEERING

Department of Metallurgical Engineering provides a program of metallurgical and materials engineering. The program is designed to give a broad understanding of all types of materials, including metals, ceramics, and polymers, with the emphasis on metals. The undergraduate course covers the fundamental techniques of science and engineering used in the profession. There are subjects concerning with the basic principles of materials science and engineering, materials processings and formings, materials properties and applications, and designing of materials and processes. The course also has many engineering practice subjects such as various laboratories, engineering project, engineering practice, and industrial visit.

HEAD:

Gobboon Lothongkum, Dr.-Ing. (F.A.F. Hamburg)

ASSOCIATE PROFESSORS:

Gobboon Lothongkum, Dr.-Ing. (F.A.F. Hamburg)
Ekasit Nisanatanaporn, Ph.D. (I.C. London)
Tachai Luangvaranunt, Ph.D. (Tokyo)
Seksak Asavavisithchai, Ph.D. (Nottingham)
Patama Visuttipitukul, Ph.D. (Tokyo)

ASSISTANT PROFESSORS:

Ittipon Diewwanit, Sc.D. (MIT)
Panyawat Wangyao, Ph.D. (T.U. Kosice)
Suvanchai Pongsugitwat, M.Eng. (Tokyo)
Mawin Supradist Na Ayudhaya, Ph.D. (CarnegieMellon)
Boonrat Lohwongwatana, Ph.D. (Galltech)

LECTURERS:

Chedtha Puncrobut, Ph.D. (I.C.London)
Jirapon Khamwannah, Ph.D. (U.C.San Diego)
### METALLURGICAL AND MATERIALS ENGINEERING CURRICULUM

#### FIRST YEAR CURRICULUM COMMON TO ALL ENGINEERING STUDENTS

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
</table>

#### THIRD SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103213</td>
<td>ENG MECH I</td>
<td>3</td>
</tr>
<tr>
<td>2109210</td>
<td>THERMO MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109211</td>
<td>PRIN ENG MAT I</td>
<td>3</td>
</tr>
<tr>
<td>2109276</td>
<td>ENG MAT LAB</td>
<td>1</td>
</tr>
<tr>
<td>2301207</td>
<td>CALCULUS III</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
</tbody>
</table>

#### FOURTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2103231</td>
<td>MECH OF MAT I</td>
<td>3</td>
</tr>
<tr>
<td>2109212</td>
<td>PRIN ENG MAT II</td>
<td>3</td>
</tr>
<tr>
<td>2109213</td>
<td>TRAN PHEN MAT PROC</td>
<td>3</td>
</tr>
<tr>
<td>2109277</td>
<td>MAT MANU LAB</td>
<td>1</td>
</tr>
<tr>
<td>2603284</td>
<td>STAT PHYS SCIENCE</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
</tr>
</tbody>
</table>

#### FIFTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
</tr>
<tr>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
</tr>
<tr>
<td>2109310</td>
<td>CHEM ENG MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109321</td>
<td>QC QM MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109333</td>
<td>MET MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109377</td>
<td>MICROSTRUC LAB</td>
<td>1</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>FREE ELECTIVES</td>
<td>3</td>
</tr>
</tbody>
</table>

Applicants must take at least 12 credits of electives in which they must select at least one course offered in both two groups including Advanced Processing group and Advanced Materials group. If seminar (2109480) course is chosen, the applicant has to take another course offered in the advance processing group.

#### SIXTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109334</td>
<td>POLY MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109335</td>
<td>CERAMIC MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109341</td>
<td>MAT CHAR</td>
<td>3</td>
</tr>
<tr>
<td>2109399</td>
<td>IND VISIT</td>
<td>1</td>
</tr>
<tr>
<td>2100311</td>
<td>ENGINEERING ESSENTIALS</td>
<td>3</td>
</tr>
<tr>
<td>2109336</td>
<td>MAT DAILY LIFE</td>
<td>3</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>3</td>
</tr>
<tr>
<td>2109400</td>
<td>COM PRES MET</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>ELECTIVES</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SUMMER SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2</td>
</tr>
</tbody>
</table>

#### SEVENTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109411</td>
<td>MECH BEHAV MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109478</td>
<td>MECH TEST LAB</td>
<td>1</td>
</tr>
<tr>
<td>2109428</td>
<td>MAT PROC</td>
<td>3</td>
</tr>
<tr>
<td>2109430</td>
<td>CORROSION OF METAL</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>ELECTIVES</td>
<td>6</td>
</tr>
</tbody>
</table>

#### EIGHTH SEMESTER

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>2109300</td>
<td>CON VOC MAT</td>
<td>3</td>
</tr>
<tr>
<td>2109445</td>
<td>FAIL ANAL</td>
<td>3</td>
</tr>
<tr>
<td>2109450</td>
<td>MAT SELECT DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2109488</td>
<td>MET MAT ENG PROJ</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxxx</td>
<td>ELECTIVES</td>
<td>3</td>
</tr>
</tbody>
</table>

TOTAL CREDITS FOR GRADUATION = 146
METALLURGICAL ENGINEERING

NAME OF DEGREE
: Master of Engineering
: M. Eng.

HEAD:
Gobboon Lothongkum, Dr.-Ing.(F.A.F. Hamburg)

ASSOCIATE PROFESSORS:
Gobboon Lothongkum, Dr.-Ing.(F.A.F. Hamburg)
Pata W Visuttipitkul, Ph.D. (Tokyo)
Seksa Aasavavithichai, Ph.D. (Nottingham)
Tachai Luangvaranunt, Ph.D. (Tokyo)
Ekasit Nisaratapanorn, Ph.D.(I.C. London)

ASSISTANT PROFESSORS:
Ittipon Diewwanit, Sc.D. (MIT)
Suvanchai Pongsugliatw, M.Eng. (Tokyo)
Mawin Supradist Na Ayudhaya, Ph.D. (Carnegie Mellon)
Boonrat Lohongwatana, Ph.D. (Caltech)
Panyawat Wangyao, Ph.D.(T.U. Kosice)

LECTURERS:
Chedtha Puncreobutr Ph.D. (I.C.London)
Jirapon Khamwannah Ph.D. (U.C.SanDiego)

ADMISSION
The applicant must hold a Bachelor's Degree in Engineering or consent of faculty.
The admitted students whose degrees are not Metallurgical Engineering are required to take at least 15 credits of undergraduate courses in Engineering as approved by the Graduate Program Committee during their studies.

DEGREE REQUIREMENTS
The Program consists of 36 credits of course work and thesis.
Candidates must earn a minimum of 24 credits of graduate course work and 12 credits of thesis. The candidate is required to maintain at least a "B" average.

COURSE REQUIREMENTS

1) Required Courses 6 credits

2109601 Thermodynamics and Phase Equilibria in Multicomponent System 3(3-0-9)
2109602 Transport Phenomena in Solids 3(3-0-9)
2109603 Concepts in Metallurgical and Materials Engineering 3(3-0-9)
2109711 Seminar in Metallurgical and Materials Engineering I S/U
2109712 Seminar in Metallurgical and Materials Engineering II S/U
2109713 Seminar in Metallurgical and Materials Engineering III S/U

2) Elective Courses 18 credits

2109504 Advanced Physical Metallurgy I 3(2-3-7)
2109507 Advanced Mechanical Metallurgy. 3(2-3-7)
2109508 Rate Phenomena and Modelling in Process Metallurgy. 3(3-0-9)
2109510 Instrumental Analysis 3(2-3-7)
2109514 Advanced Corrosion 3(3-0-9)
2109515 Quantitative Analysis of Microstructure 3(3-0-9)
2109516 Advanced Topics in Physical Metallurgy 3(3-0-9)
2109517 Composite Materials I 3(3-0-9)
2109518 Surface Technology 3(3-0-9)
2109519 Solidification of Casting 3(3-0-9)
2109520 Physical Ceramics 3(3-0-9)
2109525 Welding Engineering 3(3-0-9)
2109526 Advanced Topics in Chemical Metallurgy 3(3-0-9)
2109527 High Temperature Materials 3(3-0-9)
2109528 Properties of Solids 3(3-0-9)
2109530 Physical Metallurgy of Steels 3(3-0-9)
2109533 Powder Metallurgy 3(3-0-9)
2109535 Cellular Metal 3(3-0-9)
2109536 Advanced Topics in Production Metallurgy 3(3-0-9)
2109537 Tribology of Materials 3(3-0-9)
2109555 Nano and Amorphous Materials 3(3-0-9)
2109605 Physical Chemistry of Iron and Steel Manufacture 3(3-0-9)
2109610 Physical Chemistry of Chemical Metallurgy 3(3-0-9)
2109617 Composite Materials II 3(3-0-9)
2109620 Solution Concentration and Purification 3(3-0-9)
2109623 Fracture Analysis 3(3-0-9)
2109630 Forming Process Analysis 3(3-0-9)
2109659 Aluminium Technology 3(3-0-9)
2109811 Thesis 12 credits
METALLURGICAL ENGINEERING

NAME OF DEGREE

: Doctor of Engineering
: D. Eng.

HEAD:

Gobboon Lothongkum, Dr.-Ing.(F.A.F. Hamburg)

ASSOCIATE PROFESSORS:

Gobboon Lothongkum, Dr.-Ing.(F.A.F. Hamburg)
Ekasit Nisaratapanorn, Ph.D.(I.C.London)
Patama Visuttipitukul, Ph.D.(Tokyo)
Seksak Asavavisithchay, Ph.D.(Nottingham)
Tachai Luangvananunt, Ph.D. (Tokyo)

ASSISTANT PROFESSORS:

Ittipon Diewwanit, Sc.D. (MIT)
Suvanchai Pongsugwit, M.Eng. (Tokyo)
Panyawat Wangyao, Ph.D. (T.U.Kosice)
Boonrat Lohwongwanta, Ph.D. (Caltech)
Mawin Supradist Na Ayudhaya, Ph.D.(Carnegie Mellon)

LECTURERS:

Chedtha Puncreobutr Ph.D. (I.C.London)
Jirapon Khamwannah Ph.D. (U.C.SanDiego)

ADMISSION

1. The applicant must hold a Degree of Master of Engineering or consent of faculty.
2. The other qualifications must meet the regulations of the Graduate School, Chulalongkorn University, which will be annually announced or earned approval to be the candidate by the graduate committee of the Faculty of Engineering.

DEGREE REQUIREMENTS

Number of credit units for graduation not less than 48 credits: 4 credits for core courses and 48 credits for Dissertation.

A student who has fulfilled the requirement of the program and of the Graduate School and satisfactorily pass an oral examination, will be awarded the Degree of Doctor of Engineering.

COURSE REQUIREMENTS

1) Core Courses 4 credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109714 Seminar in Metallurgical and Materials Engineering IV</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>2109715 Seminar in Metallurgical and Materials Engineering V</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>2109716 Seminar in Metallurgical and Materials Engineering VI</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>2109717 Seminar in Metallurgical and Materials Engineering VII</td>
<td>1(1-0-3)</td>
</tr>
</tbody>
</table>

2) Dissertation 48 credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
</tbody>
</table>

Study Program for Doctoral Degree in Metallurgical Engineering

First Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
<tr>
<td>2109714 Seminar in Metallurgical and Materials Engineering IV</td>
<td>1</td>
</tr>
</tbody>
</table>

Second Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
<tr>
<td>2109715 Seminar in Metallurgical and Materials Engineering V</td>
<td>1</td>
</tr>
</tbody>
</table>

Third Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
<tr>
<td>2109716 Seminar in Metallurgical and Materials Engineering VI</td>
<td>1</td>
</tr>
</tbody>
</table>

Fourth Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
<tr>
<td>2109717 Seminar in Metallurgical and Materials Engineering VII</td>
<td>1</td>
</tr>
</tbody>
</table>

Fifth Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
</tbody>
</table>

Sixth Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2109828 Dissertation</td>
<td>8</td>
</tr>
</tbody>
</table>

Total credits for graduation 48 credits
2109101 Engineering Materials 3(3-0-6)
Relationship between structures, properties, production processes and applications of main groups of engineering materials; crystal structure of solids; crystal defects; mechanical properties of materials; dislocation and strengthening mechanism of metals; mechanical failure of materials; phase diagram and solid state reaction; fabrication and applications of metals; structure, properties and applications of ceramic; structure, properties and applications of polymers; structure, properties and applications of composite materials; corrosion and degradation of materials; properties and applications of electronic materials; electrical properties of materials; magnetic properties of materials; innovation in material technology.

2109210 Thermodynamics of Materials 3(3-0-6)
First and second laws of thermodynamics; criteria for equilibria in constant pressure processes; free energies as a function of temperature, pressure and chemical potential; numerical calculation of free energies from available thermodynamic data; equilibrium in gas mixtures; equilibrium between condensed phases and gas phases; Richardson's free energy diagram; reduction of oxides and sulphides; activities of various substances in metals and slags; application of thermodynamics to extractive metallurgical processes, smelting and refining, solution behavior.

2109211 Principles of Engineering Materials I 3(3-0-6)
Electron; atomic structure; molecules and bonding; crystal structure; x-ray diffraction in crystalline solid; crystal defects; crystal interfaces and microstructure; solid solution and compound; thermodynamics and phase diagrams; solidification.

2109212 Principles of Engineering Materials II 3(3-0-6)
Condition: PRER 2109211
Diffusion; principles of solid-state phase transformation; plastic deformation in crystalline solid recovery; recrystallization; grain growth; strengthening mechanism and microstructural control.

2109213 Transport Phenomena in Materials Processing 3(3-0-6)
Fluid flow: laminar and turbulent flow, flow and vacuum production; materials and energy balance; energy transport; mass transport.

2109216 Engineering Materials Laboratory I(0-3-0)
Crystal structure; metallographic sample preparation; macro and microstructure; structure examination; cooling curve.

2109217 Material and Manufacturing Processes Laboratory 3(3-0-9)
Heat treatment of steels; hardening, tempering, full annealing and normalizing; practice in sand mold casting of metals; welding practice.

2109300 Basic Concepts and Vocabulary in Metallurgical and Materials Engineering 3(2-2-5)
Introduction to concepts and technical terminologies of materials used for different machines and industries: automotive, aerospace, ship, power plant and petrochemical, working mechanism of machine components produced from different materials.

2109310 Chemistry of Engineering Materials 3(3-0-6)
Thermodynamics of aqueous solutions; kinetics of leaching and precipitation, pressure leaching and reduction; solvent extraction and ion exchange; principles of electrochemistry of aqueous solutions; conductance and transference; electrolytic cell types and potential; current and energy efficiency; principles of pyrometallurgy, including calculation of the values of thermodynamics functions, calcination, roasting, reduction and reduction at slag-metal interfaces; extraction of ferrous and nonferrous metals.

2109321 Quality Control and Quality Management for Materials Engineering 3(3-0-6)
Quality philosophy; quality management strategies in Materials Engineering; organizing for quality; quality concepts; quality control techniques in Materials Engineering.

2109333 Metallic Materials 3(3-0-6)
Microstructures, properties, and application of ferrous and non-ferrous alloys including plain carbon steels, alloy steels, cast irons, aluminium alloys, copper alloys, and white metals.

2109334 Polymeric Materials 3(3-0-6)
Monomer and polymerization; basic polymer molecular concepts; polymer additives; structures, properties, and application of polymers including thermoplastic, thermoset, elastomer, and composite polymers.

2109335 Ceramic Materials 3(3-0-6)
Structure of ceramic crystals; structure of glass; structural imperfection: structural defects, association of defects, non-stoichiometric solids; properties and application of ceramics in Engineering.

2109336 Materials in Daily Life 3(3-0-6)
Learn different aspects of materials as found in daily life, in various occupations and in suitable applications. Environmentally friendly materials: Full utilization of materials in both efficient sense and aesthetic sense. Topics include materials for design and architecture, fashion, arts and craft materials, biomedical materials and biomaterials, automotive materials and household materials.

2109341 Materials Characterisation 3(3-0-6)
Principles and operation of scanning electron microscopy, transmission electron microscopy, x-ray fluorescence, x-ray diffraction, atomic absorption, emission spectrometer, image analyser; non-destructive testing.
2109377 Microstructure Laboratory 1(0-3-0)
Analysis of microstructure of metallic materials.

2109399 Industrial Visit 1(0-3-0)
Condition: 3rd year student
Visiting the factories related to metal and materials processing; analyzing the processes and presenting a report of the visit.

2109400 Communication and Presentation Skills for Metallurgical Engineers 3(3-0-6)
Necessary skills needed for a winning presentation performance in various settings: academic presentations, project demonstrations, and job interviews; a systemic approach to a great stress-free presentation and a personal design to effectively interact with an audience, sell their ideas, and share their enthusiasm; workshop dealing with common mistakes, miscues, and unexpected surprises that may arise during any meeting encounter.

2109411 Mechanical behaviour of Materials 3(3-0-6)
Condition: PRER 2109212, 2103231
Elastic behaviour; theory of plasticity; dislocation theory; mechanical failure: fractures, fatigue, creep, embrittlement; materials testing: tension, hardness, torsion, impact, fatigue, creep; fracture mechanics; mechanical behaviour of composite materials.

2109428 Materials Processing 3(3-0-6)
Theory and modern development of foundry processes; pattern design; casting design; runner and riser design; finishing and inspection of casting products; causes and elimination of defects and design limitations; injection moulding; rapid solidification; theory and practice of rolling, forging, extrusion, wire and tube drawing, deep drawing; causes and elimination of defects.

2109430 Corrosion of Metals 3(3-0-6)
Principles of corrosion; anode and cathode processes; origin and characteristic of corrosion currents; standard electrochemical series; passivity and protective films; effects of rolling, forging, extrusion, wire and tube drawing, deep drawing; causes and elimination of defects.

2109445 Failure Analysis 3(3-0-6)
General practice in failure analysis: data collection, non-destructive testing, mechanical testing, macro and micro analysis, determination of failure mechanism; failure mechanisms and related environmental factors: fractures in ductile, brittle and fatigue modes; failure due to creep, corrosion and stress-corrosion, weld decay; defects due to heat treatment, case studies.

2109450 Materials Selection and Design 3(3-0-6)
Criteria and concept in design of component and products and economic consideration; materials selection process; material property charts; effects of composition, processing, and structure on materials properties; properties versus performance of materials; case studies of materials processing and design; case studies of materials selection.

2109478 Mechanical Testing Laboratory 1(0-3-0)
Mechanical properties testing: tension test, bending and torsion test, impact test and hardness test.

2109488 Metallurgical and Materials Engineering Project 3(0-6-3)
Practical interesting projects or problems in various fields of metallurgical and materials engineering.

Course group in Advanced Processing

2109312 Chemical Metallurgy II 3(3-0-6)
Condition: PRER 2109310
Physical chemistry in iron and steel making; blast furnace; steel making processes; direct reduction processes; reaction of carbon, silicon and chromium; removal of sulphur and phosphorus; deoxidation; vacuum degassing of steel; hydro and pyrometallurgy of ores commonly found in Thailand.

2109419 Directional Solidification 3(3-0-6)
Solidification behaviour of ferrous and non-ferrous alloys; modulus of cooling and feeder head calculation; the use of internal and external chill; exothermic anti-piping powder and exothermic feeder head.

2109423 Electroplating 2(1-3-2)
Condition: PRER 2109310
Fundamentals of electrochemistry; technology and control of various electroplating processes including chromium plating, nickel plating, copper plating, tin and zinc alloys plating, and zinc and zinc alloys plating.

2109424 Iron-making and Steel-making 2(2-0-4)
Fundamentals of iron-making and steel-making processes including blast furnace, direct reduction, direct smelting, basic oxygen process, electric arc furnace, secondary metallurgy and continuous casting processes; physical chemistry of iron-making and steel-making processes.

2109425 Materials Joining 3(3-0-6)
Introduction to materials joining: soldering, brazing and welding, wetting, solid-phase welding, adhesive joining, joining of ceramic, fusion welding processes, mass and heat flow in fusion welding, metallurgical effects of the weld thermal cycle, weld defect, hot and cold cracking, porosity in welds, residual stress in welds, destructive and non-destructive testing of the joints, safety in welding, welding laboratory demonstration.

2109454 Computational Materials Engineering 3(2-3-4)
Information technology (IT) in materials engineering. Introduction to some basic tools/computer software for programming and computation. Review of heat transfer in solid. Introduction to computational materials engineering with some applications.

2109463 Jewelry Metals and Processing 3(3-0-6)
Presentation and discussion on topics of interest in metallurgical and materials engineering.

Interesting issues in metallurgical and materials engineering.

Rate of metallurgical processes with engineering application to process simulation and control; special attention to processes important to iron and steelmaking homogeneous and heterogeneous reaction kinetics; mass and energy transport; steady-state and nonsteady-state reaction systems; development of process models.

Operation principles of transmission electron microscopy and scanning electron microscopy, X-ray diffraction, X-ray fluorescence, atomic absorption and spectro analysis, ESCA and Auger electron spectrometer; interpretation of instrumental results in terms of mechanical properties.

Advanced topics of current research interests in physical metallurgy.

Carburizing, nitriding, flame hardening, diffusion hardening; chemical vapor deposition and physical vapor deposition; electro-plating; hot dip coating; metal spraying and ion implantation.

Study of solidification of metal in molds; characteristics of liquid-solid phase transformations; Sand and metal thermal behavior; macroscopic structures; mechanical properties, and casting defects.

Types of welding; mass and heat flow during welding; metallurgy effects of heat thermal cycle; solid-phase welding and joining of ceramics; welding of ferrous and non-ferrous metals; behavior of welds in service.

Advanced topics of current research interests in chemical metallurgy.

Advanced topics of current research interests in production metallurgy.

Solid lubrication and surface treatment; fundamentals of contacts between solids; abrasive, erosive, and cavitation wear; adhesion and adhesive wear, corrosive and oxidative wear; fatigue wear; fretting and minor wear mechanism; wear of non-metallic materials; case study.

Types of superalloys, production processes and its microstructures, superalloys applications. The relationship among heat treatments, forming processes, microstructures and mechanical properties at high temperatures of nickel, cobalt and iron based superalloys, HIP restoration, microstructure analysis by SEM and TEM.

Classification of refractory materials; properties of important refractory materials; application of refractories in materials processing units; failures of refractories in materials processing units.

Elementary quantum physics; the band theory of solids semiconductors; semiconductor devices; dielectric materials and insulation; superconductivity.

Properties and types of materials for medical uses; mechanical, structural, chemical and biological characterization; production technology and formation of materials for medical application; research and technology development for advanced materials; advanced material used as biosensor; future trends in biomedical engineering.

Point defects; thermodynamics of points defects; extended defects; structural aspects of composition variation; defects and diffusion; intrinsic defect and extrinsic defect in insulators, nonstoichiometry and intrinsic electronic conductivity, nonstoichiometry and extrinsic electronic conductivity; magnetic and optical defects.

Principles of sustainability analysis; sustainability indexes; materials technology and nanotechnology enabling development sustainability in materials production; renewable energy; fuel cell; photovoltaic; bioenergy; green-house gas emissions; sustainable environment; materials life cycle analysis; materials recycling.
2109504 Advanced Physical Metallurgy I 3(2-3-7)
Classification of phase transformations continuous and discontinuous precipitation from solid solution; eutectoidal transformation, massive and martensitic transformation, order-disorder changes; relation of properties to microstructure; techniques and methodology used to study microstructure.

2109509 Stainless Steel Technology 3(3-0-9)
Stainless steel development; stainless steel grades; phase equilibrium diagram; microstructure and metallography; passive films; martensitic, ferritic, austenitic, duplex and precipitation hardening stainless steels; production technology; improvement of mechanical and corrosion properties and selection.

2109514 Advanced Corrosion 3(3-0-9)
Engineering aspects of corrosion and its control; forms by which corrosion manifests itself; simplified mechanisms of corrosion and methods of combating corrosion; electrode processes; activation, ohmic, and concentration polarization; passivation; potentiostatic studies and alloy design; applications to engineering systems.

2109517 Composite Materials I 3(3-0-9)
Properties of engineering composite materials; types of composite materials; fiber and their interfaces; geometrical properties; elasticity; case studies.

2109520 Physical Ceramics 3(3-0-9)
Physical and chemical process responsible for microstructure development; modern electronic ceramics; structural defects, sintering of ceramics and grain growth; mechanical, thermal, electrical, magnetic properties and dielectric property.

2109527 High Temperature Materials 3(3-0-9)
Theory of alloying and relationship among temperature, structure, and mechanical properties in nickel, cobalt, and iron base alloys; effect of thermomechanical processing; analysis of microstructures by transmission electron microscopy, scanning electron microscopy, X-ray diffraction, and X-ray microprobe.

2109530 Physical Metallurgy of Steels 3(3-0-9)
Condition: Consent of Faculty
Properties of high purity iron; interstitial and substitutional solutes; carbon steels; high strength low alloy steels; thermomechanical treatment of steels; alloy steels; steels for magnetic and electrical application.

2109533 Powder Metallurgy 3(3-0-9)
Preparation and fabrication of metal powder; engineering properties and industrial uses; theory of compaction and sintering.

2109535 Cellular Metal 3(3-0-9)
The structure, manufacturing methods, characterization techniques, mechanics. Physical and mechanical properties of cellular metals; energy absorption; sandwich structures and case studies.

2109555 Nano-structured Materials and Amorphous Materials 3(3-0-9)
Definition of classifications of nano-structured materials and amorphous materials; nanomaterials and amorphous materials in nature; processing pathways in relation to metastability and free energy; zero-dimensional, one-dimensional, two-dimensional and three-dimensional nanomaterials; nanomaterials characterizations; environmental and health impacts of nanomaterials.
Physical Metallurgy 3(3-0-9)
Structures of metals; physical properties of single crystals, and polycrystals; defects in crystals; diffusion in metals; recovery recrystallization and grain growth; binary and ternary phase equilibrium diagrams; principles of phase transformation.

Structures and Properties of Metals 3(3-0-9)
Structures and properties of metals and its alloy; relationship between microstructures and mechanical properties of metals.

Macro and microscopic examinations of important ferrous and non-ferrous metals.

Classification of phase transformations continuous and discontinuous precipitation from solid solution; eutectoidal transformation, massive and martensitic transformation, order-disorder changes; relation of properties to microstructure; techniques and methodology used to study microstructure.

Rate phenomena and modeling in process metallurgy 3(3-0-9)
Rate of metallurgical processes with engineering application to process simulation and control; special attention to processes important to iron and steelmaking heterogeneous and homogeneous reaction kinetics; mass and energy transport; steady-state and nonsteady-state reaction systems; development of process models.

Stainless steel technology 3(3-0-9)
Stainless steel development; stainless steel grades; phase equilibrium diagram; microstructure and metallography; passive film; martensitic, ferritic, austenitic, duplex and precipitation hardening stainless steels; production technology; improvement of mechanical and corrosion properties and selection.

Instrumental analysis 3(2-3-7)
Operation principles of transmission electron microscopy and scanning electron microscopy, X-ray diffraction, X-ray fluorescence, atomic absorption and spectro analysis, ESCA and Auger electron spectrometer; interpretation of instrumental results in terms of mechanical properties.

Extractive metallurgy 3(3-0-9)
Principles of extractive metallurgy; thermodynamics and kinetics of pyrometallurgy including roasting, smelting and refining; physical chemistry of iron and steel-making; principles of hydrometallurgy including thermodynamics of aqueous solutions, kinetics of leaching and precipitation.

Advanced Corrosion 3(3-0-9)
Engineering aspects of corrosion and its control; forms by which corrosion manifests itself; simplified mechanisms of corrosion and methods of combating corrosion; electrode processes; activation, ohmic, and concentration polarization; passivation; potentiostatic studies and alloy design; applications to engineering systems.

Basic probability theory and statistical analysis relevant to the quantitative description of a microstructure stereological relationships and the mathematical foundation and the microstructural tools needed to quantify the structure; applications of quantitative metallography to problems in failure analysis; solidification, heat treatment, phase equilibria, and deformation behavior.

Advanced topics in current research interests in physical metallurgy.

Properties of engineering composite materials; types of composite materials; fiber and their interfaces; geometrical properties; elasticity; case studies.

Carburizing, nitriding, flame hardening, diffusion hardening; chemical vapor deposition and physical vapor deposition; electro-plating; hot dip coating; metal spraying and ion implantation.

Study of solidification of metal in molds; characteristics of liquid-solid phase transformations; Sand and metal thermal behavior; macroscopic structures; mechanical properties, and casting defects.

Physical ceramics 3(3-0-9)
Physical and chemical process responsible for microstructure development; modern electronic ceramics; structural defects, sintering of ceramics and grain growth; mechanical, thermal, electrical, magnetic properties and dielectric property.

Type and process of welding; mass and heat flow during welding; metallurgical effects of heat thermal cycle; solid-phase welding and joining of ceramic; welding of ferrous and non-ferrous metals; behavior of welds in service.

Advanced topics of current research interests in chemical metallurgy.

Theory of alloying and relationship among temperature, structure, and mechanical properties in nickel, cobalt, and iron base alloys; effect of thermomechanical processing; analysis of
microstructures by transmission electron microscopy, scanning electron microscopy, X-ray diffraction, and X-ray microprobe.

2109528 Properties of Solids
  Atomistic approach of metal physics, crystal structure, lattice vibration, energy band; electric, electronic, optical and thermal properties of metal; electron spins; introduction to basis quantum mechanics.

2109530 Physical Metallurgy of Steels
  Properties of high purity iron; interstitial and substitutional solutes; carbon steels; HSLA steel; thermomechanical treatment of steel, alloy steels, steels for magnetic and electrical applications.

2109533 Powder Metallurgy
  Preparation and fabrication of metal powder; engineering properties and industrial uses; theory of compaction and sintering.

2109535 Cellular Metal
  The structure, manufacturing methods, characterization techniques, mechanics. Physical and mechanical properties of cellular metals; energy absorption; sandwich structures and case studies.

2109536 Advanced Topics in Production Metallurgy
  Advanced topics of current research interests in production metallurgy.

2109537 Tribology of Materials
  Solid lubrication and surface treatment; fundamentals of contacts between solids; abrasive, erosive, and cavitation wear; adhesion and adhesive wear, corrosive and oxidative wear; fatigue wear; fretting and minor wear mechanism; wear of non-metallic materials; case study.

2109541 Principles of Metallurgical Processing
  Introduction to the science of metallurgy; metallurgical furnaces; refractories; metallurgical fuels; temperature measurement and control; metallurgical calculation; energy and mass balances; analysis of steady and non-steady state processes, heat and mass transfer applied to metallurgical processes.

2109555 Nano-structured and Amorphous Materials
  Definition and classification of nano-structured materials and amorphous materials; nanomaterials and amorphous materials in nature; processing pathways in relation to metastability and free energy; zero-dimension, one-dimensional, two-dimensional and three-dimensional nanomaterials; nanomaterials characterizations; environmental and health impacts of nanomaterials.

2109601 Thermodynamics and Phase Equilibria in Multicomponent System
  Examination and study of thermodynamics of phase equilibria in multicomponent systems; measurements of thermodynamic activity, graphical presentation of phase equilibrium, solid and liquid solution models, development of equations of state using statistical models.

2109602 Transport Phenomena in Solids
  Fick’s first and second law and their solutions; continuity equation; diffusion couples; interaction between diffusing atoms rate of diffusion; quantitative analysis of diffusion problems; energy and rate at which solid-state transformation occurs in pure metal and alloys; influences of defects on nucleation and grain growth.

2109603 Concepts in Metallurgy and Materials Engineering
  Physical metallurgy aspect to metallurgy and materials engineering which includes crystallography, defects and dislocations; microstructure, phase, phase boundaries and related energies; solidification theories; phase transformations and phase equilibria; continuous and discontinuous precipitations.

2109605 Steel Manufacture
  Structure and properties of slags; ionic theory and reactions in slags gas reactions in the blast furnace, partitioning of solute elements between iron and slag in blast furnace; steelmaking processes; refining slags; oxidation and deoxidation reactions; distribution of sulphur between the slag and the metals; removal of phosphorus from the metal.

2109610 Physical Chemistry of Chemical Metallurgy
  Kinetics and mechanisms of reaction in chemical metallurgical systems; high temperature oxidation and reduction; slag metal reactions and other related processes; direct reduction.

2109617 Composite Materials II
  Theory of laminate, unidirectional strength of laminate; Fiber strength, Short fiberous composite, other topics and case study.

2109620 Solution Concentration and Purification
  Study of aqueous solution chemistry including estimation of activity coefficients and complex equilibria calculations, application of solution chemistry of reaction kinetics and mass transfer phenomena in cementation; solvent extraction; and precipitation reactions.

2109623 Fracture Analysis
  Deformation and fracture mechanics of engineering materials; fracture, microstructural aspects of fracture toughness; environment-assisted cracking; fatigue crack propagation; analysis of engineering failures.

2109630 Forming Process Analysis
  Plastic forming of metals bending, forging rollings; forge rolling, drawing; sheet metal forming; forging of complicated shapes; geometry of plastic area; formability; asymmetry of plastic deformation; computer analysis of forming process.
2109659 Aluminium Technology 3(3-0-9)
Physical metallurgy of aluminium and its alloys; productions of aluminium; deformation process such as rolling extrusion; relationship between microstructure and materials properties of aluminium alloys; recrystallization - recovery; structural developments from the as cast to the worked and quenched state; surface finishes and treatments.

2109701 Seminar in Metallurgical Engineering I 1(1-0-3)
Condition: Consent of Faculty
Seminar in selected research topics of interest in Metallurgical Engineering.

2109702 Seminar in Metallurgical Engineering II 1(1-0-3)
Condition: Consent of Faculty
Seminar in selected research topics of interest in Metallurgical Engineering.

2109703 Seminar in Metallurgical Engineering III 1(1-0-3)
Condition: Consent of Faculty
Seminar in selected research topics of interest in Metallurgical Engineering.

2109704 Seminar in Metallurgical Engineering IV 1(1-0-3)
Condition: Consent of Faculty
Selected research topics of interest in Metallurgical Engineering.

2109705 Seminar in Metallurgical Engineering V 1(1-0-3)
Condition: Consent of Faculty
Selected research topics of interest in Metallurgical Engineering.

2109706 Seminar in Metallurgical Engineering VI 1(1-0-3)
Condition: Consent of Faculty
Selected research topics of interest in Metallurgical Engineering.

2109707 Seminar in Metallurgical Engineering VII 1(1-0-3)
Condition: Consent of Faculty
Selected research topics of interest in Metallurgical Engineering.

2109711 Seminar in Metallurgical and Materials Engineering I 1(1-0-3)
Seminar in selected research topics of interest in Metallurgical and Materials Engineering.

2109712 Seminar in Metallurgical and Materials Engineering II 1(1-0-3)
Seminar in Metallurgical and Materials Engineering II

2109713 Seminar in Metallurgical and Materials Engineering III 1(1-0-3)
Seminar in Metallurgical and Materials Engineering III

2109714 Seminar in Metallurgical and Materials Engineering IV 1(1-0-3)
Selected research topics of interest in metallurgical and materials engineering.

2109715 Seminar in Metallurgical and Materials Engineering V 1(1-0-3)
Selected research topics of interest in metallurgical and materials engineering.

2109716 Seminar in Metallurgical and Materials Engineering VI 1(1-0-3)
Selected research topics of interest in metallurgical and materials engineering.

2109717 Seminar in Metallurgical and Materials Engineering VII 1(1-0-3)
Selected research topics of interest in metallurgical and materials engineering.

2109811 Thesis 12 Credits

2109828 Dissertation 48 Credits

2109894 Doctoral Dissertation Seminar 0(0-0-0)

2109897 Qualifying Examination 0(0-0-0)
DEPARTMENT OF COMPUTER ENGINEERING

Objectives

1. Graduates have knowledge of basic sciences and engineering sciences necessary to engage in further learning.
2. Graduates have knowledge and skills needed for the engineering profession.
3. Graduates are able to use engineering tools appropriately.

The undergraduate program in Computer Engineering is relatively broad-based. The program covers various aspects in computer science and engineering which include the design, analysis, organization, and applications of computer systems. The department offers courses which can be divided into three major areas.

1. Digital System Engineering: Courses cover the design and analysis of digital computer systems which include logic design, microprocessors, microcomputer systems, assembly language, VLSI design, computer architectures, data communications and computer networks.

2. Systems Software Engineering: Courses cover the principles of design and analysis of algorithms, systems software, programming languages, compilers, and operating systems. The students will, in addition, understand the interactions between software and hardware at various interface levels.

3. Information Processing: Courses cover the design and analysis of information processing systems, information technology, software engineering, artificial intelligence, data base management system, computer graphics, and their applications.

A bachelor degree in Computer Engineering will be awarded upon successful completion of the four year curriculum. Being highly competent in the design, analysis, and applications of systems software, digital systems, and information processing, the graduate will be able to work as a systems programmer, a systems analyst or a system engineer.

The department also offers four additional curriculums leading to the Master Degree in Computer Science, Master Degree in Software Engineering, Master Degree in Computer Engineering, and Doctor of Philosophy in Computer Engineering.

HEAD:
Natawut Nupairoj, Ph.D. (Michigan St.)

PROFESSORS:
Boonserm Kjisirikul, Ph.D. (Tokyo Institute of Technology)
Prabhas Chongstitvatana, Ph.D. (Edinburgh U.)

ASSOCIATE PROFESSORS:
Atiwong Suchato, Ph.D. (M.I.T.)
Kultida Rojviboonchai, Ph.D (Tokyo)
Nongluk Covavisaruch, M.S. in E.E. (Missouri Columbia)
       (Eastern Michigan)
Pornsiri Muenchaisiri, Ph.D. (Oregon State)
Saritd Vongpradhip, Ph.D. (U.of Tech. Sydney)
Setha Pan-Ngum, Ph.D. (U. of Warwick)
Somchom Prasitjutrukul, Ph.D. (U. of Illinois)
Wiwat Vatanawood, Ph.D. (Chula)
Taratip Suwannasart, Ph.D. (Illinois Institute of Technology)
Twittie Senivongse, Ph.D. (U. of Kent)
Yachai Limpiyakorn, Ph.D. (Illinois Institute of Technology)

ASSISTANT PROFESSORS:
Arthit Thongtak, D.Eng. (Tokyo Institute of Technology)
Athasit Surarerks, Ph.D. (U.of Pierre et Marie Curie)
Attawith Sudsang, Ph.D. (U. of Illinois)
Boonchai Sowanwanichakul, B.Eng. (Chula)
Chotirat Ratanamahatana, Ph.D. (U. of California)
Kerck Piromsopa, Ph.D. (Michigan St.)
Natawut Nupairoj, Ph.D. (Michigan St.)
Nakornthip Prompoon, M.S. (George Wash.U.)
Nattee Niparn, Ph.D. (Chula)
Suebskul Phiphobmongkol, Ph.D. (Auburn)
Sukree Sinthupinyo, Ph.D. (Chula)
Proadpran Punyabukkana Pitsatorn, Ph.D. (Claremont)
Pizzanu Kanonchoiyos, Ph.D. (U.of Tokyo)
Thanawan Chantaratanapibul, M.Sc. (Chula)
Thanarat Chalidabhornse, Ph.D. (Maryland)
Veera Muangsinn, Ph.D. (U. of Manchester)
Vishnu Kotrajaras, Ph.D. (Imperial College)

LECTURERS:
Chairat Phongphanhanee, Ph.D. (U. of Southampton)
Chate Patanothai, M.Sc. in EE. (U. of Miami)
Duangdao Wichadakul, Ph.D. (U. of Illinois)
Nuttapong Chentanez, Ph.D. (Berkeley)
Peerapon Vateekul, Ph.D. (U. of Miami)
Pitchaya Sithi-Amorn, Ph.D. (U. of Virginia)
Thit Siriboon, Ph.D. (Colorado State)
Thongchai Rojviboonchai, M.Sc. (Chula)
## COMPUTER ENGINEERING CURRICULUM
### FIRST YEAR CURRICULUM
**COMMON TO ALL ENGINEERING STUDENTS**

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THIRD SEMESTER</strong></td>
<td></td>
<td></td>
<td><strong>SIXTH SEMESTER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2110200</td>
<td>DISCRETE STRUC</td>
<td>3</td>
<td>2110318</td>
<td>DIS SYS ESSEN</td>
<td>1</td>
</tr>
<tr>
<td>2110215</td>
<td>PROG METH I</td>
<td>3</td>
<td>2110332</td>
<td>SYS ANA DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2110221</td>
<td>COMP ENG ESSENTIALS</td>
<td>3</td>
<td>2110422</td>
<td>DB MGT SYS DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2110251</td>
<td>DIG COMP LOGIC</td>
<td>3</td>
<td>2110471</td>
<td>COMP NETWORK I</td>
<td>3</td>
</tr>
<tr>
<td>2110253</td>
<td>COMP ELEC INTF</td>
<td>3</td>
<td>2110xxxx</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>2110263</td>
<td>DIG LOGIC LAB I</td>
<td>1</td>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
</tr>
<tr>
<td><strong>FORTH SEMESTER</strong></td>
<td></td>
<td><strong>19</strong></td>
<td><strong>SUMMER SEMESTER</strong></td>
<td></td>
<td><strong>19</strong></td>
</tr>
<tr>
<td>2110201</td>
<td>COMP ENG MATH</td>
<td>3</td>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2</td>
</tr>
<tr>
<td>2110211</td>
<td>INTRO DATA STRUC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2110254</td>
<td>DIG DESIGN VER</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2110265</td>
<td>DIG DESIGN LAB I</td>
<td>1</td>
<td>2110423</td>
<td>SOFTWARE ENG</td>
<td>3</td>
</tr>
<tr>
<td>2603284</td>
<td>STAT PHYS SCIENCE</td>
<td>3</td>
<td>2110355</td>
<td>FORM LANG/AUTO</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td>2110490</td>
<td>COMP ENG PRE-PROJ</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td></td>
<td>2110xxx</td>
<td>APPROVED ELECTIVES</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>xxxxxxx FREE ELECTIVE</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FIFTH SEMESTER</strong></td>
<td></td>
<td><strong>16</strong></td>
<td><strong>EIGHTH SEMESTER</strong></td>
<td></td>
<td><strong>15</strong></td>
</tr>
<tr>
<td>2110313</td>
<td>OS AND SYS PROG</td>
<td>3</td>
<td>2110499</td>
<td>COMP ENG PROJECT</td>
<td>3</td>
</tr>
<tr>
<td>2110316</td>
<td>PROG LANG PRIN</td>
<td>3</td>
<td>2110xxxx</td>
<td>APPROVED ELECTIVES</td>
<td>9</td>
</tr>
<tr>
<td>2110327</td>
<td>ALGORITHM DESIGN</td>
<td>3</td>
<td>xxxxxxx</td>
<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>2110352</td>
<td>COMP SYS ARCH</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2110363</td>
<td>HW SYN LAB I</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>GENERAL EDUCATION</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION = 142**
MASTER DEGREE PROGRAMS
COMPUTER SCIENCE

NAME OF THE DEGREE
: Master of Science
: M.Sc.

ADMISSION
The applicant must have the following qualification:
1. Hold a Bachelor degree in Computer Science, Computer Engineering, Software Engineering, Information Technology, Mathematics, Physics, Statistics, or other Engineering fields.
2. Have other qualifications as announced each year by Graduate School of Chulalongkorn University (if any), or have other qualifications approved by the Computer Science Program Committee.

DEGREE REQUIREMENTS
The program requires the total of 36 credits comprising
1. Required Courses: 9 credits (including a non-credit Seminar course)
2. Track Elective Courses: 9 credits chosen from one of the following tracks:
   a. Intelligent Systems track
   b. Enterprise Information Systems track
3. General Elective Courses: 6 credits
4. Thesis: 12 credits

COURSE REQUIREMENTS
1) Required Courses
2110607  Research Methods in Computer Science  3(3-0-9)
2110636  Performance Analysis and Evaluation  3(3-0-9)
2110681  Computer Algorithm  3(3-0-9)
2110701  Seminar in Computer Engineering I  1(0-1-3)
Remark: 2110701 Seminar in Computer Engineering I is a non-credit course, with S/U evaluation.

2) Track Elective Courses
Each student must choose one of the tracks.

Intelligent Systems Track
Each student chooses 3 courses from the following list.
(Remaining courses in the track can be chosen as General Elective Courses.)
2110654  Artificial Intelligence  3(3-0-9)
2110682  Embedded and Real-Time Systems  3(3-0-9)
2110714  Digital Systems  3(3-0-9)
2110743  Machine Learning  3(3-0-9)
2110773  Data Mining  3(3-0-9)

Enterprise Information Systems Track
Each student chooses 3 courses from the following list.
(Remaining courses in the track can be chosen as General Elective Courses.)
2110523  Enterprise Application Architecture  3(3-0-9)
2110637  Large-Scale Information Systems  3(3-0-9)
2110640  Information Security  3(3-0-9)
2110663  Worldwide Network Infrastructure  3(3-0-9)
2110673  Information Storage and Retrieval  3(3-0-9)

3) General Elective Courses
Each student chooses 2 courses from the following list.
2110522  UNIX/LINUX for Enterprise Environment  3(3-0-9)
2110638  Object-Oriented Technology  3(3-0-9)
2110651  Digital Image Processing  3(3-0-9)
2110678  Mobile Computing  3(3-0-9)
2110694  Directed Studies in Computer Science  3(3-0-9)
2110697  Special Topics in Computer Science I  3(3-0-9)
2110698  Special Topics in Computer Science II  3(3-0-9)
2110713  Optimization Methods  3(3-0-9)
2110731  Distributed Systems  3(3-0-9)
2110732  Parallel Computing  3(3-0-9)
2110741  Robotics  3(3-0-9)
2110742  Evolutionary Computation  3(3-0-9)
2110746  Big Data Analytics  3(3-0-9)
2110747  Social Network Analysis  3(3-0-9)
2110781  Special Topics in Distributed Systems  3(3-0-9)
2110792  Advanced Topics in Artificial Intelligence  3(3-0-9)
2110795  Advanced Topics in Computer Network  3(3-0-9)

In addition to the list above, students can choose among the following as General Elective Courses:
1. Remaining elective courses of the chosen track which are not part of the 9-credit Track Elective Courses
2. Electives courses of the other track that is not chosen
3. Graduate courses of other programs of the Department (i.e. 21105xx, 21106xx, or 21107xx courses not listed as the General Elective Courses above)
4. Graduate courses of Chulalongkorn University (approval by the Computer Science Program Committee is required).

4) Thesis
2110811  Thesis  12 credits

STUDY PROGRAM
First Semester
2110606  Research Methods in Computer Science  3
2110636  Performance Analysis and Evaluation  3
2110681  Computer Algorithm  3

Second Semester
2110xx  Track Elective Courses  6
### Third Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110711</td>
<td>Seminar in Computer Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>2110xxx</td>
<td>General Elective Courses</td>
<td>3</td>
</tr>
<tr>
<td>2110811</td>
<td>Thesis</td>
<td>3</td>
</tr>
</tbody>
</table>

### Fourth Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110811</td>
<td>Thesis</td>
<td>3</td>
</tr>
</tbody>
</table>

### Course Requirements

1) **Required Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110606</td>
<td>Research Methods in Computer Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110701</td>
<td>Seminar in Computer Engineering I</td>
<td>1(0-3-1)</td>
</tr>
<tr>
<td>2110702</td>
<td>Seminar in Computer Engineering II</td>
<td>1(0-3-1)</td>
</tr>
</tbody>
</table>

2) **Elective Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110xx</td>
<td>General Elective Courses</td>
<td>3</td>
</tr>
<tr>
<td>2110xxxx</td>
<td>Track Elective Courses</td>
<td>3</td>
</tr>
<tr>
<td>2110xxx</td>
<td>General Elective Courses</td>
<td>3</td>
</tr>
<tr>
<td>2110811</td>
<td>Thesis</td>
<td>3</td>
</tr>
<tr>
<td>2110632</td>
<td>Advanced Topics in Operating Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110634</td>
<td>Software Design and Development</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110636</td>
<td>Performance Analysis and Evaluation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110637</td>
<td>Large-Scale Information Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110638</td>
<td>Object-Oriented Technology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110639</td>
<td>Computer System Security</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110640</td>
<td>Information Security</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110642</td>
<td>Object-Oriented Software Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110644</td>
<td>Formal Software Specification</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110645</td>
<td>Software Engineering Methodology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110646</td>
<td>User Interface Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110651</td>
<td>Digital Image Processing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110654</td>
<td>Artificial Intelligence</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110657</td>
<td>Computer Simulation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110661</td>
<td>Computer Network</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110663</td>
<td>Worldwide Network Infrastructure</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110664</td>
<td>Network Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110665</td>
<td>Computer Communication System and Standards</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110671</td>
<td>Database Management Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110672</td>
<td>Data Modeling Techniques</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110673</td>
<td>Information Storage and Retrieval</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110674</td>
<td>Information Technology Center Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110678</td>
<td>Mobile Computing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110681</td>
<td>Computer Algorithm</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110682</td>
<td>Embedded and Real-time Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110685</td>
<td>Computer Application in Enterprises</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110686</td>
<td>Enterprise Computing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110694</td>
<td>Directed Studies in Computer Science</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110696</td>
<td>Advanced Topics in Computer Application</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110697</td>
<td>Special Topics in Computer Science I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110698</td>
<td>Special Topics in Computer Science II</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110699</td>
<td>Theory of Computation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110712</td>
<td>Analysis of Algorithms</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110713</td>
<td>Optimization Methods</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110714</td>
<td>Digital Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110721</td>
<td>Software Metrics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110722</td>
<td>Software Project Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110723</td>
<td>Advanced Software Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110724</td>
<td>Software Testing and Quality Assurance</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110730</td>
<td>Software Quality Process and Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110731</td>
<td>Distributed Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110732</td>
<td>Parallel Computing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110741</td>
<td>Robotics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110742</td>
<td>Evolutionary Computation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110743</td>
<td>Machine Learning</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110744</td>
<td>Machine Vision</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110745</td>
<td>Cryptography</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110746</td>
<td>Big Data Analytics</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

---

**NAME OF THE DEGREE**

: Master of Engineering

**ADMISSION**

The applicant must hold a Bachelor’s Degree in Computer Engineering for plan A(1) or a Bachelor’s Degree in any Engineering discipline for plan A(2), meet the Graduate School requirements, and also must pass the Interview by the Computer Engineering Department.

**DEGREE REQUIREMENTS**

Plan A(1) program consists of three non-credit required courses and 36 credits of thesis. Plan A(2) program consists of 3 non-credit required courses, 12 credits of elective courses, and 24 credits of thesis.
SOFTWARE ENGINEERING

NAME OF THE DEGREE

: Master of Science
: M.Sc.

ADMISSION

The program has 2 plans.

Plan A(2) is the plan with thesis. The applicant must
1. Hold a Bachelor's degree in Engineering, Statistics, Science, or equivalent.
2. Have other qualifications as announced each year by Graduate School of Chulalongkorn University (if any), or have other qualifications approved by the Software Engineering Program Committee.

Plan B is the plan with no thesis, but students must do the master project and pass the comprehensive exam. The applicant must
1. Hold a Bachelor's degree in one of these fields.
   - Engineering
   - Statistics
   - Science
   - Industrial Education with one of these sub-fields
     - Education Technology and Communication
     - Computer and Information Technology
     - Computer Technology or Electronics and Computer
   - Business Administration with one of these sub-fields
     - Business Computer
     - Business Information Technology
     - Computer Information or Computer Information Systems - Software Development
   - or hold other Bachelor's degree but have at least 1 year experience working in Information Technology or Computer.
2. Have other qualifications as announced each year by Graduate School of Chulalongkorn University (if any), or have other qualifications approved by the Software Engineering Program Committee.

DEGREE REQUIREMENTS

Both Plan A(2) and Plan B require the total of 36 credits.

Plan A(2)

1. Non-credit Courses (2 courses)
2. Required Courses 12 credits
3. Electives 12 credits
4. Thesis 12 credits

Plan B
1. Non-credit Courses (2 courses)
2. Required Courses 18 credits
3. Electives 12 credits
4. Master Project 6 credits
5. Comprehensive Exam

COURSE REQUIREMENTS

Plan A(2)
1) Non-credit Courses

2110606 Research Methods in Computer Engineering 3(3-0-9)
2110701 Seminar in Computer Engineering I 1(0-3-1)

Remark: Non-credit courses will be evaluated with S/U.

2) Required Courses

2110623 Software Requirements Engineering 3(3-0-9)
2110634 Software Design and Development 3(3-0-9)
2110721 Software Metrics 3(3-0-9)
2110724 Software Testing and Quality Assurance 3(3-0-9)
2110725 Software Engineering Process and Improvement 3(3-0-9)

3) Electives

Choose 4 courses. Electives will be divided in 2 groups: Software Engineering Electives and General Electives. Student must study at least 2 courses (6 credits) of Software Engineering Electives.

---Software Engineering Electives

2110502 Formal Verification 3(3-0-9)
2110521 Software Architectures 3(3-0-9)
2110523 Enterprise Application Architecture 3(3-0-9)
2110644 Formal Software Specification 3(3-0-9)
2110645 Software Engineering Methodology 3(3-0-9)
2110646 User Interface Design 3(3-0-9)
2110722 Software Project Management 3(3-0-9)
2110723 Advanced Software Engineering Development 3(3-0-9)
2110725 Software Engineering Process and Improvement 3(3-0-9)
2110726 Software Configuration Management 3(3-0-9)
2110727 Software Evolution and Maintenance 3(3-0-9)
2110728 Special Topics in Software Engineering I 3(3-0-9)
2110729 Special Topics in Software Engineering II 3(3-0-9)
2110730 Software Quality Process and Management 3(3-0-9)
2110791 Advanced Topics in Software Engineering 3(3-0-9)

---General Electives

Plan B
1) Non-credit Courses

2110606 Research Methods in Computer Engineering 3(3-0-9)
2110701 Seminar in Computer Engineering I 1(0-3-1)

Remark: Non-credit courses will be evaluated with S/U.

2) Required Courses

2110623 Software Requirements Engineering 3(3-0-9)
2110634 Software Design and Development 3(3-0-9)
2110721 Software Metrics 3(3-0-9)
2110722 Software Project Management 3(3-0-9)
2110724 Software Testing and Quality Assurance 3(3-0-9)
2110725 Software Engineering Process and Improvement 3(3-0-9)

3) Electives

Choose 4 courses. Electives will be divided in 2 groups: Software Engineering Electives and General Electives. Student must study at least 2 courses (6 credits) of Software Engineering Electives.

---Software Engineering Electives

2110502 Formal Verification 3(3-0-9)
2110521 Software Architectures 3(3-0-9)
2110523 Enterprise Application Architecture 3(3-0-9)
2110644 Formal Software Specification 3(3-0-9)
2110645 Software Engineering Methodology 3(3-0-9)
2110646 User Interface Design 3(3-0-9)
2110723 Advanced Software Engineering Development 3(3-0-9)
2110726 Software Configuration Management 3(3-0-9)
2110727 Software Evolution and Maintenance 3(3-0-9)
2110728 Special Topics in Software Engineering I 3(3-0-9)
2110729 Special Topics in Software Engineering II 3(3-0-9)
2110730 Software Quality Process and Management 3(3-0-9)
2110791 Advanced Topics in Software Engineering 3(3-0-9)

---General Electives

Student can enroll in any courses open for graduate students. Course must be instructed either by the Department of Computer Engineering or any department in Chulalongkorn University (approval by...
the Software Engineering Program Committee is required).

4) Master Project

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110797</td>
<td>Pre-Master Project in Software Engineering</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td>2110798</td>
<td>Master Project in Software Engineering</td>
<td>3(0-0-12)</td>
</tr>
</tbody>
</table>

5) Comprehensive Exam

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110896</td>
<td>Comprehensive Examination</td>
<td></td>
</tr>
</tbody>
</table>

Remark: Comprehensive examination will be evaluated with S/U. The student can enroll in this course since the semester that all courses in the program are registered.

STUDY PROGRAMS

Plan A(2)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Semester</td>
<td>2110623</td>
<td>Software Requirement Eng.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2110701</td>
<td>Seminar in Computer Engineering 1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2110724</td>
<td>Software Testing and Quality Assurance</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2110xxx</td>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>Second Semester</td>
<td>2110634</td>
<td>Software Design and Development</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2110721</td>
<td>Software Metrics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2110xxx</td>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>Third Semester</td>
<td>2110606</td>
<td>Research Methods in Computer Engineering</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2110xxx</td>
<td>Electives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2110797</td>
<td>Pre-Master Project in Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Fourth Semester</td>
<td>2110xxx</td>
<td>Electives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2110xxx</td>
<td>Master Project in Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2110896</td>
<td>Comprehensive Exam</td>
<td>9</td>
</tr>
</tbody>
</table>

PH.D. DEGREE PROGRAM

NAME OF THE DEGREE

: Doctor of Philosophy

: Ph.D.

ADMISSION

The applicant must hold one of the following qualification:

A) Bachelor’s Degree (Hons-2nd level or equivalent) or grade point not less than 3.25.
B) Master’s Degree of Engineering or Science in Computer, Physics or Mathematics.

In addition he/she has to meet the Graduate School requirement.

DEGREE REQUIREMENTS

The program for Bachelor’s Degree Holder, plan 2(1), consists of 12 credits of required courses including 4 non - credit seminars , 12 credits of elective courses, and 48 credits of thesis , for a total of 72 credits.

The program for Master’s Degree Holder, plan 2(2), consists of 4 non - credits seminars, 12 credits of elective courses, and 48 credits of Dissertation, for a total of 60 credits.

The student who has fulfilled the requirement of the program and of the Graduate School will be awarded the Degree of Doctor of Philosophy in Computer Engineering.

COURSE REQUIREMENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110711</td>
<td>Theory of Computation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110712</td>
<td>Analysis of Algorithms</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110713</td>
<td>Optimization Methods</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110714</td>
<td>Digital Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110716</td>
<td>Seminar I</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>2110717</td>
<td>Seminar II</td>
<td>1(1-0-3)</td>
</tr>
<tr>
<td>2110718</td>
<td>Seminar III</td>
<td>1(1-0-3)</td>
</tr>
</tbody>
</table>
2110719 Seminar IV  
2) Elective Courses 12 credits
2110694 Directed Studies in Computer Science 3(3-0-9)
2110697 Special Topics in Computer Science I 3(3-0-9)
2110698 Special Topics in Computer Science II 3(3-0-9)
2110721 Software Metrics 3(3-0-9)
2110722 Software Project Management 3(3-0-9)
2110723 Advanced Software Engineering Development 3(3-0-9)
2110724 Software Testing and Quality Assurance 3(3-0-9)
2110730 Software Quality Process and Management 3(3-0-9)
2110731 Distributed Systems 3(3-0-9)
2110732 Parallel Computing 3(3-0-9)
2110741 Robotics 3(3-0-9)
2110742 Evolutionary Computation 3(3-0-9)
2110743 Machine Learning 3(3-0-9)
2110744 Machine Vision 3(3-0-9)
2110746 Big Data Analytics 3(3-0-9)
2110747 Social Network Analysis 3(3-0-9)
2110751 Computer Aided Design in Digital Systems 3(3-0-9)
2110752 Design for Testability 3(3-0-9)
2110753 Asynchronous Design 3(3-0-9)
2110771 Advanced Database Design 3(3-0-9)
2110772 Multi-Dimensional Database Systems 3(3-0-9)
2110773 Data Mining 3(3-0-9)
2110791 Advanced Topics in Software Engineering 3(3-0-9)
2110792 Advanced Topics in Artificial Intelligence 3(3-0-9)
2110793 Advanced Topics in Digital Systems 3(3-0-9)
2110794 Advanced Topics in Database Systems 3(3-0-9)
2110795 Advanced Topics in Computer Network 3(3-0-9)
1) Dissertation 48 credits
2110828 Dissertation 0(0-0-0)
2110894 Doctoral Dissertation Seminar 0(0-0-0)
2110897 Qualifying Examination 0(0-0-0)

STUDY PROGRAMS

Plan 2 (1)

First Semester
2110716 Seminar I -
2110 xxx Required courses 12
2110717 Seminar II -
2110 xxx Electives 9
2110828 Thesis 3

Second Semester
2110718 Seminar III -
2110 xxx Electives 3
2110828 Thesis 9

Third Semester

Fourth Semester
2110719 Seminar IV -
2110828 Thesis 12

Fifth Semester
2110828 Thesis 12

Sixth Semester
2110828 Thesis 12

Plan 2 (2)

First Semester
2110716 Seminar I -
2110 xxx Electives 9

Second Semester
2110717 Seminar II -
2110 xxx Electives 3
2110828 Thesis 6

Third Semester
2110718 Seminar III -
2110828 Thesis 9

Fourth Semester
2110719 Seminar IV -
2110828 Thesis 9

Fifth Semester
2110828 Thesis 12

Sixth Semester
2110828 Thesis 12

COURSE DESCRIPTIONS IN COMPUTER ENGINEERING (B.ENG.)

2110101 Computer Programming 3(3-0-6)
Computer concepts, computer system components, hardware and software interaction, electronic information and data processing concepts; programming: data types, operators, statements, control structures; programming tools; programming styles and conventions; debugging; program design and development with applications to engineering problems using a high level language.

2110191 Innovative Thinking 3(3-0-6)
Condition: Free Elective
Definition of innovative thinking; Types of innovation; Innovator Role Model; Innovative thinking process; Creative mistakes; Innovation development.
2110200  Discrete Structures  3(3-0-6)
Sets, relations, functions, theorem and proof; combinatorics; counting, principle of inclusion exclusion, recurrent relations, generating functions; graphs and trees; introduction to number theory.

2110201  Computer Engineering Mathematics  3(3-0-6)
Linear algebra, vector, matrix, inverse matrix, solution to system of linear equations, factorization, vector space, subspace, rank, dimension, basis, orthogonality, projection, determinant, determinant computation, eigenvalue, eigenvector, singular value decomposition, computer programming for linear algebra.

2110211  Introduction to Data Structures  3(3-0-6)
Condition : Prerequisite 2110101
Linear allocation: array, stack, queue, dequesues; linked allocation: singly linked lists, and doubly linked lists; string processing and pattern matching; trees: binary tree, traversal, representation, B-tree and AVL-tree; internal searching and sorting: binary, radixes, shell, quicksort and merge sort; heap storage, hash coding and table handling.

2110213  Information Systems Organization  3(3-0-6)
Hardware systems: personal computer, network, Internet, internet protocol, domain name, cable, hub, switch, router, modem, Internet server, corporate server, real-time server, embedded system; application systems: multi-tier system, web server, markup language, application server, database server, query language, multi-vendor database access interface; transaction systems: process abstraction, inter-process communication, synchronization, deadlock, transaction atomicity, checkpoint and rollback, concurrency control.

2110215  Programming Methodology I  3(2-3-4)
Condition : Prerequisite 2110101
Programming methodology: object-oriented programming, event-driven programming, concurrent programming; error and exception handling; application programming interface (API); programming tools; programming styles and practice.

2110221  Computer Engineering Essentials 3(3-0-6)
Overview of computer engineering, information system and information technology; hardware and software; logic circuit and processor; algorithm and program; database; computer network and internet, artificial intelligence and robot; embedded system; data center; security; computer ethics; intellectual property; computer industry.

2110250  Computer Organization  3(3-0-6)
Computer systems organization, hardware components in a computer system, basic computer principles, instruction unit, instruction execution cycle, instruction set architecture, assembly language principles.

2110251  Digital Computer Logic  3(3-0-6)
Number systems; logic gates and logic expressions; Boolean algebra: Karnaugh map and tabulation method; combination logic circuit and applications: adder, subtractor, multiple outputs circuit, decoder, encoder, multiplexer and demultiplexer; gate implementation: tristate; speed and delay in logic circuits; sequential circuits and design; flip-flop, and counter, register.

2110253  Computer Electronics and Interfacing  3(3-0-6)
Principles of design: design of DC and AC circuits using diodes, bipolar junction transistors, field-effect transistors and use of transistors in digital circuits, physical design of simple gates, flip-flops, and memory circuits, interfacing logic families and standard buses.

2110254  Digital Design and Verification 3(3-0-6)
Condition : Prerequisite 2110251 or 2110254
Processor design at instruction set level and register transfer level; hardware description language (HDL); functional verification of HDL models; microprocessors; control unit; memory unit; adders; I/O device interfaces.

2110263  Digital Computer Logic Laboratory I  1(0-2-1)
Hands-on experience in using digital electronics by way of logic gates and integrated circuits; practical construction, testing, and implementation of combinational and sequential logic circuits.

2110265  Digital Design and Verification Laboratory I  1(0-2-1)
Condition : Prerequisite 2110251
Writing hardware description language (HDL) to implement digital designs, adder, arithmetic logic unit, control unit, memory modules, system integration, writing test benches to verify the design.

2110271  Programming Tools  3(2-2-5)
Source-code tools; executable-code tools; user-interface tools; code management tools; deployment tools; documentation tools; testing tools; integrated development environments.

2110291  Individual Study in Computer Engineering I  1(0-0-3)
Independent study and investigation, theoretically and practically, in computer engineering topics according to each student's interest under the supervision and guidance of the instructor.

2110292  Individual Study in Computer Engineering II  1(0-0-3)
Independent study and investigation, theoretically and practically, in computer engineering topics according to each student's interest under the supervision and guidance of the instructor.

2110313  Operating Systems and System Programming  3(3-0-6)
Condition : Prerequisite 2110211, 2110213 or 2110221
OS services: functions, organisation, process, concurrent programming, synchronisation, critical section, semaphore, monitor, deadlock, processor management, memory management, device management, file management, resource protection.
and networking; service interfaces: system call, application programming interface (API); service development; tools and utilities: system management tools, development tools, and operation tools.

2110316 Programming Languages Principles 3(3-0-6)  
Condition: Prerequisite 2110211  
Language definition: grammar, syntax, and semantics; conventional paradigm: data type, control structure, block structure, and recursion; interpretive languages; runtime environment and virtual computer; unconventional paradigm: functional, logic, and markup languages; object-orientation and software components: class, instance processing systems; inheritance, method binding, polymorphism, framework, and component-based programming; basic compiling techniques: scanner, parser, code generation, and tools.

2110317 Fundamental of Distributed Systems 3(3-0-6)  
Condition: Prerequisite 2110313  
Interprocess communication and remote procedure call; Logical clock and ordering; centralised transaction and concurrency control; distributed transaction; two-phase commit protocol; distributed concurrency control; deadlock and distributed deadlock; load distribution; fault tolerance; fault model, recovery; replication; view and vector clock; distributed transaction under failure conditions; security; distributed services.

2110318 Distributed Systems Essentials 1(1-0-2)  
Condition: Prerequisite 2110313 or Consent of faculty  
Characteristics and system models: client/server, proxy, peer-to-peer; message passing: marshaling, request-reply protocol; distributed objects and remote invocation; time, clock, and ordering; group communication: basic, reliable, and ordered multicast; transaction and concurrency control; distributed transaction: two-phase commit, recovery; advanced topics: consensus, replication, Web services.

2110327 Algorithm Design 3(3-0-6)  
Condition: Prerequisite 2110200, 2110211  
Algorithm design techniques: divide and conquer, dynamic programming, greedy algorithms, state-space search; asymptotic analysis of algorithms; introduction to computational complexity; algorithm designs for NP-hard problems; backtracking, branch and bound, approximation algorithms.

2110332 System Analysis and Design 3(3-0-6)  
Condition: Prerequisite 2110211  
Data processing systems and systems life cycle; analysis methodology: tools, cost analysis, problem definition, proposal and feasibility study; design methodology: tools, database approach, systems design, file and form design, program design, documentation; implementation methodology: coding, testing and software maintenance.

2110333 Event-Driven Programming 3(2-2-5)  
Condition: Prerequisite 2110101 or Consent of Faculty  
Events, event queues, event focus, event handlers, event loop, callbacks, delegation; GUI and distributed environments; event-driven I/Os; windowing system; GUI programming; event-driven program interactions.

2110334 Network Programming 3(2-2-5)  
Condition: Prerequisite 2110210 and 2110213 Consent of Faculty  
Networking concepts; internet standards; sockets programming; web programming; client-server programming.

2110352 Computer System Architectures 3(3-0-6)  
Condition: Prerequisite 2110250 or 2110253  
Performance metrics; central processing unit; hardwired and microprogram of control units; instruction level parallelism: pipeline, superscalar; memory system: cache memory, virtual memory, disk array; development and future of architecture.

2110355 Formal Languages and Automata Theory 3(3-0-6)  
Studies concepts of grammars, automata, languages, computability and complexity; the relationship between automata and various classes of languages; Turing machine and equivalent models of computation, the Chomsky hierarchy, context-free grammar, push-down automata, etc.; pumping lemmas and variants, closure properties and decision properties; parsing algorithms.

2110361 Hardware Synthesis Laboratory 2(0-4-2)  
Condition: Prerequisite 2110264  
Synthesis of digital systems on FPGA technology; use of hardware description language to model digital systems and implement the design on a programmable device, design decomposition, testing and debugging the design.

2110363 Hardware Synthesis Laboratory 1(0-2-1)  
Condition: Prerequisite 2110265  
Synthesis of digital systems on FPGA technology; use of hardware description language to model digital systems, testing and debugging the design.

2110388 Database Programming 4(2-4-6)  
Condition: Prerequisite 2110210 and 2110213, Consent of Faculty  
Structured query language (SQL), database connectivities; database programming tools and components; concurrency control; transactions processing; programming for database-backed site.

2110391 Individual Study in Computer Engineering III 1(0-0-3)  
Independent study and investigation, theoretically and practically; in computer engineering topics according to each student’s interest under the supervision and guidance of the instructor.

2110392 Individual Study in Computer Engineering IV 1(0-0-3)  
Independent study and investigation, theoretically and practically, in computer engineering topics according to each student’s interest under the supervision and guidance of the instructor.

2110398 Software Development Pre - Project 1(0-2-1)  
Study and specifying topic, scope, methodologies of problem solving and expected benefit of various areas of software development project under project advisor’s supervision. Project proposal is examined by a
department committee. Written progress reports must be submitted and presented periodically.

2110399 Software Development Project 3(0-8-3)
Continuing of the approved project from Software Development Pre-Project course must be carried out under project advisor’s supervision. Written progress report must be submitted periodically. A written final report is required and an oral examination must be taken with a department project committee at the end of the project.

2110401 Computer Engineering Professional Ethics 3(3-0-6)
Ethical theory; privacy; intellectual properties: patents, copyrights; computer crimes; professional codes of ethics; social issues; case studies.

2110412 Parallel Computer Architecture 3(3-0-6)
Condition : Prerequisite 2110211
Parallel architectures; parallel computation models; parallel algorithms; parallel programming and languages.

2110413 Computer Security 3(3-0-6)
Computer security principle; symmetric key cryptography; public key cryptography; message digest; authentication: access control; enterprise security; network security.

2110414 Large Scale Computing Systems 3(3-0-6)
High-performance and large-scale computing infrastructure: cluster, peer-to-peer, Grid, Cloud; virtualization; software architecture and middleware; HPC applications and algorithms; HPC software development.

2110420 Compiler Construction 3(3-0-6)
Grammar, syntax, and semantics; lexical analysis; parsing methods; symbol table construction; intermediate representation; code generation; basic and advanced code optimization techniques.

2110421 Theory of Programming Languages 3(3-0-6)
Data and control abstractions; binding; type checking; advanced control constructs, backtracking and nondeterminism; formal methods for program description, formal syntax and formal semantics; methods for proving programs correctness.

2110422 Database Management Systems Design 3(3-0-6)
Condition : Prerequisite 2110201, 2110211
Database concepts: goals, data independence, relationships, logical and physical organizations, schema and subschema; data models: hierarchical, network, and relational models; data normalization: first, second, and third normal forms of data relations; canonical schema, data independence; data description languages; query facilities: relational algebra, relational calculus, data structures for establishing relations, query functions, design and translation strategies; file organization, file security; data integrity and reliability.

2110423 Software Engineering 3(3-0-6)
Design tools and techniques: top-down design, modular design, software tools, debugging and test data; software reliability, theory and concepts, errors, faults and estimation, reliability models, availability models; management techniques, cost estimation, software maintenance.

2110424 Software Process Improvement 3(3-0-6)
Condition : Consent of Faculty
Software process improvement premise; software process modeling; foundation and infrastructure of software process improvement; approach for transitioning to process improvement program; quality assurance components in software project life cycle; software engineering process group; software process and product measurement.

2110428 Introduction to Data Mining 3(3-0-6)
Fundamental concepts of data mining; data mining methodologies, decision trees, classification, association, clustering; data mining algorithms.

2110429 Information Retrieval Systems 3(3-0-6)
Condition : Prerequisite 2110211
Information structures; dictionary systems; statistical systems; vector matching and searching strategies; input specifications and systems organization; output systems; evaluation; automatic question answering.

2110430 Time Series Mining and Knowledge Discovery 3(3-0-6)
Time series mining: classification, clustering (shape-based/model-based), association rules, summarization/visualization, anomaly detection, motif discovery; similarity measurement: dynamic time warping; distance measure; data preprocessing; time series indexing; time series representation and dimensionality reduction.

2110431 Introduction to Digital Imaging 3(3-0-6)
Overview of theory of digital image processing and analysis: definition of terms, basic principles of human visual perception, image representation, preprocessing, image enhancement, image segmentation, feature extraction and analysis, image compression; survey of applications.

2110432 Automatic Speech Recognition 3(3-0-6)
Condition : Consent of Faculty
Overview of speech and language technology; human speech production models; spectrogram; speech sounds in languages and spectrogram reading; speech representation; template matching using dynamic time warping; acoustic modeling; frame-based speech recognition using Hidden Markov models; language modeling; examples of other approaches to automatic speech recognition.

2110433 Computer Vision 3(3-0-6)
Image formation; feature detection; color, texture; region segmentation and representation; object recognition; dynamic vision; 3D vision; vision applications.

2110435 Introduction to Robotics 3(3-0-6)
An overview of robotics technology; introduction to the configuration space concept, rigid transformation and manipulator kinematics; sensing and control; robot programming; robot motion planning and application; robot manipulation.
2110441 Software Design and Development 3(3-0-6)
Design techniques: models of structured programming, code reading and correctness, stepwise refinement and reorganization, top-down design and development, structured design, strength, and coupling measures; organization and management: milestones and estimation, chief programmer teams, program libraries, walk through, and documentation; team project: organization, management and development of large scale software.

2110442 Object-Oriented Analysis and Programming 3(3-0-6)
Object-oriented design and object-oriented software construction; design and construct: classes, methods, messages, instances, inheritance, static and dynamic binding, replacement and refinement and polymorphism analyze: frameworks and design patterns, and object-oriented software engineering.

2110443 Human-Computer Interaction 3(3-0-6)
HCI design, implementation and evaluation; graphical user interface programming; prototyping tools and toolkits; window-based systems; usability engineering.

2110444 Introduction to Formal Verification 3(3-0-6)
Fundamental concepts of mathematical logic; formal specification language definition: syntax, semantics, formal specification language: Z, Object Z, CafeOBJ; mathematical models of software and hardware; formal verification methods.

2110445 Enterprise Information Systems 3(3-0-6)
Condition: Consent of Faculty
Enterprise information systems; information technology infrastructure and integration; impact of information systems on organizations; information technology and business strategies; e-business and e-commerce; ethical and social issues related to technology; technology decisions; business value of information systems.

2110451 Digital Computer Hardware Design 3(3-0-6)
The principles of design of modern digital computers; especially in the simple and advanced microprogrammed control unit; ALU design, carry look-ahead and multiplication and division algorithms.

2110455 Testing Digital Circuits 3(3-0-6)
Testing techniques for digital logic circuits; fault modelling; test generation; test evaluation; testability analysis; design for greater testability; automatic test equipment; IDDQ testing; writing simulation programs, current research issues on testing.

2110471 Computer Networks I 3(2-3-4)
Condition: Prerequisite 2110221

2110473 Fault Tolerant Computing 3(3-0-6)
Fault model; test generation of combinational and sequential circuits; Boolean difference, path sensitization and algorithm; digital simulation technique; design of self checking circuit; error detection and correction codes redundancy techniques; diagnosis of digital system and design of simplified testing.

2110475 VLSI Design 3(3-0-6)
Integrated circuit technology; design and implementation of very large scale integrated circuits including design methodology; design using stick diagram; the use of CAD tools including layout generators, simulators, and plot utilities; I/O pads; study of some digital subsystem, digital architecture and design styles; Fabrication processes; criterion for foudnries; case study of some custom design integrated circuits.

2110476 Artificial Intelligence I 3(3-0-6)
Philosophy of mind, knowledge and reasoning, agent-based systems, planning perception, robotics: sensing, navigation & control, introduction to evolutionary computation.

2110477 Artificial Intelligence II 3(3-0-6)
Definition of Artificial Intelligence problem solving by search, knowledge representation, natural language processing, Prolog programming, machine learning, neural networks.

2110478 Computer and Communication 3(3-0-6)
Introduction: computer and communication technology; Communication and network model: Shannon and Weaver model, ISO-OSI model, LAN, and Inter/Intranet; System component: modem, multiplexer, interface, and repeater/bridge/router/switch; Resource management and error control; Data security: natural disaster and vandalism.

2110479 Computer Graphics 3(3-0-6)
The fundamentals of computer imagery; modeling : curve, surface, geometric primitives 2D and 3D geometric transformations, rendering; clipping and windowing, scene, algorithms for visible surface determination, introduction to local and global shading models, color, and real-time rendering methods; presentation of projects in computer graphics engineering.

2110481 Wireless Computer Networks 3(3-0-6)
Condition: Prerequisite 2110478
Digital transmission; queueing theory, mobile IP internetworking, IPv6, DHCP, proxy service.

2110482 High Technology Entrepreneurship 3(3-0-6)
This is a course focused on the student participating in the building business plan for new venture that create or use a new technology to create significant new value.

2110490 Computer Engineering Pre-Project 1(0-2-1)
Determination of topics or problems; scope, methodologies of problem solving and expected benefit from various areas of computer engineering projects under the supervision of a project advisor; examination of project proposal; periodical writing of progress reports and report presentation.
2110491 Topics in Systems and Languages 3(3-0-6)  
Condition: Prerequisite 2110421  
Current interest and new developments in the areas of software systems, theory of programming languages and translations.

2110492 Topics in Operations Systems 3(3-0-6)  
Condition: Prerequisite 2110411  
Topics of current interest and new developments in the areas of operating systems, modeling, performance analysis, utility systems.

2110493 Topic in Database Management Systems 3(3-0-6)  
Condition: Prerequisite 2110422  
Topics of current interest and new developments in the areas of database management systems, information systems and data dictionary.

2110495 Advanced Topics in Computer Engineering I 3(3-0-6)  
Condition: Senior Standing or Consent of instructor  
Topics of current interest and new developments in various fields of computer engineering.

2110496 Advanced Topics in Computer Engineering II 3(3-0-6)  
Condition: Senior Standing or Consent of instructor  
Topics of current interest and new developments in various fields of computer engineering.

2110497 Special Problems in Computer Engineering I 3(2-3-4)  
Condition: Senior Standing or Consent of instructor  
A study of investigation of special problems assigned by the instructor with the consent of the head of department. The work must be completed within one semester. A written report, a copy of which is to be kept by the department, is required and an oral examination must be taken.

2110498 Special Problems in Computer Engineering II 3(2-3-4)  
Condition: Senior Standing or Consent of instructor  
A study of investigation of special problems assigned by the instructor with the consent of the head of department. The work must be completed within one semester. A written report, a copy of which is to be kept by the department, is required and an oral examination must be taken.

2110499 Computer Engineering Project 3(0-8-3)  
Condition: Prerequisite 2110490  
Continuing of approved project from course 2110490 must be carried out under project advisor's supervision. Written progress reports must be submitted periodically. A written final report is required and an oral examination must be taken with a department project committee at the end of project.

2110501 Automata Computability and Formal Languages 3(3-0-9)  
Finite states concepts: regular expressions, closure properties, sequential machines and finite state transducers, state minimization; formal grammars; chomsky hierarchy grammars, pushdown acceptors and linear bounded automata, closure properties and algorithms on grammars; computability and Turing machines as acceptor and transducer; universal machine, computable and noncomputable functions, and halting problem.

2110502 Formal Verification 3(3-0-9)  
Mathematical logic and temporal logic; formal models: identifying problem domain and building the formal models of concurrent system and/or asynchronous system; verification of the formal models: model checking; verification modeling language and tools: Petri Nets, signal transition graph, Promela and SPIN.

2110505 Distributed Systems 3(3-0-9)  
Definition; interprocess communication; logical clock; concurrency control; two-phase locking, optimistic, timestamp ordering; distributed transaction, atomic commit protocol; deadlock: detection, prevention, avoidance, distributed detection; scheduling; reliability; fault tolerance, replication, recovery; security; distributed services: name, file, distributed management; standards and cases.

2110511 Game Programming 3(3-0-9)  
Condition: Consent of Faculty  
Theory of game design; graphics programming; computer graphics model; data structure for game programming; online game.

2110512 Computer Animation 3(3-0-9)  
Condition: Consent of Faculty  
Techniques and algorithms in computer-generated animation; vector algebra; numerical techniques; 2D and 3D animation programming; motion specification: shape interpolation algorithms and models for rule-and constraint-based motion generations.

2110513 Assistive Technology 3(3-0-9)  
Background, issues, and research in assistive technology, application of IT in designing and developing software application; tools, or programs to the need of disabled or the elderly to increase their independence and improve their quality of life.

2110521 Software Architectures 3(3-0-9)  
Condition: Consent of Faculty  
Principles of software architectures; practical methods in software architectures using scenario-based analysis, heuristic, and formal approaches; architectural styles; architectural description language; software architectural analysis and design; software architectures specification tools; software architecture-based testing; use of software architectures in the software development process.

2110522 UNIX/Linux for Enterprise Environment 3(3-0-9)  
Historical perspectives; branches and distributions; main characteristics and components; subsystems and supports; advancements; server: performance considerations, monitoring, and tuning;
Research techniques and tools; Project and time translation lexical analysis, and parsing, and code center management.

Communications and computer networks; computer processing methods, computer development and simulation scientific computing and games.

Structures; software-simulated computer; language data, operation, control and program design; introduction to software engineering.

Languages and Compilation 3(3-0-9)
Language structures data, operation, control structures; software-simulated computer; language translation lexical analysis, and parsing, and code generation; other language methodologies list processing, logic programming, object-oriented programming.

2110523 Enterprise Application Architecture3(3-0-9)
Foundation concepts of enterprise architecture; analysis and design of enterprise application; UML profile specification, design quality metrics; patterns of enterprise application architecture: structure, constraints and limitation of the patterns; enterprise applications integration techniques and implementation: presentation, data, application level integration approach and their implementations; best practices and enterprise architecture modelling standards and tools.

2110541 Computer Systems Audit 3(3-0-9)
Design of information system; internal control and auditing of data; validity, reliability, security and protection.

2110579 Computer Graphics Systems 3(3-0-9)
Architectural aspects of modern GPUs, programming on GPU: high level languages for GPU programming. GPU applications for graphics and general purposes: geometry modelling, physical simulation scientific computing and games.

2110605 Computer Programs Structure 3(3-0-9)
High-level structured programming languages; data types and operations; control structures; subprograms; records, sets, pointers and dynamic memory allocations; recursive programming; non-numerical problem solving techniques; problem analysis and program design; introduction to software engineering.

2110606 Research Methods in Computer Engineering 3(3-0-9)
Research methods in Computer Engineering; Research techniques and tools; Project and time management; Technical paper writing; Oral presentation; Current research topics.

2110607 Research Methods in Computer Science 3(3-0-9)
Research methods in Computer Science; research techniques and tools in Computer Science; project and time management; academic writing; oral presentation; code of conduct for researchers; current Computer Science research topics.

2110611 Information Processing and Computer System 3(3-0-9)
Introduction to information processing concepts, processing methods, computer development and applications; classification and architecture; data communications and computer networks; computer center management.

2110612 System Programming 3(3-0-9)
Components of a programming system; evolution of operating systems; design of assembler, macro language, macro processor, loader schemes; types of loaders; design of loaders.

2110614 Programming Languages and Compilation 3(3-0-9)
Language structures data, operation, control structures; software-simulated computer; language translation lexical analysis, and parsing, and code generation; other language methodologies list processing, logic programming, object-oriented programming.

2110621 System Analysis and Design 3(3-0-9)
Basic analysis steps, determining system alternatives, determining system economics, defining logical system requirements, basic design tools and objectives; hardware and software: selection and evaluation; design and engineering of software; database development, program development, system implementation, post implementation analysis.

2110622 Data Management 3(3-0-9)
List structures: lists, stacks, queues; table and hash in tree structures: binary search trees, AVL trees, B-trees, heaps; searching and sorting: fundamental of file structures.

2110623 Software Requirements Engineering 3(3-0-9)
Methods, tools, notations, and validation techniques for the elicitation, analysis and specification of software requirements; investigating the project or applying approaches to software requirements engineering.

2110624 Software Engineering 3(3-0-9)
Fundamental areas of software engineering: life cycle, paradigms, metrics, and tools; management techniques; cost estimation; software maintenance methodologies; incremental programming: very high level languages.

2110629 File Management 3(3-0-9)
Introduction to data management, files, and applications; an overview of input/output system architecture; logical file organizations; mapping logical organization onto physical storage; operating systems; file system interface; higher level languages; data management facilities.

2110631 Operating System 3(3-0-9)
Evolution, types, goals, functions and organization: concepts of process; process synchronization; process management; memory management; device management; file management.

2110632 Advanced Topics in Operating Systems 3(3-0-9)
Condition: Consent of Faculty
Advanced and current topics in Operating Systems.

2110634 Software Design and Development 3(3-0-9)
Techniques of software design and development: project management, structured programming, verification and validation, security and privacy, and project documentation; students are required to apply these techniques to large software projects.

2110636 Performance Analysis and Evaluation 3(3-0-9)
Performance metrics; performance measurements; benchmarking; workload characterization; summarizing measured data; introduction to queuing theory; single queue analysis; introduction to simulation; analysis of simulation results.

2110637 Large-Scale Information Systems 3(3-0-9)
System framework; middleware; service-oriented architecture; large-scale services; scalable data services; cloud computing; cluster architecture and
system; management distributed algorithms; map-
reduce architecture; volunteer computing.

2110638 Object-Oriented Technology 3(3-0-9)
Object orientation concepts and software development; object-oriented programming language implementation; software development frameworks; design patterns; design heuristics; design flaws; aspect-oriented programming; case studies; current topics in object-oriented technology.

2110639 Computer System Security 3(3-0-9)
Security system planning and administration; access control; data encryption; computer crime protection; disaster recovery planning; security models; including Orange book, and RACF

2110640 Information Security 3(3-0-9)
Information security models: confidentiality; integrity; authentication software security; network security; privacy; security management security; related laws and regulations.

2110642 Object-Oriented Software Engineering 3(3-0-9)
An overview of object-oriented technology concepts on objects, classes, inheritance, polymorphism, and relationship between classes; software development process, software configuration management, software quality assurance, object-oriented project planning and management, object-oriented analysis and design methodologies, object-oriented programming and object-oriented software testing and maintenance, use of CASE tools.

2110644 Formal Software Specification 3(3-0-9)
Mathematical Logic: Set, Relation, Function, Predicate Calculus, Algebraic system; Formal software specification language: Z, CafeOBJ; Identifying problem domain; Design and software modeling; Formal software specification method; Consistency verification of formal specification and its proof; Utilization of formal software specification in software process.

2110645 Software Engineering Methodology 3(3-0-9)
Software engineering process concepts; context for personal software process; planning and measurement concepts; software size measurement; general size estimating methods; resource and schedule estimation; process measurement; design and code reviews; software quality management.

2110646 User Interface Design 3(3-0-9)
Foundations of user-interface; human-centered software evaluation; software development; graphic user-interface design; graphic user-interface programming; multimedia systems.

2110651 Digital Image Processing 3(3-0-9)
Visual perception, digitization and coding of images, converting pictures to discrete(digital) forms; image enhancement; image restoration including improving degraded low-contrast, blurred, or noisy pictures; image compression: data compression used in image processing; image segmentation referred to as first step in image analysis.

2110654 Artificial Intelligence 3(3-0-9)
Definitions and application of artificial intelligence; knowledge representation; Prolog programming; natural language processing; machine learning techniques.

2110657 Computer Simulation 3(3-0-9)
Monte Carlo simulation; discrete event simulation and implementation techniques, queueing theory; equilibrium and steady state; input/output analysis; random numbers; output measurement; simulation accuracy; trace and execution-driven simulation; computer system simulation; continuous system simulation; combining continuous and discrete-event simulation.

2110661 Computer Network 3(3-0-9)
Introduction to network and network components; transmission links and protocols; design and analysis of networks; WAN; IMP; topology; network protocols; flow control and routing techniques.

2110662 Communication and Computer Network 3(3-0-9)
Network components; transmission links and protocols; design and analysis of networks; WAN; IMP; topology; network protocols; flow control and routing techniques.

2110663 Worldwide Network Infrastructure 3(3-0-9)
Background and history of networks and the internet; principles of network applications, protocols, services, socket programming; client/server and peer-to-peer paradigms; reliable data transfer; congestion control; the Internet Protocol (IP); routing in the internet; multimedia networking; wireless and mobile networks; large-scale and global networks; next generation networks.

2110664 Network Management 3(3-0-9)
Condition: Consent of Faculty
Information systems environment, business, and networks; network management data integrity, data security, network availability, network service, network adaptability.

2110665 Computer Communication System and Standards 3(3-0-9)
Introduction to computer and communication systems: on-line system, computer networks; distributed processing; communication model; OSI Standard; networks and standards: ISDN; X.25.

2110671 Database Management Systems 3(3-0-9)
Definition, objectives, and basic concepts information storage and retrieval system; data management system; data management functions and components of database management system; database interrogation, update; data model; security policy; major trade-offs in database management; introduction to object oriented database.

2110672 Data Modeling Techniques 3(3-0-9)
Data modelling concepts; conceptual objects used on simple and complex abstraction level: entity and
entity set, entity attributes, relationship and relationship
sets, relationship attributes, domain; normalization of
relation: INF, 2NF, 3NF, 4NF and 5NF; conceptual data
modeling; entity-relationship; data flow, logical and
physical model, transformation of theological model into
a physical model, and functional design; object-oriented
design concept.

2110673 Information Storage and
Retrieval 3(3-0-9)
Models and methods for storage and retrieval of
information; Topics include information retrieval
techniques, text analysis and automatic indexing,
document clustering; search techniques, retrieval
performance measurement, and search mechanisms for
retrieval from the World Wide Web.

2110674 Information Technology Center
Management 3(3-0-9)
Organization of the Information-Technology Center,
computer personnel; nature of the users; software
development tools; computer site operation; personnel
management; software tuning; hardware
evaluation; problems facing the director of the center.

2110678 Mobile Computing 3(3-0-9)
Principles, technologies and applications of mobile
computing and wireless networks; mobile and wireless
environment; protocols and architecture of mobile
computing; mobile device technology; mobile computing
security; application of distributed system in mobile
computing; mobile middleware; mobile information and
database access; mobile computing platforms; Web-
based mobile application development.

2110681 Computer Algorithm 3(3-0-9)
Analysis and design of efficient algorithms; divide
and conquer, recursion, dynamic programming and
greedy algorithm; selection of appropriate data
abstraction; analysis and correctness of algorithms;
algebraic algorithms; combination problems; proving
techniques for complexity analysis.

2110682 Embedded and Real-time
Systems 3(3-0-9)
Microcontroller architecture (RAM, ROM, CPU), I/O,
and peripheral devices; I/O interfacing, real-time
operating systems, real-time constraints, scheduling
theory, real-time system design methodology, case studies.

2110683 Concurrent Processing 3(3-0-9)
Principles of distributed, parallel and concurrent
systems, parallel architecture and concurrent computing
models; concepts of networks protocols for concurrent
processing, operating systems and hardware support
for distribution of codes, concurrent processing, parallel
processing and networking.

2110684 Information System
Architecture 3(3-0-9)
Hardware systems: personal computers, network
equipments, clusters and super servers, embedded
system; application systems: multi-tier systems,
markup language, query language; transaction
systems: process abstraction, inter-process communication,
synchronization, deadlock, transactions, concurrency
control; Web-based applications; global systems.

2110685 Computer Application in
Enterprises 3(3-0-9)
Business transaction; processes and organisation;
information and business decision; human resources
and knowledge management; data warehousing.

2110686 Enterprise Computing 3(3-0-9)
IT infrastructure; management; stability, efficiency
and responsiveness; theoretical and practical aspects of
systems management; discipline in data centres;
development, integration, and management of IT
processes; business-support functions; enterprise
services; information systems services.

2110694 Directed Studies in Computer
Science 3(3-0-9)
Study of current interest and new developments in
various fields of computer science.

2110696 Advanced Topics in Computer
Application 3(3-0-9)
Current advanced topics and technologies in
computer applications.

2110697 Special Topics in Computer
Science I 3(3-0-9)
Current special topics and new technologies in
computer science.

2110698 Special Topics in Computer
Science II 3(3-0-9)
Current special topics and new technologies in
computer science.

2110701 Seminar in Computer
Engineering I 1(0-3-1)
Seminar in Computer Engineering about the thesis
and assignments.

2110702 Seminar in Computer
Engineering II 1(0-3-1)
Seminar in Computer Engineering about the thesis
and assignments.

2110711 Theory of Computation 3(3-0-9)
Computable functions: decidable predicates and
solvable problems; computational complexity; NP-
complete problems; automata theory; formal language;
λ calculus.

2110712 Analysis of Algorithms 3(3-0-9)
Algorithm complexity and problem complexity;
discrete mathematics: real analysis, and combinatorics;
algorithms and data structures; average-case worst-
case and amortized analysis.

2110713 Optimization Methods 3(3-0-9)
Dynamic optimization; mathematical programming;
least square methods; gradient methods; Newton's
method; linear programming; nonlinear programming;
discrete optimizations.

2110714 Digital Systems 3(3-0-9)
Digital system architecture; logic elements,
processor, compilers, operating systems; digital
abstraction, synthesis of digital systems; performance measures; interpretation; micro architecture; memory architecture; processes; multiplexing; synchronization; interrupts; real time systems.

2110716 Seminar I 1(1-0-3) Seminar in the assigned topics on current experiment and / or research on computer engineering.

2110717 Seminar II 1(1-0-3) Seminar on current experiment and / or research on computer engineering concerning theses.

2110718 Seminar III 1(1-0-3) Seminar on current experiment and / or research on computer engineering concerning theses.

2110719 Seminar IV 1(1-0-3) Seminar on current experiment and / or research on computer engineering concerning theses.

2110721 Software Metrics 3(3-0-9) Theoretical foundations of software metrics; data collection; experimental design and analysis; software metric validation; measuring the software development and maintenance process; measuring software systems; support for metrics; statistical tools; applications of software measurement.

2110722 Software Project Management 3(3-0-9) Concepts of software product and process quality; roles of Total Quality Management (TQM); use of metrics, feasibility studies; cost and effort estimates; discussion of project planning and scheduling; the Capability Maturity Model; basis tenets and application of process validation.

2110723 Advanced Software Engineering Development 3(3-0-9) Software development process improvement; a series of individual programming and process projects; project planning measurement size estimation task scheduling and defect clarification.

2110724 Software Testing and Quality Assurance 3(3-0-9) Technical and management views of software testing and SQA; quality concepts; black and white box testing techniques; test coverage; levels of testing; the formation of a testing organization; testing-in-the-large; documentation for testing; inspections and walkthroughs.

2110725 Software Engineering Process and Improvement 3(3-0-9) Condition : Consent of Faculty Process definition; software engineering process model; process implementation and change; process quality assessment; process and product measurement; software engineering process standards such as IEEE and ISO Standards.

2110726 Software Configuration Management 3(3-0-9) Condition : Consent of Faculty Software configuration management (SCM) process; SCM planning; configuration management plan; SCM measures; software configuration identification; software change request process; software configuration status reporting; software configuration auditing; software release management and delivery.

2110727 Software Evolution and Maintenance 3(3-0-9) Condition : Consent of Faculty Basic knowledge on software evolution; software comprehension and software maintenance; definition of software evolution and maintenance; laws of software evolution; maintenance categories; maintenance process and process models; maintenance metrics and testing; impact analysis; software rejuvenation; software maintainability.

2110728 Special Topics in Software Engineering I 3(3-0-9) Condition : Consent of Faculty Current advanced topics and new technologies in software engineering.

2110729 Special Topics in Software Engineering II 3(3-0-9) Condition : Consent of Faculty Current advanced topics and new technologies in software engineering.

2110730 Software Quality and Process Management 3(3-0-9) Software quality basics; quality tools; software life cycle processes and process assets establishment; process management premise; process improvement models; improvement paradigms; quality management in process improvement context; configuration management; measurement information model.

2110731 Distributed Systems 3(3-0-9) Characterization and models of distributed systems; remote communication between system components; distributed applications; transactional applications; concurrency control of transactions; coordination between system components; global system state, time synchronization, access to shared resources, ordering of exchanged messages, agreement; fault tolerance; data replication; system recovery; current distributed systems and related issues; current research topics.

2110732 Parallel Computing 3(3-0-9) Condition : Consent of Faculty Architectures in parallel computing: shared/distributed memory, SIMD/MIMD architecture, interconnection networks; granularity of the machines, dataflow and systolic arrays computers; parallel processing: pipelining and parallelism, software for parallel computers.

2110741 Robotics 3(3-0-9) A broad view of robotics: robot control, sensors and interfacing, robot intelligence and programming; a broad spectrum of disciplines: mechanical, electrical, industrial, and computer engineering; current topics: planning, subsumption architecture, reactive systems.

2110742 Evolutionary Computation 3(3-0-9) Condition : Consent of Faculty Computer algorithms gleaned from the model of biology; algorithms inspired by organic evolution: genetic algorithms, classifier systems, genetic programming and evolution strategies; theoretical basis of these algorithms.

2110743 Machine Learning 3(3-0-9) Computing with logic; using logic set theory, number theory, algebras graph theory, automata;
language of first order logic, model theory and logic programming; problems of inductive inference in the framework of first-order predicate calculus and the probability calculus; introduction of computational learning theory.

2110744 Machine Vision 3(3-0-9)
Low-level vision and higher-level techniques: binary machine vision, morphology, neighborhood operators, labeling, texture, region segmentation, feature extraction, motion, image matching, model matching and knowledge-based vision systems.

2110745 Cryptography 3(3-0-9)
Introduction; symmetric encryption; block ciphers; pseudorandom permutations and pseudorandom functions; one-way functions; pseudorandom generators; hash functions; message authentication; authenticated encryption; asymmetric encryption; digital signatures; authenticated key exchange; interactive proofs and zero knowledge.

2110746 Big Data Analytics 3(3-0-9)
Introduction to Big Data Analytics, Hadoop, MapReduce, Spark, Programming Languages for Big Data Analytics, Search and Indexing, Recommendation System, Regression, Classification, Clustering and Feature Selection.

2110747 Social Network Analysis 3(3-0-9)
Social networks definition; types of social networks; Social Network Representation by Computational Models; Random Network Models; Network Centrality; Clusters in Social Networks; Small World Models; Data Retrieval from Social Networks Data Analysis and Classification from Social Networks; Application examples, such as an analysis for enterprises.

2110751 Computer Aided Design in Digital Systems 3(3-0-9)
Layout editing; schematic datacapture; simulation; design rule checking; automatic placement and routing; logic synthesis for combinational and sequential circuits; logic synthesis for architectural design; formal method for specifications.

2110752 Design for Testability 3(3-0-9)
Methods of design for testability; digital chip design for automatic testing equipment; ad hoc rules and structured method called scan design; fault analysis; controllability; observability; Scan-In Scan-Out (SISO) principle; Level Sensitive Scan Design (LSSD); built-in testing and other current techniques.

2110753 Asynchronous Design 3(3-0-9)
Design of digital systems not using global clock; limitation to synchronous processor; hazard analysis; Fundamental of asynchronous logic design; delay assumption; signaling protocol; asynchronous communication; Petri net; signal transition graph; completion detection; data and control paths implementations.

2110771 Advanced Database Design 3(3-0-9)
Fundamental of database design: data modeling, relational theory, query language, dependency theory; query optimization, computing with logic and universal relation.

2110772 Multi-Dimensional Database Systems 3(3-0-9)
Modern multi-dimensional database systems: spatial databases, temporal databases, multimedia databases; algorithms and data structures: R-tree, R* tree, quad-tree, spatial and temporal reasoning, disk clustering and declustering.

2110773 Data Mining 3(3-0-9)
Overview of data mining; process of knowledge discovery in large databases; applications of data mining to real-world problems; data preprocessing; data warehousing and OLAP; data mining methods: association, classification, clustering.

2110779 Advanced Topics in Computer Graphics 3(3-0-9)
In-depth study of selected current and interesting topics in computer graphics; hardware architecture, graphics systems, picture/image generation, graphics utilities, computational geometry and object modeling, methodology and techniques, three-dimensional graphics and realism and current applications.

2110781 Special Topics in Distributed Systems 3(3-0-9)
Current topics, related researches, and technology trends in distributed systems.

2110791 Advanced Topics in Software Engineering 3(3-0-9)
State of the art and current interest in software engineering.

2110792 Advanced Topics in Artificial Intelligence 3(3-0-9)
In-depth study of the current and interesting topics in artificial intelligence: problem solving, search, heuristic methods, machine learning, knowledge representation, natural language processing, computer vision, expert systems, theorem proving and current applications.

2110793 Advanced Topics in Digital Systems 3(3-0-9)
State of the art and current interest in digital systems.

2110794 Advanced Topics in Database Systems 3(3-0-9)
State of the art and current interest in database systems.

2110795 Advanced Topics in Computer Network 3(3-0-9)
State of the art and current interest in computer network.

2110797 Per-Master Project in Software Engineering 3(0-0-12)
Condition: Consent of Faculty
Integration of software engineering principles to prepare for software engineering project to get the output which in the project proposal.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2110798</td>
<td>Per-Master Project in Software</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td></td>
<td>Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Condition:</strong> Prerequisite 2110797</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integration of software engineering principles for software engineering project.</td>
<td></td>
</tr>
<tr>
<td>2110799</td>
<td>Master Project</td>
<td>6(0-0-24)</td>
</tr>
<tr>
<td>2110814</td>
<td>Thesis</td>
<td>12 Credits</td>
</tr>
<tr>
<td>2110816</td>
<td>Thesis</td>
<td>24 Credits</td>
</tr>
<tr>
<td>2110828</td>
<td>Dissertation</td>
<td>36 Credits</td>
</tr>
<tr>
<td>2110894</td>
<td>Doctoral Dissertation Seminar</td>
<td>48 Credits</td>
</tr>
<tr>
<td></td>
<td><strong>COURSES OFFERED TO STUDENTS OUTSIDE FACULTY OF ENGINEERING ONLY :</strong></td>
<td></td>
</tr>
<tr>
<td>2110102</td>
<td>Computer Programming - Fortran</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td></td>
<td>Computer systems, problem-solving procedures, algorithms, control structures, data types, vector, array and record, string manipulation. Coding, compiling and linking Fortran programs, constants and variables, operators and expressions, assignment statements, control statements, functions and subprograms, numeric and character applications.</td>
<td></td>
</tr>
<tr>
<td>2110103</td>
<td>Computer Programming-Pascal</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td></td>
<td>Computer systems, problem-solving procedures, algorithms, control structures, data types, vector, array and record, string manipulation. Pascal data types, variables, operators, expression, assignment statement, identifiers, program structure, input, output and control statements, procedures and functions compositied data types, files.</td>
<td></td>
</tr>
<tr>
<td>2110104</td>
<td>Computer Programming - C</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td></td>
<td>Computer system, problem-solving procedures, algorithms, control structures, data types, vector, array and record, string manipulation. C programming concepts, constants, variables, operators and expressions, statements, functions, array and pointer, structure, preprocessor.</td>
<td></td>
</tr>
<tr>
<td>2110172</td>
<td>Information Technology</td>
<td>3(2-2-5)</td>
</tr>
<tr>
<td></td>
<td>Application software packages: word processing, spreadsheet, presentation and database software; utility software; basic computer system management: backup and restore, software installation and uninstallation.</td>
<td></td>
</tr>
<tr>
<td>2110182</td>
<td>Introduction to computer and data Processing</td>
<td>2(2-0-4)</td>
</tr>
<tr>
<td></td>
<td>An overview of computer components, hardware and software interaction: basic data processing concepts, data transformation, method of data processing, data communication and programming concepts.</td>
<td></td>
</tr>
<tr>
<td>2110183</td>
<td>Introduction to Computer and Programming</td>
<td>3(3-0-6)</td>
</tr>
<tr>
<td></td>
<td>An overview of computer components, hardware and software interaction, EDP concepts: programming concepts and introduction to FORTRAN programming.</td>
<td></td>
</tr>
<tr>
<td>2110206</td>
<td>Assembly Language Programming</td>
<td>3(2-2-4)</td>
</tr>
<tr>
<td></td>
<td>This course will emphasized hand-on experience with Assembly language programming, loader, assembler and I/O devices.</td>
<td></td>
</tr>
<tr>
<td>2110201</td>
<td>Basic Programming</td>
<td>2(1-2-3)</td>
</tr>
<tr>
<td></td>
<td>Overview of elements of Basic Language, including BASIC statements: arithmetic, input and output, flow of control, subprogram; file processing; sequential access, and random access; application programs in various fields.</td>
<td></td>
</tr>
</tbody>
</table>

COURSES OFFERED TO STUDENTS OUTSIDE FACULTY OF ENGINEERING ONLY:

Integration of software engineering principles to prepare for software engineering project to get the output which in the project proposal.
The Department of Nuclear Technology (former name) or the Department of Nuclear Engineering was established in 1972 with the main purpose to train students planning a career in nuclear energy. The department offers programs leading to degrees in Doctor of Engineering (D.Eng.) in Nuclear Engineering, Master of Engineering (M.Eng.), Master of Science (M.Sc.) in Nuclear Technology and Bachelor of Engineering in Nuclear and Radiological Engineering. The curriculum is a multidisciplinary one and structured to cover diversified principles of nuclear technology ranging from fundamental science and mathematics to specialized engineering applications. Areas of specialization include nuclear power engineering, environmental and industrial applications of radiation, nuclear instrumentation, radioisotope production, radiation processing, radiation protection and nuclear materials. Most of the graduates entered the government institutions such as Office of Atoms for Peace (OAP), Thailand Institute of Nuclear Technology (TINT) public and private universities, Electricity Generating Authority of Thailand (EGAT), Department of Medical Sciences and various industrial and medical sectors.

At present, the use of nuclear energy in industry is increasing. Thus, there is a need for personnel in this specialized field for safety control and research & development leading to proper, efficient and safe use of radioisotopes including develop techniques and instruments for in-house use. Furthermore, preparations of personnel with solid background in nuclear engineering is crucial to the future decision to use nuclear energy in generating electricity, if necessary.

HEAD:
Sunchai Nilsuwankosit, Ph.D. (Wisconsin)

ASSOCIATE PROFESSORS:
Somyot Srisatit, M.Eng. (Chula)
Supitcha Chanyotha, Ph.D. (Arizona)
Sunchai Nilsuwankosit, Ph.D. (Wisconsin)
Doonyapong Wongsawaeng, Ph.D. (Berkeley)

ASSISTANT PROFESSORS:

LECTURERS:
Decho Thong-Aram, M.Eng. (Chula)
Chadet Yenchai, M.Sc. (Chula)
Phongphaeth Pengvanich, Ph.D. (Michigan)
Somboon Rassame Ph.D. (Purdue)
Phannee Saengkaew Ph.D. (Magdeburg)

NAME OF THE DEGREE:
: Doctor OF Philosophy
: Ph.D.

ADMISSION:
The applicant must submit an application under one of the following Admission Types.

Type 1.1: Ph.D. with Nuclear Background
The applicant must have a Master’s Degree in Nuclear Engineering or Nuclear Technology; meet the requirements of the Graduate School; have a minimum grade point average of 3.50 (out of 4); and have at least one good-quality international publication (conference or journal).

Type 1.2: Master’s continuing Ph.D with Nuclear Background
The applicant must have a Bachelor’s Degree in Nuclear Engineering from Chulalongkorn University; meet the requirements of the Graduate School; obtain at least an honor-level grade; and have at least one international publication (conference or journal).

Type 2.1: Ph.D. with Non-Nuclear Background
The applicant must have a Master’s Degree in Science or Engineering (non-nuclear); meet the requirements of the Graduate School; and have a minimum grade point average of 3.50.

Type 2.2: Master’s continuing Ph.D. with Non-Nuclear Background
The applicant must have a Master’s Degree in Engineering (non-nuclear) from Chulalongkorn University; meet the requirements of the Graduate School; and obtain at least an honor-level grade.

FIELDS OF STUDY:
The student must concentrate on one of the following fields of study:
- Nuclear Engineering
- Nuclear Security and Safeguards

DEGREE REQUIREMENTS:
The student entering under
- Admission Type 1.1 must pass 49 credits of dissertation course;
- Admission Type 1.2 must pass 74 credits of dissertation course;
- Admission Type 2.1 must pass 13 credits of the specific required courses (see COURSE
REQUIREMENTS) and pass 36 credits of dissertation course;
  Admission Type 2.2 must pass 13 credits of the specific required courses (see COURSE REQUIREMENTS), pass 9 credits of the specific elective courses, pass 3 credits of the general elective courses, and pass 49 credits of dissertation course.

Every student must also
  pass total of 6 credits of the general required courses (see COURSE REQUIREMENTS);
  pass a qualification examination;
  present an acceptable dissertation and pass an oral examination; publish at least 1 research paper related to the dissertation work in an international research journal;
  present the dissertation work in a national or international symposium; and meet publication requirements of the Graduate School.

COURSE REQUIREMENTS

Courses are divided into prerequisite, general required, specific required, general elective, specific elective, and thesis courses. Course requirements may vary depending on the field of study and the study plan.

0) Prerequisite Courses

Student with insufficient background knowledge of mathematics and/or nuclear engineering must take

2111600 Nuclear Engineering I * 3(3-0-9)
2111631 Applied Mathematics in Nuclear Technology * 3(3-0-9)

*Non-credit course. Student is given S (atisfied) /U (nsatisfied) instead of letter grades.

Student with Admission Type 1.1 or 1.2 with insufficient practical knowledge of experimental nuclear must take ONE of the following courses

2111603 Radiation Detection and Measurements Laboratory * 1(0-3-7)
2111604 Radiation Detectors and Nuclear Instruments Laboratory * 1(0-3-7)
2111659 Methods and Instrumentation for Nuclear Security and Safeguards Laboratory * 1(0-3-7)

*Non-credit course. Student is given S(atified)/U(nsatisfied) instead of letter grades.

Student may be exempted from doing so upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses:

All of the following courses are required for all Admission Types (1.1, 1.2, 2.1, and 2.2) for the total of 6 credits.

2111801 Seminar in Nuclear Engineering I * 2(2-0-6)
2111802 Seminar in Nuclear Engineering II * 2(2-0-6)
2111803 Seminar in Nuclear Engineering III * 2(2-0-6)

*Non-credit course. Student is given S(atified)/U(nsatisfied) instead of letter grades.

2) Specific Required Courses:

The following courses are required for Admission Types 2.1 and 2.2 for the total of 13 credits

2.1) Nuclear Engineering Field of Study: All of the following courses are required for the total of 13 credits.

2111604 Radiation Detectors and Nuclear Instruments Laboratory 1(0-3-7)
2111613 Radiation Safety and Shielding 3(3-0-9)
2111642 Nuclear Reactor Engineering 3(3-0-9)
2111643 Nuclear Power Engineering 3(3-0-9)
2111663 Radiation Detectors and Nuclear Instruments 3(3-0-9)

2.2) Nuclear Security and Safeguards Field of Study: All of the following courses are required for the total of 13 credits.

2111610 Nuclear Security 3(3-0-9)
2111651 Weapon Mass Destruction Nonproliferation 3(3-0-9)
2111658 Methods and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)
2111659 Methods and Instrumentation for Nuclear Security and Safeguards Laboratory 1(0-3-7)

and select from ONE of the following courses

2111642 Nuclear Reactor Engineering 3(3-0-9)
2111643 Nuclear Power Engineering 3(3-0-9)

3) Specific Elective Courses minimum 12 credits

3.1) Nuclear Engineering Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111603 Radiation Detection and Measurements Laboratory 1(0-3-7)
2111607 Environmental Radiation Measurements 3(3-0-9)
2111608 Practical Radiation Detection and Measurements 3(3-0-9)
2111609 Radiation Dosimetry 3(3-0-9)
2111616 Environmental Impact of Nuclear Power Plant 3(3-0-9)
2111621 Radiation Chemistry and Processing 3(3-0-9)
2111626 Industrial Radiation and Radioisotope Applications 3(2-3-7)
2111627 Material Analysis by Nuclear Techniques 3(3-0-9)
2111628 Radioisotope Production and Utilization 3(3-0-9)
2111629 Nuclear Chemical Engineering 3(3-0-9)
3.2) Nuclear Security and Safeguards Field of Study: Choose from the following courses; minimum of 9 credits are required.

- 2111652 Strategic Trade Control 3(3-0-9)
- 2111653 Nuclear Safeguards 3(3-0-9)
- 2111654 Nuclear Fuel Cycle and Environmental Impacts 3(3-0-9)
- 2111656 Physical Protection of Nuclear Materials and Facilities I 3(3-0-9)
- 2111657 Advanced Detection Technologies for Radioactive and Nuclear Materials 3(3-0-9)

4) General Elective Course

Both fields of study: Student must take 3 credits of the courses available in the Master of Engineering in Nuclear Engineering Program.

5) Dissertation

Number of required credits depends on student's admission type.

For Admission Types 1.1 and 2.2 : 49 credits of the following course

- 2111829 Dissertation 3(3-0-9)

For Admission Type 2.1 : 36 credits of the following course

- 2111826 Dissertation 3(3-0-9)

For Admission Type 1.2 : 74 credits of the following course

- 2111830 Dissertation 3(3-0-9)

(Student may register for this course multiple times. The number of credits for each registration depends upon the agreement between the student and his/her thesis advisor.)

NAME OF THE DEGREE

- Master of Engineering
- M.Eng.

ADMISSION

The applicant must have received a Bachelor's Degree in engineering or a Bachelor Degree of equivalent related field, must meet the requirements of the Graduate School and also must pass the entrance examination administered by the department.

DEGREE REQUIREMENTS

A student must pass a minimum of 15 credits of the required courses and another 12 credits from elective courses, a total of 27 credits.

A student must present an acceptable thesis and pass an oral examination in the field of Nuclear Technology for a quantity of 12 credits.

A student who has fulfilled the requirements of the program with a passing grade not less than 3.00 within a period of study of not less than 4 regular semesters and not more than 8 regular semesters will be awarded the Degree of Master of Engineering in Nuclear Technology.

FIELDS OF STUDY

The student must concentrate on one of the following fields of study:

- Nuclear Engineering
- Nuclear Security and Safeguards

STUDY PLAN

In each field of study, two study plans are possible:

- A-1 Full coursework plan
- A-2 Coursework and thesis plan

DEGREE REQUIREMENTS

For A-1 plan, the student must

- pass 2 credits of the required courses (see COURSE REQUIREMENTS);
- pass a minimum of 37 credits of the thesis course;
- present an acceptable thesis and pass an oral examination;
- meet publication requirements of the Graduate School; and
- obtain "satisfied (S)" grade in all courses within the allowed period of study (no less than 4 and no more than 8 regular semesters).
For A-2 plan, the student must

- pass a minimum of 27 credits of the required and the elective courses (see COURSE REQUIREMENTS);
- pass total of 12 credits of the thesis course;
- present an acceptable thesis and pass an oral examination;
- meet publication requirements of the Graduate School; and
- obtain a passing grade point average (GPA) of no less than 3.00 within the allowed period of study (no less than 4 and no more than 8 regular semesters).

COURSE REQUIREMENTS

Courses are divided into prerequisite, general required, specific required, general elective, specific elective, and thesis courses. Course requirements may vary depending on the field of study and the study plan.

A-1 Plan

0) Prerequisite Courses

Student with insufficient background knowledge of nuclear engineering must take

2111600 Nuclear Engineering I * 3(3-0-9)
*Non-credit course. Student is given S (satisfied) /U (unsatisfied) instead of letter grades.

Student may be exempted from the course upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses

Both fields of study: The following courses are required for the total of 2 credits.

2111701 Seminar in Nuclear Technology I 1(1-0-3)
2111702 Seminar in Nuclear Technology II 1(1-0-3)

2) Thesis Course

Both fields of study: 37 credits of the following course are required.

2111812 Thesis

Student may register for this course multiple times. The number of credits for each registration depends upon the agreement between the student and his/her thesis advisor. S(atified)/U(nsatisfied) is given instead of letter grades.)

A-2 Plan

0) Prerequisite Courses

Student with insufficient background knowledge of nuclear engineering must take

2111600 Nuclear Engineering I * 3(3-0-9)
*Non-credit course. Student is given S (atified) /U (nsatisfied) instead of letter grades.

Student may be exempted from the course upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses

Both fields of study: The following courses are required for the total of 2 credits.

2111701 Seminar in Nuclear Technology I 1(1-0-3)
2111702 Seminar in Nuclear Technology II 1(1-0-3)

2) Specific Required Courses

2.1) Nuclear Engineering Field of Study: All of the following courses are required for the total of 13 credits.

2111604 Radiation Detectors and Nuclear Instruments Laboratory 1(0-3-7)
2111613 Radiation Safety and Shielding 3(3-0-9)
2111642 Nuclear Reactor Engineering 3(3-0-9)
2111643 Nuclear Power Engineering 3(3-0-9)
2111663 Radiation Detectors and Nuclear Instruments 3(3-0-9)

2.2) Nuclear Security and Safeguards Field of Study: All of the following courses are required for the total of 13 credits.

2111610 Nuclear Security 3(3-0-9)
2111651 Weapon Mass Destruction Nonproliferation 3(3-0-9)
2111658 Methods and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)
2111659 Methods and Instrumentation for Nuclear Security and Safeguards Laboratory 1(0-3-7)

and select from ONE of the following courses

2111642 Nuclear Reactor Engineering 3(3-0-9)
2111643 Nuclear Power Engineering 3(3-0-9)

3) Specific Elective Courses minimum 12 credits

3.1) Nuclear Engineering Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111603 Radiation Detection and Measurements Laboratory 1(0-3-7)
2111607 Environmental Radiation Measurements 3(3-0-9)
2111608 Practical Radiation Detection and Measurements 3(3-0-9)
2111609 Radiation Dosimetry 3(3-0-9)
2111616 Environmental Impact of Nuclear Power Plant 3(3-0-9)
2111621 Radiation Chemistry and Processing 3(3-0-9)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2111626</td>
<td>Industrial Radiation and Radiisotope Applications</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2111627</td>
<td>Material Analysis by Nuclear Techniques</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111628</td>
<td>Radioisotope Production and Utilization</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111629</td>
<td>Nuclear Chemical Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111632</td>
<td>Numerical calculation for Nuclear Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111640</td>
<td>Nuclear Reactor Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111646</td>
<td>Radioactive Waste Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111647</td>
<td>Nuclear Fuels and Nuclear Fuel Cycles</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111648</td>
<td>Nuclear Power Plant Systems and Operation</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2111650</td>
<td>Introduction to Plasma Physics and Nuclear Fusion</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111655</td>
<td>Computer Application in Nuclear Technology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111660</td>
<td>Industrial Radiation Imaging</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111661</td>
<td>Experimental Nuclear Engineering</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2111662</td>
<td>Nuclear Electronics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111664</td>
<td>Digital Computer Interfacing for Nuclear Instrument</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111666</td>
<td>Radiation Machines</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111678</td>
<td>Nuclear Materials Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111693</td>
<td>Current Topics in Nuclear Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111687</td>
<td>Special Topics in Nuclear Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111684</td>
<td>Nuclear Power Plant Systems and Operation</td>
<td>3(2-3-7)</td>
</tr>
</tbody>
</table>

3.2) Nuclear Security and Safeguards Field of Study: Choose from the following courses; minimum of 9 credits are required.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2111652</td>
<td>Strategic Trade Control</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111653</td>
<td>Nuclear Safeguards</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111654</td>
<td>Nuclear Fuel Cycle and Environmental Impacts</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111656</td>
<td>Physical Protection of Nuclear Materials and Facilities I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2111657</td>
<td>Advanced Detection Technologies for Radioactive and Nuclear Materials</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

4) General Elective Course

Both fields of study: Student must take 3 credits of the courses available in the Master of Engineering in Nuclear Engineering Program.

5) Thesis

For A1 plan: 2111811 Thesis 12 credits
For A2 plan: 2111817 Thesis 37 credits

NAME OF DEGREE

- Master of Science
- M.Sc.

ADMISSION

The degree of Master of Science in Nuclear Technology is offered under the general regulations of the Graduate School. The program is intended to those students who plan a career of research related to nuclear technology. The courses cover basic nuclear science & technology, radiation protection, radiation measurement, application of radiation and radiisotope, nuclear materials and radiation chemistry & processing. From November 2013, the program also includes courses related to nuclear security and safeguards.

To be eligible for admission to the program an applicant must hold a Bachelor's degree in science, applied science, technology or engineering. Applicants are required to take the entrance examination administered by the department.

DEGREE REQUIREMENTS

The program consists of 27 credits of courses, 12 credits of required courses and 15 credits of electives. To graduate, a student must present an acceptable thesis and pass an oral examination for a quantity of 12 credits.

A student who has fulfilled the requirements of the program with the cumulative GPA of not less than 3.00 with a period of study not less than 4 regular semesters and not more than 8 regular semesters will be awarded a Degree of Master of Science in Nuclear Technology with concentration in Nuclear Technology or in Nuclear Security and Safeguards.

FIELDS OF STUDY

The student must concentrate on one of the following fields of study:
- Nuclear Technology
- Nuclear Security and Safeguards

COURSE REQUIREMENTS

Courses are divided into prerequisite, general required, specific required, general elective, specific elective, and thesis courses. Course requirements may vary depending on the field of study and the study plan.

0) Prerequisite Courses

Student with insufficient background knowledge of nuclear engineering must take

- 2111601* Introduction to Nuclear science and Technology 3(3-0-9)
- 2111631* Applied Mathematics in Nuclear Technology 3(3-0-9)

*Non-credit course. Student is given S (satisfied) /U (unsatisfied) instead of letter grades.

Student may be exempted from the course upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses

Both fields of study: The following courses are required for the total of 2 credits.

- 2111701 Seminar in Nuclear Technology I 1(1-0-3)
- 2111702 Seminar in Nuclear Technology II 1(1-0-3)
2) Specific Required Courses

2.1) Nuclear Technology Field of Study: All of the following courses are required for the total of 10 credits

2111603 Radiation Detection and Measurement Laboratory 1(0-3-7)
2111608 Practical Radiation Detection and Measurement 3(3-0-9)
2111612 Radiation Protection 3(3-0-9)
2111684 Current Topics in Nuclear Technology 3(3-0-9)

2.2) Nuclear Security and Safeguards Field of Study: All of the following courses are required for the total of 10 credits.

2111610 Nuclear Security 3(3-0-9)
2111651 Weapon Mass Destruction Nonproliferation 3(3-0-9)
2111658 Methods and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)
2111659 Methods and Instrumentation for Nuclear Security and Safeguards Laboratory 1(0-3-7)

3) Specific Elective Courses minimum 9 credits

3.1) Nuclear Technology Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111604 Radiation Detectors and Nuclear Instruments Laboratory 1(0-3-7)
2111607 Environmental Radiation Measurements 3(3-0-9)
2111609 Radiation Dosimetry 3(3-0-9)
2111613 Radiation Safety and Shielding 3(3-0-9)
2111616 Environmental Impact of Nuclear Power Plant 3(3-0-9)
2111621 Radiation Chemistry and Processing 3(3-0-9)
2111626 Industrial Radiation and Radioisotope Applications 3(2-3-7)
2111627 Material Analysis by Nuclear Techniques 3(3-0-9)
2111628 Radioisotope Production and Utilization 3(3-0-9)
2111629 Nuclear Chemical Engineering 3(3-0-9)
2111632 Numerical calculation for Nuclear Engineering 3(3-0-9)
2111640 Nuclear Reactor Control 3(3-0-9)
2111646 Radioactive Waste Management 3(3-0-9)
2111647 Nuclear Fuels and Nuclear Fuel Cycles 3(3-0-9)
2111648 Nuclear Power Plant Systems and Operation 3(2-3-7)
2111650 Introduction to Plasma Physics and Nuclear Fusion 3(3-0-9)
2111655 Computer Application in Nuclear Technology 3(3-0-9)
2111660 Industrial Radiation Imaging 3(3-0-9)
2111662 Nuclear Electronics 3(3-0-9)

2111663 Radiation Detectors and Nuclear Instruments 3(3-0-9)
2111664 Digital Computer Interfacing for Nuclear Instrument 3(3-0-9)
2111666 Radiation Machines 3(3-0-9)
2111678 Nuclear Materials Engineering 3(3-0-9)
2111683 Current Topics in Nuclear Engineering 3(3-0-9)
2111686 Special Topics in Nuclear Technology 3(3-0-9)

3.2) Nuclear Security and Safeguards Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111652 Strategic Trade Control 3(3-0-9)
2111653 Nuclear Safeguards 3(3-0-9)
2111654 Nuclear Fuel Cycle and Environmental Impacts 3(3-0-9)
2111656 Physical Protection of Nuclear Materials and Facilities I 3(3-0-9)
2111657 Advanced Detection Technologies for Radioactive and Nuclear Materials 3(3-0-9)

4) General Elective Course

Both fields of study: Student must take 6 credits of the courses available in the Master of Science in Nuclear technology Program.

5) Thesis

2111811 Thesis 12 credits
NUCLEAR AND RADIOLOGICAL ENGINEERING CURRICULUM
FIRST YEAR CURRICULUM
COMMON TO ALL ENGINEERING STUDENTS

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>THIRD SEMESTER</td>
<td></td>
<td></td>
<td>SIXTH SEMESTER</td>
<td></td>
</tr>
<tr>
<td>2103213</td>
<td>ENG MECHANICS I</td>
<td>3</td>
<td>2111311</td>
<td>RAD MAC I</td>
<td>3</td>
</tr>
<tr>
<td>2103241</td>
<td>THERMODYNAMICS I</td>
<td>3</td>
<td>2111303</td>
<td>ENV ASP NUC</td>
<td>3</td>
</tr>
<tr>
<td>2111200</td>
<td>ESS NUC ENG</td>
<td>3</td>
<td>2111304</td>
<td>PRI NUC INS</td>
<td>3</td>
</tr>
<tr>
<td>2111202</td>
<td>BAS NUC DET</td>
<td>3</td>
<td>2111305</td>
<td>NUC INS LAB</td>
<td>1</td>
</tr>
<tr>
<td>2111203</td>
<td>NUC RAD LAB</td>
<td>1</td>
<td>2111310</td>
<td>NUC REA SAF</td>
<td>3</td>
</tr>
<tr>
<td>2111204</td>
<td>HEA PHY RAD</td>
<td>3</td>
<td>2111309</td>
<td>NUC REA LAB</td>
<td>1</td>
</tr>
<tr>
<td>2111205</td>
<td>INT NUC MAT</td>
<td>3</td>
<td>2111401</td>
<td>SEM NUC ENG</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>XXXXXXXX APPROVED ELECTIVES</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FORTH SEMESTER</td>
<td></td>
<td></td>
<td>SUMMER SEMESTER</td>
<td></td>
</tr>
<tr>
<td>2104223</td>
<td>ENG STAT I</td>
<td>3</td>
<td>2100301</td>
<td>ENGINEERING PRACTICE</td>
<td>2</td>
</tr>
<tr>
<td>2111206</td>
<td>NUC PLA TEC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2102391</td>
<td>ELEC ENG I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2102392</td>
<td>ELEC ENG LAB I</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2103351</td>
<td>FLUID MECHANICS I</td>
<td>3</td>
<td>2104203</td>
<td>ENG MANAGEMENT</td>
<td>3</td>
</tr>
<tr>
<td>2111208</td>
<td>NUC REAC ANALYSIS</td>
<td>3</td>
<td>2111402</td>
<td>PRO NUC ENG I</td>
<td>1</td>
</tr>
<tr>
<td>5500208</td>
<td>COM PRES SKIL</td>
<td>2</td>
<td>2111444</td>
<td>SOC SCI NUE</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>XXXXXXXX APPROVED ELECTIVES</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXXXXXXX GENERAL EDUCATION</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXXXXXXX FREE ELECTIVE</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FIFTH SEMESTER</td>
<td>19</td>
<td></td>
<td>EIGHTH SEMESTER</td>
<td>19</td>
</tr>
<tr>
<td>2100311</td>
<td>ENG ESSENTIALS</td>
<td>3</td>
<td>2111403</td>
<td>PRO NUC ENG II</td>
<td>1</td>
</tr>
<tr>
<td>2111301</td>
<td>ENV ASP NUC</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>APPROVED ELECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>2111308</td>
<td>ELE CIR NUC</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>GENERAL EDUCATION</td>
<td>6</td>
</tr>
<tr>
<td>2111306</td>
<td>IND RAD MAT</td>
<td>3</td>
<td>XXXXXXXX</td>
<td>FREE ELECTIVE</td>
<td>3</td>
</tr>
<tr>
<td>2111307</td>
<td>IND RAD LAB</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111312</td>
<td>NUC3S</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5500308</td>
<td>TECH WRIT ENG</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL CREDITS FOR GRADUATION = 145</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COURSE DESCRIPTIONS IN NUCLEAR AND RADIOLOGICAL ENGINEERING (B.ENG.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111200  Essence of Nuclear Engineering  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atomic physics and nuclear physics; interaction between</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>radiation and matters; neutron calculations; types of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nuclear reactors; generation of nuclear reactors;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>applications of nuclear technology and radioisotopes;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>research reactor; Thailand nuclear power program; other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>topics of interest in nuclear engineering.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111201  Basic Principle of Nuclear Radiation Detection and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Laboratory  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation sources; nuclear radiation properties; interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of radiation with matter, statistics of radiation counting;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>characteristics of various nuclear radiation detectors;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relative and absolute measurements.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111202  Nuclear Radiation Detection and Measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory works on nuclear radiation properties; interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of radiation with matter; characterization of various</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nuclear radiation detectors; statistical errors of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>radiation counting; relative and absolute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>measurements; nuclear radiation spectroscopy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111203  Health Physics and Radiation Protection  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic concepts of radiation; interactions with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tissue; biological effects of radiation; radiation detection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and dosimetry; dose limits &amp; regulatory issues; protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from external radiation; internal radiation hazard;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>surface contamination and decontamination; calculation of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internal and external body radiation exposure dose;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>calculation of gamma and x-ray shielding; clinical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>applications.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111204  Introduction to Nuclear Materials  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear fuel cycle; uranium resources in Thailand; uranium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>extraction from seawater; materials used in nuclear power</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plants; crystal structures of metals; point defect in metals;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diffusion in solids; non-permanent and permanent deformation;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dislocation theory; creep; grain and grain growth; generation of fission gas and release; effect of radiation on structure and properties of materials.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111205  Nuclear Power Plant Technology  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to nuclear power plant technologies, pressurized</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>water reactor, boiling water reactor, other advanced reactor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>types, Thermodynamics of nuclear power plants, rankine cycle,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>thermal design of nuclear reactors, reactor heat generation,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>single phase heat transfer, two phase heat transfer in nuclear reactor.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111206  Nuclear Reactor Analysis  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production and characteristics of neutrons; the fission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>process; neutron diffusion theory; slowing-down theory;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fermi theory of the bare thermal reactor; one- and multi-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>group diffusion methods; basic principles of nuclear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reactor kinetics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111207  Environmental Aspects of Nuclear Engineering 3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Aspects of Nuclear Engineering at</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>impact of nuclear power plants; impact of nuclear fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cycle; radionuclides released from nuclear power plants;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>atmospheric diffusion; marine diffusion; dispersion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>simulation using computer codes; types of radioactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>waste; radioactive waste transport; radioactive waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>management; spent fuel transport; spent fuel management.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111208  Industrial Control Electronics  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principle of industrial control systems; transducer devices e.g. temperature, pressure, humidity, strain/stress; signal conditioning; electronic equipment; analog and digital control system; data transmission/receiving with computer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111209  Principle of Nuclear Instrument  3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Properties of radiation; interaction of radiation with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>matter; radiation detection standard NIM and CAMAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>instrumentation system; principle of nuclear instruments e.g. low voltage power supply, high voltage power supply, pre-amplifier, main-amplifier, rate meter, single channel analyzer, counter and timer, multi-channel analyzer radiation detection system setting.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111210  Nuclear Instrument Laboratory  1(0-3-0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of nuclear instrumentation laboratory e.g. low voltage power supply, high voltage power supply, pre-amplifier, main-amplifier, rate meter, single channel analyzer, counter and timer, radiation detection system setting.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111211  Industrial Uses of Radiation and Radioactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material 3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic principle of nuclear techniques used for industrial application; radiation sources and equipment used for industrial application; industrial radiography and computed tomography; nuclear techniques used for industrial gauging; nuclear analytical techniques for online elemental analysis in industry; radiisotope tracers used in industrial processes; basic principle of radiation processing for industrial application.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111212  Industrial Uses of Radiation and Radioactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material Laboratory 3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory works on nuclear techniques used for industrial application; industrial radiography and computed tomography; nuclear techniques used for industrial gauging; nuclear analytical techniques for online elemental analysis in industry; radiisotope tracers used in industrial processes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2111213  Electronic Circuits for Nuclear Instruments 3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study the principles, behavior and characteristic of the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>passive/active electronic devices; electrical signal and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>waveform; designing and calculation of electronic circuits,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>including the power supply circuit, feedback amplifier,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oscillator, Filters, logic, application of radiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>measurement devices and in other areas; electronic circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>simulation on computer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2111309 Nuclear Reactor Laboratory 3(3-0-6)
Condition: Prerequisite 2111208
Approaching of critically, control rod calibration, measurement of thermal neutron flux, measurement of fast neutron flux, profiling of axial flux, calibration of thermal power.

2111310 Nuclear Reactor Safety 3(3-0-6)
Condition: Prerequisite 2111206
Safety systems and functions of current and advanced reactor technologies, design basis accidents, severe accidents, safety analysis report, probabilistic safety analysis, technology of accident analysis, computer simulation of accidents, role of safety culture, current regulatory issues, significant nuclear accidents.

2111311 Radiation Machines I 3(3-0-6)
Particle Sources; Charge Particle Motion in Static Fields; Linear Transverse Motion; Acceleration and Longitudinal Motion; Beam Distribution; Guiding and Focusing; Accelerator; Laser; Cyclotron; Synchrotron; Other Auxiliary Components.

2111312 Nuclear Safety, Security, and Safeguards 3(3-0-6)
Condition: Prerequisite 2111201
Nuclear Safety; Nuclear Security; Nuclear Safeguards; Objectives; Interrelationship between Safety, Security, and Safeguards; National and International Policies; Related Law & Regulations; Related Regimes; Important Elements; Case Studies.

2111401 Seminar in Basic Nuclear Engineering 3(3-0-6)
Condition: Senior Standing or Consent of Faculty
Instructors provide research topics in nuclear technology to students; each student requires selecting a tentative project with a written report and making an oral presentation and discussion of relevance items of selected topic.

2111402 Project in Nuclear Engineering I 3(3-0-6)
Condition: Senior Standing or Consent of Faculty
Perform a preliminary nuclear engineering project in a team manner such that the processes comply with prescribed design processes including report documenting and presenting the project in a professional way.

2111403 Project in Nuclear Engineering II 3(3-0-6)
Condition: Prerequisite 2111402
Perform and complete a nuclear engineering project in a team manner such that the processes comply with prescribed design processes including report documenting and presenting the project in a professional way.

2111404 Microcontroller Programming and Interfacing 3(3-0-6)
Architecture and principle of microprocessor, microcontrollers, and peripheral devices: programming for control applications; interfacing methods and techniques with real world.

2111405 Vacuum Technology for Scientific Instrument 3(3-0-6)
Gas properties; relevant physical concept of vacuum system; vacuum gauge; vacuum pump; control valve; vacuum system design; cleaning techniques; applications of vacuum technology for scientific instruments and devices; leak detection techniques and maintenance.

2111406 Principle of Scientific Instrument 3(3-0-6)
Theory and principle of scientific instrument e.g. spectrophotometer, x-ray spectroscopy and radiography, electron microscopy; maintenance method for scientific instrument.

2111407 Basic scientific instrument maintenance 3(3-0-6)
Condition: Prerequisite 2111308
Using fault finding tools for investigation fault of device and electronic signal; scientific instrument structure and components study; fault diagnosis of Scientific Instruments; circuit analysis; replacement parts and accessories correctly; test the validity of the operation after maintenance.

2111408 Ionizing Radiation Calibration and Dosimetry 3(3-0-6)
Radiation terminology and units; basic principle of radiation dosimetry for various kinds of ionizing radiation; low and high level radiation dosimetry; various types of radiation dosimeter; radiation calibration systems; radiation calibration techniques.

2111410 Plasma Physics and Applications 3(3-0-6)
Basic characteristics of plasma; motions of charge particles under electric and magnetic fields; Maxwell's equations; plasma as fluid; plasma oscillation; different types of waves in plasma; diffusion process in plasma; methods of plasma generation; plasma measurements; nuclear fusion and current technology; plasma applications in industry.

2111411 Nuclear Techniques for Material Analysis 3(3-0-6)
Theoretical principle; methodology; instrumentation and characteristics of nuclear analytical techniques e.g. thermal and fast neutron activation techniques, prompt gamma radiation measurement techniques, measurement of gamma radiation from inelastic neutron collision, charged particles induced x-ray and gamma-ray analytical techniques, x-ray fluorescence techniques, electron and X-ray microanalysis, x-ray diffraction, track-etch techniques.

2111412 Nuclear Technology in Medicine 3(3-0-6)
Condition: Prerequisite 2111201
Radiopharmaceuticals as radioactive tracers in medical imaging, functional studies, and therapy for many diseases e.g. cardiovascular disease, digestive system, lung, skeleton, blood and nervous system etc., Positron emission tomography (PET), Radiotherapy; teletherapy and brachytherapy, Radioimmunoassay for measuring concentrations of antigens, Medical Radiography; computed tomography (CT); Magnetic
resonance imaging (MRI) or magnetic resonance tomography (MRT), PET, Single-photon emission computed tomography (SPECT), mammography; dental radiology, Neutron therapy, Heavy-ion therapy.

2111416 Nuclear Techniques for Measurement and Inspection in Industrial Process 3(3-0-6)
Condition: Prerequisite 2111304
Radiation gauging for measurement of thickness, level, moisture and density; detection of corrosion and blockage; distillation column and packed column scan; industrial radiography and tomography; elemental analysis techniques; radiotracer techniques.

2111417 Nuclear Techniques for elemental Analysis 3(3-0-6)
Condition: Prerequisite 2111304
Principles of nuclear analytical techniques; advantages and limitations; x-ray fluorescence analysis technique; nuclear activation analysis techniques; prompt gamma-ray neutron activation analysis techniques; charged particle activation analysis techniques.

2111421 Thermal Hydraulics 3(3-0-6)
Condition: Prerequisite 2111206
Two-phase flow, conservation equations, flow patterns, void fraction modeling, pressure drop modeling, steam separation, flow instabilities, critical flow, bubble nucleation, pool boiling, subcooled and saturated flow boiling, boiling crises, transient analysis (single channel), loop analysis, condensation.

2111422 Nuclear Power Plant Simulation 3(3-0-6)
Condition: Prerequisite 2111206
Operational characteristics of nuclear power plants with the simulation computer programs, reactivity control systems, safety systems, and response to transients and accident situations.

2111423 Heat Transfer Process in Nuclear Power Plant 3(3-0-6)
Condition: Prerequisite 2111206
Heat production from a nuclear reactor, nuclear reactor cooling system, boiling and condensation, two-phase fluid, thermal energy-mechanical energy conversion, thermal cycle, efficiency improvement for heat transfer process, accident involving thermal system in a nuclear power plant and the emergency cooling system.

2111424 Radiation Transport 3(3-0-6)
Definitions and Assumptions regarding the radiation, interaction with the radiation, radiation transport theory, Pn approximation, Sn approximation, numerical calculation for radiation transport, monte-carlo technique.

2111425 Basic Nuclear Reactor Engineering 3(3-0-6)
Applying the nuclear reactor theory for the design and the operation of the nuclear theory, evaluation of the nuclear reactor’s importance, safety by design for the nuclear reactor and the thermal system, the management on the operation of a nuclear reactor and the economics of the nuclear reactor’s operation.

2111431 Nuclear Weapons and Nuclear Accidents 3(3-0-6)
History of nuclear weapon development; how nuclear weapons work; materials for construction of nuclear weapons; impact of nuclear weapons; current topics on nuclear weapons; Three Mile Island accident, Chernobyl accident and Fukushima accident; impacts on human and the environment; roles of International Atomic Energy Agency; potential of utilizing nuclear explosion for peaceful purposes.

2111432 Corrosion in Nuclear Power Systems 3(3-0-6)
Condition: Prerequisite 2111205
Structural metals in nuclear power plants; properties and fabrication of Zircaloy; aqueous corrosion of reactor components; structural integrity of reactor components under combined mechanical loading, neutron irradiation, and chemical environment.

2111434 Radiation processing and its applications 3(3-0-6)
Condition: Prerequisite 2111201
Radiation sources; chemical and physical effects of radiation; radiation effects to water, gases, monomers and polymers; polymer modification by radiation; radiation sterilization; development of material structures by radiation; radiation degradation of materials; food irradiation; radiation application in Agriculture.

2111435 Radiation Detection Materials Development 3(3-0-6)
Reviews of radiation measurement and detection, types of radiation detectors and their characterizations, development of radiation detection materials; crystal synthesis by chemical processes; the methods of bulk-crystal growths e.g. Bridgman-Stockbarger technique and Czochralski technique; thin-film growth by chemical and physical deposition e.g. epitaxial technique and sputter technique.

2111443 Nuclear Waste Disposal 3(3-0-6)
Radioactivity; radiation effects on living things; dose limit; various characteristics of radioactive wastemanagement; disposal technology of nuclear waste.

2111444 Social Sciences for Nuclear Engineering 3(3-0-6)
2111600 * Nuclear Engineering I 3(0-3-9)
Atomic physics and nuclear physics; interaction between radiation and matter; neutron diffusion; types of nuclear reactors; generation of nuclear reactors; nuclear fuel cycle; applications of nuclear technology and radioisotopes; nuclear weapons; Thailand nuclear power program.

2111603 * Radiation Detection and Measurements Laboratory 1(0-3-7)
Laboratory work on radiation measurements; basic principles; interactions of nuclear radiation with matter; interactions of charged particle through matter; interactions of neutrons with matter; radiation effects to water, gases, monomers and polymers; polymer modification by radiation; radiation sterilization; food irradiation; radiation degradation of materials.

2111604* Radiation Detectors and Nuclear Instruments laboratory 1(0-3-7)
Laboratory works on electronics circuit of radiation detectors, nuclear pulse shaper and discriminator circuits; inspection and calibration of Nuclear Instrument Module, pulse amplifier, single channel analyzer, multichannel analyzer, time to amplitude converter and some special nuclear instruments; experiment on parameters that affect energy resolution of the spectroscopy system and pulse pile-up rejection.

2111607 Environmental Radiation Measurements 3(0-3-9)
Natural sources of radiation and man-made sources of radionuclides; instrumentation for radiation detection and measurement; measurement techniques and procedures for environmental samples; sampling and sample preparation for analyses in laboratory; statistical treatment of radioactivity measurements; laboratory and field radiation measurements.

2111608* Practical Radiation Detection and Measurements 3(0-3-9)
Nuclear radiation basics; sources of nuclear radiation; types of radioactive decay; statistical errors of radiation counting; interactions of nuclear radiation with matter; characteristics and utilization of various nuclear radiation detectors; relative and absolute measurements; gamma and X-ray spectroscopy; charged-particle spectroscopy; neutron detection and spectroscopy.

2111609 Radiation Dosimetry 3(0-3-9)
Basic principle of radiation dosimetry for various kinds of radiation; charged particle radiation, gamma radiation and neutron; low and high level radiation dosimetry; various types of radiation dosimeter.

2111610* Nuclear Security 3(0-3-9)
Nuclear security; overview of related legal framework; interrelationships between nuclear safety, security and safeguards; nuclear and radiation threat by non-State actors; counterterrorism; chemical biological, radiological and nuclear security of nuclear and nuclear (CBRN) Weapons; basic elements of nuclear security; planning nuclear materials and other radioactive materials outside regulatory control; information security; security culture.

2111612 Radiation Protection 3(3-0-9)
Basic concepts of radiation; biological effects of radiation on human body; dose limits; protection from external radiation; Internal radiation hazard; surface contamination and decontamination; radiation dosimetry; calculation of internal and external radiation exposure dose; calculation of gamma and x-ray shielding.

2111613 Radiation Safety and Shielding 3(3-0-9)
Definitions and basic concepts of radiation safety; biological effects of radiation; protection, dose limits; regulation concerning radioactive materials; transportation of radioactive materials; accidents and emergency procedure; gamma radiation and x-ray shielding; radiation shielding from nuclear reactor.

2111616 Environmental Impact of Nuclear Power Plant 3(3-0-9)
Radioisotopes released from nuclear power plant, dispersion in the atmosphere; dispersion in aquatic environment; radiation dose calculation; food chain; reactor siting; accident risk analysis; emergency management.

2111621 Radiation Chemistry and Processing 3(3-0-9)
Radiation sources; chemical and physical effects of radiation; radiation effects to water, gases, monomers and polymers; polymer modification by radiation; radiation sterilization; food irradiation; radiation degradation of materials.

2111627 Material Analysis with Nuclear Techniques 3(3-0-9)
Condition: Prere 2111608 or 2111663
Theoretical principle; methodology; instrumentation and characteristics of nuclear analytical techniques e.g.l thermal and fast neutron activation techniques, prompt gamma radiation measurement techniques, measurement of gamma radiation from inelastic neutron collision, charged particles induced x-ray and gamma-ray analytical techniques, x-ray fluorescence techniques, electron and X-ray microanalysis, x-ray diffraction, track-etch techniques.

2111628 Radioisotope Production and Utilization 3(3-0-9)
Radioisotope production; nuclear reactor-produced radioisotopes; special techniques to produce radioisotope; radioisotopes derived from generators; accelerator produced isotopes, labelled compounds; dispensing and quality control; radioisotope utilization.

2111629 Nuclear Chemical Engineering 3(3-0-9)
Production of fissiles and nuclear reactor materials; isotope separation; property of spent nuclear fuel; separation of remaining and newly producing fissiles from spent nuclear fuel.

2111631 Applied Mathematics in Nuclear Technology 3(3-0-9)
Ordinary differential equations; linear differential equations with constant coefficients; Laplace transform, vector analysis; finite differences; gamma and beta functions; Fourier series and integral.
2111632  Numerical Calculation For Nuclear Engineering 3(3-0-9)
Numerical technique for differential, integration and finding; matrix manipulation; data interpolation; finite difference; simulation with Monte Carlo technique.

2111640  Nuclear Reactor Control 3(3-0-9)
Condition: Prerequisite consent of faculty
Phylosophy of nuclear reactor and plant control; elementary physics of reactor control; nuclear reactor kinetics; nuclear reactor control radiation instruments; nuclear reactor control mechanisms; nuclear reactor control problems; computer simulation of nuclear reactor power.

2111642  Nuclear Reactor Engineering 3(3-0-9)
Production and characteristics of neutrons; the fission process; neutron diffusion theory; slowing-down theory; Fermi theory of the bare thermal reactor; one- and multi-group diffusion methods; basic principles of nuclear reactor kinetics and nuclear reactor control.

2111643  Nuclear Power Engineering 3(3-0-9)
Condition: Prerequisite consent of faculty
Power reactor systems; vapor power cycle; reactor heat generation; reactor heat transport, single phase flow, two- phase flow; reactor core thermal analysis; practices using PC-based simulators of nuclear power plants for operations under normal and abnormal conditions.

2111646  Radioactive Waste Management 3(3-0-9)
Nature of radioactive wastes; origin of low-high radioactive wastes; characteristics, forms and quantity of radioactive wastes; storage and transportation; waste management technologies; radioactive waste management plans in various countries.

2111647  Nuclear Fuels and Nuclear Fuel Cycles 3(3-0-9)
Condition: Prerequisite 2111642
Characteristics of fuel-element materials; design of fuel-elements; fuel-element fabrication; fuel cycles in nuclear reactors; properties of irradiated fuel; spent fuel reprocessing; economics of nuclear power.

2111648  Nuclear Power Plant Systems and Operation 3(2-3-7)
Condition: Prerequisite consent of faculty
Functions, equipment and operation of the main systems of a nuclear power plant; how each system is controlled, principles of overall unit operation and control, reactor safety and protection for the public; experiments used PC-based simulators of nuclear power plants for operations under normal and abnormal conditions.

2111650  Introduction to Plasma Physics and Nuclear Fusion 3(3-0-9)
Basic characteristics of plasma, methods of plasma generation; nuclear fusion process, problems and current status of fusion technology; single-particle motions, effects of electric and magnetic field on plasma motion; maxwell's equations, fluid equation of motion; plasma oscillation, different types of waves in plasma; diffusion process in plasma, plasma resistivity; hydrodynamic equilibrium, various types of instability in plasma.

2111651* Weapon Mass Destruction Nonproliferation 3(3-0-9)
Issues concerning the proliferation of nuclear, chemical, and biological weapons; introduction to nuclear and radiological terrorism; international nuclear nonproliferation framework; weapon technologies of mass destruction; nuclear proliferation issues in South Asia.

2111652* Strategic Trade Controls 3(3-0-9)
National and international contexts of export control; threats of nuclear proliferation to the state and business sectors, international export control framework; instruments for export control; catch-all concepts; intangible technology transfers, dual-use controls; end-use method.

2111653* Nuclear Safeguards 3(3-0-9)
Safeguarding nuclear material and facilities; monitoring principles and technologies; safeguards issues; international framework of nuclear material safeguard; nuclear proliferation threat; radiological threat; detecting nuclear and other radioactive materials; roles of intelligence; A. Q. Khan’s network; counter proliferation of nuclear weapons; nuclear material safeguard in various countries.

2111654* Nuclear Fuel Cycle and Environmental Impacts 3(3-0-9)
Technology of nuclear fuel cycle; technologies used in manufacturing, safety handling, and disposing of nuclear materials and by-products; social environmental, and health impacts of materials used in each major step in the fuel cycle; potential of nuclear proliferation.

2111655  Computer Application in Nuclear Technology 3(3-0-9)
Calculation of gamma-ray shielding calculation of primary and secondary x-ray shielding; radioactivity calculation; radiation imaging; application of data acquisition for computed tomography reconstruction.

2111656* Physical protection of Nuclear materials and Facilities 1 3(3-0-9)
Principles of physical protection of nuclear materials and facilities; detection, delay, response; threat identification and analysis; vital area analysis; international physical safeguard framework; internal threats.

2111657* Advanced Detection Technologies for Radioactive and Nuclear Materials 3(3-0-9)
Condition: Prere 2111608 or 2111658 or 2111663
Detection and identification of the types of nuclear materials; chemical and radiological characteristics of nuclear materials from raw materials to various finished products; detection technologies; nuclear forensics.
2111658* Method and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)
Counting statistics; radiation detection; gamma detection; neutron detection; detection of charged particles; gamma spectroscopy; activation analysis; destructive analysis; non-destructive analysis; quantitative nuclear material measurements; survey devices; use of detectors at port.

2111659* Method and Instrumentation for Nuclear Security and Safeguards Laboratory 1(0-3-7)
Use of gamma, neutron, and charged particle detection systems; gamma spectroscopy method; activation analysis; quantitative nuclear material measurements; uses of various survey and detection devices at port.

2111660 Industrial Radiation Imaging 3(3-0-9)
Condition: Prerequisite consent of faculty
Principles of industrial radiography and tomography; advantages and disadvantages; x-ray and gamma-ray radiography; neutron radiography; x-ray and gamma-ray computed tomography; neutron computed tomography; radiation imaging equipment.

2111661 Experimental Nuclear Engineering 3(2-3-7)
Condition: PRER2111663 or: 2111642
Nondestructive testing methods; industrial radiography using x-rays and gamma-rays and neutrons; equipment for x-ray and gamma-ray radiography; x-ray and neutron computed tomography.

2111662 Nuclear Electronics Engineering 3(3-0-9)
Condition: Prerequisite consent of faculty
Outline of nuclear electronics; nuclear measuring systems; shaping of signals for spectroscopy; radiation detection circuit; high voltage bias power supply; pulse amplifier; pulse height and shape discriminators; timing circuit; single channel and multichannel analyzer; digital counter and ratemeter; energy resolution in spectroscopy systems.

2111663* Radiation Detectors and Nuclear Instruments 3(3-0-9)
Principle of radiation detection process; modes of detector operation; NIM and CAMAC standards for modular nuclear instrumentation; configurations of nuclear measurement systems; properties of radiation detectors; operation characteristics of various radiation detector; operation characteristics of various radiation detectors; nuclear pulse signal processing; radiation spectroscopy; nuclear instrumentation; application of counting statistics and error prediction in nuclear radiation measurement.

2111664 Digital Computer Interfacing for Nuclear Instruments 3(3-0-9)
Condition: Prerequisite: 2111608 or 2111663 or consent of faculty

Standard of nuclear instrument modules; nuclear instrumental system; electronic signal conditioning and interfacing for nuclear instrument; standard data bus of parallel and serials type; analog and digital data conversion; uses of microcomputer and microcontroller interfacing for manipulation of nuclear instrument system.

2111666 Radiation Machines 3(3-0-9)
Principle and structure of radiation machine; mechanism of charge particles acceleration; electron and ion beams generation; electromagnetic and electrostatic lens; high vacuum technology; high voltage power supply; basic refrigeration; operation of various types of accelerator and radiation machine; industrial and research applications of radiation machines.

2111678 Nuclear Materials Engineering 3(3-0-9)
Condition: Prerequisite consent of faculty
Nuclear fuel cycle; materials and thermal aspects of nuclear reactors; crystal structures of solids; point defects; diffusion in solids; elastic behavior of solids; dislocations in solid and creep deformation; grain and grain boundaries; cavities in solids; fission product behavior in nuclear fuel; radiation damage and fast-neutron irradiation effects in metals; introduction to the High-Temperature Gas-Cooled Reactor Technology.

2111683 Current Topics in Nuclear Engineering 3(3-0-9)
Current topics in nuclear engineering field are selected, summarized and discussed by the students with faculty participation.

2111684 Current Topics in Nuclear Technology 3(3-0-9)
Current topics in nuclear technology field are selected, summarized and discussed by the students with faculty participation.

2111686* Special Topics in Nuclear Technology 3(3-0-9)
Special topics in nuclear technology; presentations and discussions led by instructors, concluding.

2111687* Special Topics in Nuclear Technology 3(3-0-9)
Students' selection, summaries and discussion of special topics in nuclear engineering, with faculty participation.

2111701 Seminar in Nuclear Technology I S/U
Instructors provide research topics in nuclear technology to students and each student is required to summarize with written report and oral presentation.

2111702 Seminar in Nuclear Technology II S/U
Condition: Prerequisite: 2111701
Instructors provide research topics in nuclear technology to students each student required to conduct experimental research with written report and oral presentation; discussion of topics related to research works.
<table>
<thead>
<tr>
<th>Number</th>
<th>Type</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2111811</td>
<td>Thesis</td>
<td>THESIS</td>
<td>12(0-0-0)</td>
</tr>
<tr>
<td>2111817*</td>
<td>Thesis</td>
<td>THESIS</td>
<td>37(0-0-0)</td>
</tr>
<tr>
<td>2111829*</td>
<td>Dissertation</td>
<td>DISSER</td>
<td>49(0-0-0)</td>
</tr>
<tr>
<td>2111826*</td>
<td>Dissertation</td>
<td>DISSER</td>
<td>36(0-0-0)</td>
</tr>
<tr>
<td>2111830*</td>
<td>Dissertation</td>
<td>DISSER</td>
<td>74(0-0-0)</td>
</tr>
</tbody>
</table>
Department of Water Resources Engineering

The Department of Water Resources Engineering was formerly one of the five divisions in the Department of Civil Engineering which had offered some basic courses in hydraulic, hydrology and water resources engineering to the undergraduate students in civil, environmental and survey engineering. The division had also offered a graduate program specialized in water resources engineering leading to the Master of Engineering Degree since 1971 and to the Doctor of Engineering Degree since 1984. At the end of 1991, the Department of Water Resources Engineering was established to reflect growing concern of Chulalongkorn University in the field of water resources development and management which nowadays, has become one of the nation’s most critical problems.

The Department offers programs leading to the Master and Doctor of Engineering degrees in Water Resources Engineering. Works are directed toward research and professional development in areas such as hydrology and hydrologic engineering; hydraulic engineering; irrigation engineering; groundwater; coastal engineering; and water resources planning and management. Students who wish to continue their study in water resources engineering should have completed the equivalent of the undergraduate majoring in civil engineering or water resources engineering, or other related fields with adequate background in civil engineering.

Head: Anurak Sriariyawat, Ph.D. (Nottingham)

Associate Professors:
- Sucharit Koontanakulvong, D.Agr. (Kyoto)
- Saree Chanyotha, Ph.D. (Arizona)
- Tuantan Kitpaisalsakul, D.Eng. (AIT)

Assistant Professors:
- Aksara Putthividhya, Ph.D. (U. of Michigan)
- Anurak Sriariyawat, Ph.D. (Nottingham)

Lecturers:
- Busawan Bidorn, Ph.D. (FSU)
- Piyatida Ruangrassamee, Ph.D. (MIT)
- Pongsak Suttinon, D.Eng (Kochi UT)
- Supattra Visesstti, Ph.D. (ICL)

NAME OF THE DEGREE:
- Master of Engineering
- M.Eng.

ADMISSION

An applicant must hold a Bachelor’s Degree in Civil Engineering, Irrigation Engineering, Water Resources Engineering or equivalent and also meet the requirements of the Graduate School.

Degree Requirements

The candidate is required to complete at least a total of 36 credits, of which 24 credits shall be graduate course work. These 24 credits course work shall consist of 12 credits of required courses and 12 credits of approved elective credits. The grade point (GPA) must not be less than 3.00. Plus 12 credits of thesis and satisfactorily pass an oral examination.

Course Requirements

1) Required Courses 12 credits

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits (Lecture-Tutorial-Practical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2112602</td>
<td>Hydroinformatics I</td>
<td>1(0-3-1)</td>
</tr>
<tr>
<td>2112605</td>
<td>Hydrology and Hydraulic Laboratory</td>
<td>1(0-3-1)</td>
</tr>
<tr>
<td>2112611</td>
<td>Engineering Fluid Mechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112614</td>
<td>Hydraulics of Open Channels</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112631</td>
<td>Hydrological Processes</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112698</td>
<td>Seminar in Water Resources Engineering</td>
<td>1(0-3-1)</td>
</tr>
</tbody>
</table>

2) Elective Courses

At least 12 credits must be chosen from the following courses with the approval of the advisor and in accordance with the approved student’s plan.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits (Lecture-Tutorial-Practical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2112501</td>
<td>Computer Application in Water Resources Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112503</td>
<td>Irrigation Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112504</td>
<td>Water Resources Systems Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112505</td>
<td>Water Resources Planning and Management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112541</td>
<td>Introduction to Groundwater Contamination</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112542</td>
<td>Probability and Time Series Analysis for Infrastructure Data</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112543</td>
<td>Water Resources and Environmental Project management</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112601</td>
<td>Digital Methods in Water Resources Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112603</td>
<td>Hydroinformatics II</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112604</td>
<td>Advanced Topics in Hydroinformatics for Water Resources Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112615</td>
<td>Erosion and Sedimentation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112617</td>
<td>Hydraulic Design</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112633</td>
<td>Advanced Hydrology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112634</td>
<td>Statistical Hydrology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112635</td>
<td>Stochastic Processes in Hydrology and Hydraulics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112636</td>
<td>Urban Hydrology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112637</td>
<td>Flood Plain Hydrology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112641</td>
<td>Groundwater Hydrology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112642</td>
<td>Flow Through Porous Media</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112643</td>
<td>Modelling of Subsurface Flow</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112644</td>
<td>Groundwater Exploration and Development</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112661</td>
<td>Coastal Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112662</td>
<td>Port and Harbour Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112663</td>
<td>Coastal Process and Protection</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112664</td>
<td>Estuaries Hydraulics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112671</td>
<td>Systems Analysis for Large-Scale Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112672</td>
<td>Water Resources Systems Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2112674</td>
<td>Water Management</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>
COURSE REQUIREMENTS

1) Required Courses (S/U) 2 credits
2112798 Seminar in Water Resources Engineering II 1(0-3-1)
2112799 Seminar in Water Resources Engineering III 1(0-3-1)
2112894 Doctoral Dissertation Seminar S/U
2112897 Qualifying Examination S/U

2) Elective Courses 12 credits
2112601 Digital Methods in Water Resources Engineering 3(3-0-9)
2112603 Hydroinformatics II 3(3-0-9)
2112604 Advanced Topics in Hydroinformatics for Water Resources Engineering 3(3-0-9)
2112615 Erosion and Sedimentation 3(3-0-9)
2112617 Hydraulic Design 3(3-0-9)
2112633 Advanced Hydrology 3(3-0-9)
2112634 Statistical Hydrology 3(3-0-9)
2112635 Stochastic Processes in Hydrology and Hydraulics 3(3-0-9)
2112636 Urban Hydrology 3(3-0-9)
2112637 Flood Plain Hydrology 3(3-0-9)
2112641 Groundwater Hydrology 3(3-0-9)
2112642 Flow Through Porous Media 3(3-0-9)
2112643 Modelling of Subsurface Flow 3(3-0-9)
2112644 Groundwater Exploration and Development 3(3-0-9)
2112661 Coastal Engineering 3(3-0-9)
2112662 Port and Harbour Engineering 3(3-0-9)
2112663 Coastal Process and Protection 3(3-0-9)
2112664 Estuaries Hydraulics 3(3-0-9)
2112671 Systems Analysis for Large-Scale Systems 3(3-0-9)
2112672 Water Resources Systems Engineering 3(3-0-9)

3) Thesis
2112811 Thesis 12 credits

NAME OF THE DEGREE
- Doctor of Engineering
- D.Eng.

ADMISSION
An applicant must hold a Master Degree in Civil/Water Resources Engineering or equivalent with GPA above 3.25, pass an English examination and also meet the requirements of the Graduate School.

DEGREE REQUIREMENTS
An acceptable dissertation of not less than 48 credits, together with 12 credits in the primary area plus 2 credits in seminar (S/U), is required for the Doctoral Degree.
A student who has fulfilled the requirements of the program with a period of study no more than 10 regular semesters and satisfactorily pass an oral examination, will be awarded the Degree of Doctor of Engineering.

COURSE DESCRIPTIONS IN WATER RESOURCES ENGINEERING

2112210 Water/Soc 3(3-0-6)
Importance of Water Resources; Context and roles of water resources in society, environment, and community; water cycle, surface water, precipitation, surface runoff, stream flow, erosion surface, water quality, saltwater/intrusion, groundwater, groundwater storage, groundwater abstraction, land subsidence groundwater quality groundwater contamination, remediation for contaminated groundwater, water supply water supply production poun, water distribution system, village water supply system, wastewater, parameters, treatment technologies, water resources situation in the society, flood drought climate change and impacts, transboundary water resources problems, flood and drought mitigation measures, structural measures, dam/reservoir, rainfall harvesting water drainage system, water reuse program, non-structural measures, forecasting and warning system, conjunctive use of surface and groundwater; laws and regulations.

2112341 Hydrology 2(2-0-4)
Condition: Prerequisite 2112346
Hydrologic cycles; precipitation; infiltration; rainfall - runoff and river gauging; hydrographs; reservoirs; evaporation; evapotranspiration; flood forecasting; flood routing; groundwater; measurement of hydrologic and meteorological parameters.

2112342 Principles of Hydrology 3(3-0-6)
Condition: Prerequisite 2112346
Hydrologic cycles; precipitation; infiltration; runoff rainfall and river gauging; hydrographs; reservoirs; evaporation; evapotranspiration; flood forecasting; flood routing; groundwater; measurement of hydrologic and meteorological parameters, application in water resources projects; demonstration of infiltration, runoff hydrographs; and groundwater flow.

2112343 Hydrology for Surveying Engineering 3(3-0-6)
Hydrologic cycle and processes; precipitation; streamflow and hydrograph analyses; infiltration soil and water and groundwater movement; measurement of hydrologic and hydro-meteorological parameters; rainfall-runoff relationship; statistical and probabilistic analyses of hydrologic data; introduction to water management; hydrological applications of GIS/Hydro-informatics..
2112344 Hydraulic Laboratory I 1(0-3-0)
Condition : Prerequisite 2112346
Experimental measurement of fluid pressure; principles of fluid flow through orifices and weirs; momentum forces; measurement of flow in pipe, flow in open channel and unsteady flow.

2112346 Hydraulics I 3(3-0-6)
Condition : Prerequisite 2103213
Properties of fluid statics; dynamics and kinematics of fluid flow; energy equations in steady flow; momentum and dynamic forces in fluid flow; similitude and dimensional analysis; flow of fluid in pipes; open channel flow; fluid flow measurement; unsteady flow.

2112440 Hydraulic Engineering 3(3-0-6)
Condition : Prerequisite 2112341 or 2112342 and Senior Standing
Open channel flow; flow in pressure conduits; water hammer; reservoirs; sediment transport in streams; reservoir sedimentation; dams; spillways; gates; tunnels; penstocks; turbines; hydraulic models; design of channels; groundwater and hydraulics of well; surface drainage.

2112501 Computer Application in Water Resources Engineering 3(3-0-9)
Application of computer in solving water resources problems; program development or application of available packages to solve assigned water resources problems.

2112503 Irrigation Engineering 3(3-0-9)
Land grading and field layout; irrigation water requirements; water application techniques; water conveyance, control and acquisition.

2112504 Water Resources Systems Design 3(3-0-9)
Condition : Prerequisite 2112346
Introduction to water resources engineering; application of hydraulic and hydrology to related water system projects; reservoirs; pipe system and pump; design of water distributed system and urban drainage design.

2112505 Water Resources Planning and Management 3(3-0-9)
Condition : Prerequisite 2112341 or 2112342 OR 2112343
Water resources and rainfall characteristics in Thailand; principles of water resources planning and management; water resources system modeling; role in planning and management; problem-based water resources management; concepts in probability and statistic modeling in hydrological waters; river basin models for water resources planning and management; climate change and hydrological uncertain issues.

2112541 Introduction to Groundwater Contamination 3(3-0-9)
Fundamentals of subsurface flow and transport; Relation of groundwater flow to geologic structure; man-made contamination and their impacts of subsurface environment; Behavior of chemicals in subsurface environment; Management of contaminated groundwater; Movement of contaminants through groundwater and their eventual fate; Fate of Contaminants in saturated and unsaturated groundwater aquifers.

2112542 Probability and Time Series Analysis for Infrastructure Data 3(3-0-9)
Probabilistic concepts and quantitative methods that are useful for water resources and infrastructure data analysis; random variables and their properties; hypothesis testing; analysis of trends; Fourier transformation; characterization of data in the time domain; characterization of data in the frequency domain; correlation among variables; simulation of random variables; linear regression and time series models; Theory and use of MATLAB programming language to import raw data construct simulation models analyze data and present the results.

2112543 Water resources and environmental project management 3(3-0-9)
Condition : Consent of Faculty
The importance of water resources and environment in infrastructural development, water quantity and water quality aspects in infrastructural development, the projects principles of infrastructure planning in developing countries, appropriate and sustainable technologies for water and sanitation projects, technical, socio-cultural, public health, and economic factors important to planning and design of water and sanitation systems that unique in the city critical factors that are often unique to a major water resources and environmental project; the uncertainty happen in water resources and environmental cleanup projects and process of environmental laws.

2112601 Digital Methods in Water Resources Engineering 3(3-0-9)
Condition : Consent of Faculty
Digital computer methods in solving problems in water resources engineering; selected problems in the areas of hydrology, groundwater, hydraulics, coastal engineering and water resources systems simulation and management.

2112602 Hydroinformatics I 3(3-0-9)
Condition : Consent of Faculty
Introduction to information and communication technologies (ICTs) in water resources; integration of hydraulics, hydrology and environmental engineering; assimilation of measured data; concept of the geographic information system; GIS applications in water resources engineering; social dimension of the problems of water management; decision support tools.

2112603 Hydroinformatics II 3(3-0-9)
Drainage basin form and process; geomorphologic approach; physically-based catchment modeling; development of numerical schemes; modeling and forecasting of hydrological systems; database management system; risk analysis and mitigation; decision making process; applications of information and communication technologies (ICTs) to water and related resources management.

2112604 Advanced Topic in Hydroinformatics for Water Resources Engineering 3(3-0-9)
Condition : Consent of Faculty
Analysis, design, installation and operation of combined measuring and numerical-modeling schemes; dynamic and mobile river systems; introduction to flood- and other early warning systems; introduction to real-time water management systems; contemporary issues in hydroinformatics.
2112605 Hydrology and Hydraulic Laboratory 3(3-0-1)
Experimental verification of advanced principles of hydrology and hydraulics; usage of various hydrological and hydraulic measurement devices; preparation for field laboratory/field measurement.

2112611 Engineering Fluid Mechanics 3(3-0-9)
Advanced topics in theoretical fluid mechanics and hydraulics; including mechanics of ideal fluids and viscous fluids; incompressible and compressible flow; one-two-and three-dimensional flows.

2112614 Hydraulics of Open Channels 3(3-0-9)
Continuity, energy and momentum principles applied to steady and unsteady flow in open channels; channel controls, transitions, flood routing, and models.

2112615 Erosion and Sedimentation 3(3-0-9)
Condition: Prerequisite 2112614
Form of erosion and methods of control; sediment properties and their measurement; initiation of sediment movement; transportation and deposition of sediment by flowing water; bed load and suspended load movement; sediment discharge formulas; river behavior and control.

2112617 Hydraulic Design 3(3-0-9)
Condition: Prerequisite 2112614
Analysis of flow behavior through various types of hydraulic structures such as spillway, stilling basin, energy dissipator, gates, outlet works, open channel, pressure conduit, transitions and flow measurement structure. Consideration and procedures for hydraulic design.

2112631 Hydrological Processes 3(3-0-9)
The hydrologic cycle; atmospheric moisture; precipitation; streamflow; infiltration; evaporation and evapotranspiration; groundwater and well hydraulics; hydrograph analysis; analysis and synthesis of hydrological processes; water quality; mathematical models and simulation in hydrology.

2112633 Advanced Hydrology 3(3-0-9)
Condition: Prerequisite 2112631 or Consent of Faculty
Transport phenomena in hydrology and meteorology; flood routing and overlandflow theory; linear and nonlinear analysis of rainfall-runoff system; conceptual and digital models for hydrologic processes.

2112634 Statistical Hydrology 3(3-0-9)
Condition: Prerequisite 2112631 or Consent of Faculty
Basic statistical characteristics of hydrological data; probability and distributions; parameters estimation techniques; linear and non-linear equations and coefficients estimation; maximum probable values.

2112635 Stochastic Processes in Hydrology and Hydraulics 3(3-0-9)
Condition: Prerequisite 2112631 or Consent of Faculty
Basic characteristics of time series; time series analysis and synthesis; prediction and forecasting.

2112636 Urban Hydrology 3(3-0-9)
Condition: Prerequisite 211261 or Consent of Faculty
Effects of urban on hydrological processes; urban drainage system and flood protection design; mathematical modelling and simulation for design and management.

2112637 Flood Plain Hydrology 3(3-0-9)
Condition: Prerequisite 2112631 or Consent of Faculty
Nature and origin of flood; rainfall-runoff analysis; flood routing; flood surface profile analysis; flood plain modelling and simulation; flood forecasting and flood protection measures.

2112641 Groundwater Hydrology 3(3-0-9)
Condition: Prerequisite 2112631 or Consent of Faculty
Occurrence of groundwater; basic principles of flow through porous media; hydrology of aquifers; well hydraulics; numerical and analog models for aquifer analysis; discussion on special topics such as salt-water intrusion, water quality, artificial recharge, land subsidence and groundwater basin management.

2112642 Flow Through Porous Media 3(3-0-9)
Condition: Prerequisite 2112641 or Consent of Faculty
Kinematics and dynamics of fluids in saturated and fractured media; introduction to free surface, unsaturated, and multiphase flows.

2112643 Modelling of Subsurface Flow 3(3-0-9)
Condition: Prerequisite 2112641 or Consent of Faculty
Finite difference and finite element methods for subsurface fluid flow and mass or energy transport simulation; applications to aquifers, unsaturated soils, seepage through earth dams.

2112644 Groundwater Exploration and Development 3(3-0-9)
Condition: Prerequisite 2112641 or Consent of Faculty
Review of geologic and hydrologic formation of groundwater; techniques and interpretation of field survey; data collection and analysis; water quality; groundwater exploration and construction of well; large-scale development of groundwater; simulation model of wellfields; determination of groundwater yield; analysis and management of groundwater basin; case studies.

2112661 Coastal Engineering 3(3-0-9)
Condition: Prerequisite 2112611 or Consent of Faculty
An introductory course to coastal engineering; basic wave theories; wave mechanics-refraction, diffraction, reflection and breaking; wave generation and forecasting; wave forces on structures; longshore current and sediment transport; field survey; coastal process and protection; design of coastal structure; hydraulic model.

2112662 Port and Harbour Engineering 3(3-0-9)
Condition: Prerequisite 2112661 or Consent of Faculty
Review of wave mechanics and wave forecasting; functions of ports and harbors; various types of coastal structures for ports and harbours; analysis and design of structures; planning of ports and harbours; economics and environmental consideration, case studies.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>2112663</td>
<td>Coastal Process and Protection</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112661 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Review of wave mechanics and generation process; wave forecasting; coastal process; mechanics of sediment transport; coastal protection works; beach and land reclamation; economics and environmental consideration; case studies.</td>
</tr>
<tr>
<td>2112664</td>
<td>Estuaries Hydraulics</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112661 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Estuary phenomena and its problems in hydraulic aspect; tidal phenomena; tidal dynamics; tidal computation; density current; water pollution; mixing and dispersion process; and withdrawal of water from estuaries zone.</td>
</tr>
<tr>
<td>2112671</td>
<td>Systems Analysis for Large-Scale Systems</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112671 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>An introduction to system concept and methodologies; nature of large-scale public projects; socio-economic evaluation; identification of objectives and alternatives; systems modelling; optimization techniques; simulation; applications to the design and management of large-scale projects.</td>
</tr>
<tr>
<td>2112672</td>
<td>Water Resources Systems Engineering</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112671 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Application of system analysis in water resources planning, design and operation; simulation modelling; deterministic and stochastic approaches; reservoir design and operation; optimization for multipurpose water resources system; design and management of urban water resources; river basins and groundwater aquifers. Determination of optimal operating rules and planning strategies. Current and proposed methods for feasibility studies of water resources development projects.</td>
</tr>
<tr>
<td>2112673</td>
<td>Economics of Water Resources Systems Engineering</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112671 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Discounting techniques for public works planning; socio-economic evaluation in water resources development and pollution control; benefit-cost analysis; allocation of joint-costs in multipurpose development; design and risk analysis; applications to planning and management of flood control, drainage, water supply, hydropower, irrigation, water quality control, recreation and navigation.</td>
</tr>
<tr>
<td>2112674</td>
<td>Water Management</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112671 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Water requirements for agriculture, industries, communities and environmental; economic, social and political criteria in water resources allocations; water resources allocation techniques and optional allocations.</td>
</tr>
<tr>
<td>2112681</td>
<td>Engineering for Water Disaster Mitigation</td>
<td>3 (3-0-9)</td>
<td>Condition: Consent of Faculty (S/U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Introduction to water disaster resilience, causes and mitigation of flood disaster, basic concept of designing flood mitigation and beach erosion protection, risk in hydrologic, hydraulic and coastal engineering, field trip to water disaster prone areas.</td>
</tr>
<tr>
<td>2112691</td>
<td>Special Studies in Water Resources Engineering</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112691 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Special problems in water resources engineering with emphasis on research work and independent study.</td>
</tr>
<tr>
<td>2112692</td>
<td>Advanced Topics in Water Resources Engineering</td>
<td>3 (3-0-9)</td>
<td>Condition: Prerequisite 2112692 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A special course offering the advanced topics on the current research and development in water resources engineering. (offered under special circumstance)</td>
</tr>
<tr>
<td>2112698</td>
<td>Seminar in Water Resources Engineering I</td>
<td>1 (0-3-1)</td>
<td>Condition: Prerequisite 2112698 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Discussion of special topics related to advanced water resources engineering; analysis of data and conclusion; presentation of reports.</td>
</tr>
<tr>
<td>2112798</td>
<td>Seminar in Water Resources Engineering II</td>
<td>1 (0-3-1)</td>
<td>Condition: Prerequisite 2112798 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Discussion of special topics related to advanced research works in water resources engineering; analysis of data and conclusions; presentation of reports.</td>
</tr>
<tr>
<td>2112799</td>
<td>Seminar in Water Resources Engineering III</td>
<td>1 (0-3-1)</td>
<td>Condition: Prerequisite 2112798 or Consent of Faculty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Discussion of special topics related to advanced research works in water resources engineering; analysis of data and conclusions presentation of reports.</td>
</tr>
<tr>
<td>2112811</td>
<td>Thesis</td>
<td>12 (0-0-0)</td>
<td></td>
</tr>
<tr>
<td>2112828</td>
<td>Dissertation</td>
<td>48 (0-0-0)</td>
<td></td>
</tr>
<tr>
<td>2101894</td>
<td>Doctoral Dissertation Seminar (S/U)</td>
<td>0 (0-0-0)</td>
<td></td>
</tr>
<tr>
<td>2112897</td>
<td>Qualifying Examination</td>
<td>0 (0-0-0)</td>
<td></td>
</tr>
</tbody>
</table>
VISION

ISE aims for Internationalization of Engineering under the determination of Chulalongkorn University in educating students with Knowledge and Morality and the promotion of Thai culture.

MISSION

- Teaching Engineering in English for both undergraduate and postgraduate students
- Promote and support research for academic excellence
- Support academic services for both domestic and international organizations
- Promote moral and Thai culture
- Support services after graduation for both career and higher education

ISE VALUES

- A unit under the Faculty of Engineering which has an excellence in academic, research and services in Engineering
- Readiness in human resources and forefront in teaching and learning
- Domestic and international collaboration with universities and Industries

ISE Executive Board (2016)

Chairman
Dean
Supot Techavorasinskun

Member
Associate Dean
Somporn Putvisutisak, Asst. Prof. Dr.
Naebboon Hoorchareon, Asst. Prof. Dr.
Suebskul Phipobmongkol, Asst. Prof. Dr.
Suttichai Assabumrungrat, Prof. Dr.
Cherdkul Sopavani, Asst. Prof. Dr.
Natawut Nupairoj, Asst. Prof. Dr.
Manoj Lohatepanont, Asst. Prof. Sc. D.
Natcha Thawesaengskulthai, Asst. Prof. Dr.

Assistant Dean
Chatpan Chintanapakdee, Asst. Prof. Dr.
Kuntinee Maneeratana, Assoc. Prof. Dr.
Athisit Surarerks, Asst. Prof. Dr.
Anongnat Somwangthanaroj, Assoc. Prof. Dr.
Boonrat Lohwongwatana, Dr.
Paveena Chaovalltwongse, Asst. Prof. Dr.
Noppadon Jokkaw, Asst. Prof. Dr.
Sanphet Chunihipaisan, Asst. Prof. Dr.
Atiwong Suchato, Assoc. Prof. Dr.
Pisut Painmanakul, Assoc. Prof. Dr. Ing.
Phongphaeth Pengvanich, Dr.
Jittichai Rudjanakanoknad, Asst. Prof. Dr.

Other Administrative Position
Nisachon Tangsanggiumvisai, Assoc. Prof. Dr.
Nares Chankow, Assoc. Prof. Dr.

Head of Department
Head of the Department of Mechanical Engineering
Head of the Department of Electrical Engineering
Head of the Department of Computer Engineering
Head of the Department of Industrial Engineering
Head of the Department of Chemical Engineering

Director
Supot Techavorasinskun

Associate Director
Ekachai Leelarasmee, Assoc. Prof. Dr.
Varong Pavarajarn, Asst. Prof. Dr.
Akawat Sirisuk, Dr.
Undergraduate curricula

International School of Engineering (ISE) was formed to serve as a channel for the Faculty of Engineering, Chulalongkorn University to keep abreast with the world’s challenges. Four diverse but complementary fields of study are offered at undergraduate level:

- Nano Engineering (NANO)
- Automotive Design and Manufacturing Engineering (ADME)
- Aerospace Engineering (AERO)
- Information and Communication Engineering (ICE)

Academic calendar for Undergraduate curricula

International semester system follows the international program time table set by Chulalongkorn University:

First semester: Fall (August - December)
Second semester: Spring (January - May)
Optional: Summer (June - July)

Contact:
International School of Engineering (ISE)
Faculty of Engineering
Chulalongkorn University
Phayathai Road, Pathumwan
Bangkok 10330
Tel. 02-218 6422-3
Fax. 02-218 6424
http://www.ise.eng.chula.ac.th
Email: ise@eng.chula.ac.th
Nano Engineering program is a multi-disciplinary scheme in which students learn how to understand and engineer various functional systems at the atomic scale. Sub-microscopically the physical, chemical, and biological properties of materials are different those of bulk forms in the macroscopic level from Uncovering these unique characteristics propels the groundbreaking research and development of novel applications, making nano-technology the next industrial revolution.

Nano Engineering program aims to develop produce undergraduate students with strong backgrounds in biomedical chemical, electrical, and materials engineering. Medicine, plastic, materials research, and high performance electronics are just some of the many areas in which development on the nano scale are becoming a major force for technological improvement. Upon completion of their degree, our students form a unique and important human resource pool, capable of driving manufacturing and services industries towards future success.

Nano Engineering curriculum has offered two majors in Nano-Engineering and Bio-Nano Engineering. By which, all students have to make a decision on their field in the third semester.

Each student is required to accumulate a minimum of 146 credits to graduate for Bachelor of Engineering Program in Nano-Engineering (International Program) which also includes 2 credits of industrial training and 4 credits of senior project.

Curriculum board

<table>
<thead>
<tr>
<th>Name</th>
<th>Degree/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phulporn Saengbangplia</td>
<td>M.Sc (Manchester,UK)</td>
</tr>
<tr>
<td>Pramote Dechaumpchai</td>
<td>Ph.D. (Virginia)</td>
</tr>
<tr>
<td>Ekachai Leelarasmeee</td>
<td>Ph.D. (California)</td>
</tr>
<tr>
<td>Asu Bunyajiradulaya</td>
<td>Ph.D. (California)</td>
</tr>
<tr>
<td>Sriporn Damrongseakkul</td>
<td>Ph.D. (London)</td>
</tr>
<tr>
<td>Atiwong Suchato</td>
<td>Ph.D. (Massachusetts)</td>
</tr>
<tr>
<td>Patama Visuttipitukul</td>
<td>Ph.D. (Tokyo)</td>
</tr>
<tr>
<td>Sunhapos Chatanauwathana</td>
<td>Ph.D. (Michigan)</td>
</tr>
<tr>
<td>Chaodit Aswakul</td>
<td>Ph.D. (London)</td>
</tr>
<tr>
<td>Yan Zhao</td>
<td>Ph.D. (London)</td>
</tr>
<tr>
<td>Surapong Sirikulvadhana</td>
<td>M.S. (Michigan)</td>
</tr>
<tr>
<td>Varong Pavarajarn</td>
<td>Ph.D. (Oregon)</td>
</tr>
</tbody>
</table>

Professors

Electrical Engineering
- David Banjerdpongchai, Ph.D. (Stanford)

Associate Professors

Electrical Engineering
- Songphol Kanjanachuchai, Ph.D. (Cambridge)
- Nisachon Tangsanngumvisai, Ph.D. (London)

Mechanical Engineering
- Asi Bunyajiradulaya, Ph.D. (UC, Irvine)

Chemical Engineering
- Artwan Shotipruk, Ph.D. (Michigan, Ann Arbor)
- Deacha Chatsiriwech, Ph.D. (Imperial College)
- Tharathon Mongkhonsi, Ph.D. (London)
- Sarawut Rimduwit, Ph.D. (U.S.A.)
- Anongnat Somwangthanaroj, Ph.D. (Michigan)

Metallurgical and materials Engineering
- Seksak Asavavisitchai, Ph.D. (Nottingham)

Assistant Professors

Electronic Engineering
- Arporn Teeramongkonrasmee, Ph.D. (Chula)
- Widhyakorn Asdormwised, D.Eng. (Chula)
- Chanchana Tangwongsan, Ph.D. (Wisconsin)
- Chanchai Phuempiwiriyaevil, Ph.D. (Carregie Mellon)
- Thavatchai Tayjasa, Ph.D. (Canada)

Mechanical Engineering
- Noppadai Ajavakom, Ph.D. (UC, Berkeley)
- Niphon Wonsaphark, D.Eng. (Chula)
- Thanyarat Singhthanart, Ph.D. (Tokyo)
- Alongkorn Pimpin, Ph.D. (Tokyo)

Chemical Engineering
- Varong Pavarajarn, Ph.D. (Oregon State)
- Sorata Kanokpanont, Ph.D. (Drexel)
- Kasidit Nootong, Ph.D. (Pennsylvania)
- Soorathep Kheawhom, Ph.D. (Tokyo)

Metallurgical and materials Engineering
- Ittipon Diewwanit, Sc.D. (MIT)
### Industrial Engineering
- Patama Visuttipitukul, Ph.D. (Tokyo/Japan)
- Daricha Sutivong, Ph.D. (Stanford)

### Electrical Engineering
- Chann Wissawinthanon, Ph.D. (USA)
- Boonchuay Supomonchai, B.Eng. (Chula)
- Supatana Auethavekiat, Ph.D. (Tokyo)

### Mechanical Engineering
- Tawan Paphapote, M.S. (Illinois)
- Werayut Srituravanich, Ph.D. (UCLA)

### Chemical Engineering
- Akawat Siriuk, Ph.D. (Wisconsin)
- Varun Taepaisitphongse, Ph.D. (UCLA)

### Environmental Engineering
- Acharya Suryawong, Ph.D. (St. Louis)

### Computer Engineering
- Chate Patanothai, M.Sc. in EE. (Miami)

### ISE Staffs
- Yan Zhao, Ph.D. (London)
- Porpin Pungetmongkol, Ph.D. (Tokyo)
- Rehan Hussain, Ph.D. (Cambridge)

### Visiting Professor
- Pensri Thongnopneua, Ph.D. (New Jersey)

### Assistant Professors
- Wuthichai Wongthatsanekorn, Ph.D. (U.S.A.)

### Lecturer
- Niti Yongvanich, Ph.D. (Pennsylvania)
- Nuwong Chollacoop, Ph.D. (U.S.A.)
- Pimporn Uttayarat, Ph.D. (Pennsylvania)
- Yupawadee Sathirakul, Ph.D. (Los Angeles)
- Viriya Udomphol, Ph.D. (Pennsylvania)
- Akarin Phailubapanich, Ph.D. (Michigan)
- Adisorn Tuantranont, Ph.D. (Colorado)
- Anurat Wisitsorarat, Ph.D. (U.S.A.)
- Oratai Jongprateep, Ph.D. (U.S.A.)
- Benjaratg Pupacdi, Ph.D.

### Curriculum

| Total number of credits requirement | 146 credits |

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>110 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Sciences</td>
<td>22 credits</td>
</tr>
<tr>
<td>Basic Engineering</td>
<td>30 credits</td>
</tr>
<tr>
<td>Compulsory</td>
<td>34 credits</td>
</tr>
<tr>
<td>Approved Electives</td>
<td>24 credits</td>
</tr>
</tbody>
</table>

### Free Electives | 6 credits |

#### 1. General Education
- Social Science | 3 credits
- Humanity | 3 credits
- Interdisciplinary | 3 credits
- Science and Mathematics | 3 credits
- General Education (Special) | 6 credits

2140111 Exploring Engineering World | 3 (3-0-6)
2189336 Materials in Daily Life | 3 (3-0-6)

### Foreign Language | 12 credits |

5501112 Communicative English I | 3 (3-0-6)
5501123 Communicative English II | 3 (3-0-6)
5501214 Communication and Presentation Skills | 3 (3-0-6)

5501225 Technical Writing | 3 (3-0-6)

#### 2. Core Course | 110 credits |

- Basic Mathematics and Sciences | 22 credits |
2301107 Calculus I | 3 (3-0-6)
2301108 Calculus II | 3 (3-0-6)
2302103 General Chemistry Laboratory 1 | 1 (0-3-0)
2302105 Chemistry for Engineers | 3 (3-0-6)
2303111 Biology for Engineers | 3 (3-0-6)
2303112 Biology Laboratory for Engineers | 1 (0-3-0)

2304153 Physics for Engineers | 3 (3-0-6)
2304154 Physics and Electronics for Engineers | 3 (3-0-6)

2304193 Physics Laboratory for Engineers | 3 (3-0-6)
2304194 Physics and Electronics Laboratory for Engineers | 3 (3-0-6)

### Basic Engineering | 30 credits |

2140301 Industrial Training 2 | 0 (6-0)
2182201 Mathematics for Nano-Engineers | 3 (3-0-6)
2182203 Probability and Statistics for Engineers | 3 (3-0-6)

2183101 Engineering Graphics | 3 (2-3-4)
2184303 Engineering Management | 3 (3-0-6)
2185222 Physical Chemistry for Nano-Engineers | 3 (3-0-6)
2185320 Inorganic Chemistry for Nano-Engineers | 3 (3-0-6)
2189101 Engineering Materials | 3 (3-0-6)
2189201 Introduction to Materials Science and Engineers | 3 (3-0-6)
2190101 Computer Programming | 3 (3-0-6)
2190151 Computer Programming Laboratory I | 1 (0-3-0)

### Compulsory | 34 credits |

2141490 Nano Seminar | 4 (1-0-2)
2141491 Research Methodology | 2 (2-0-4)
2141498 Nano-Engineering Pre-Project | 1 (0-2-1)
2141499 Nano-Engineering Project | 3 (0-6-3)
2182210 Electrical Circuit | 3 (3-0-6)
2182213 Electrical Circuit Laboratory | 1 (0-3-0)
2182280 Semiconductor Devices I | 3 (3-0-6)
2182311 Measurement and Instrumentation | 3 (3-0-6)
2185211 Engineering Mechanics | 4 (4-0-6)
2185220 Basic Organic Chemistry | 3 (3-0-6)
2185221 Organic Chemistry Laboratory | 1 (0-3-0)
2185322 Thermodynamics for Nano-Engineers | 3 (3-0-6)
2185333 Transport Phenomena | 3 (3-0-6)
Approved Electives
Approved Elective Level 1
Select 12 Credits from 2 fields in the following list.

Fields Nanoelectronics
2182440 Introduction to Nanoelectronics 3 (3-0-6)
2183411 Micro and Nanofabrication Technology 3 (3-0-6)

Fields Nano Chemistry
2185324 Molecular Chemistry 3 (3-0-6)
2185373 Reaction Engineering 3 (3-0-6)

Fields Biomedical Nanotechnology
2182441 Biomedical Electronics 3 (3-0-6)
2141350 Biological Interaction with Materials 3 (3-0-6)

Fields Nano Materials Science
2141400 Principles of Nanostructured Materials 3 (3-0-6)
2189301 Bonding, Crystallography and Defects 3 (3-0-6)

Approved Elective Level 2
Select 12 credits from any courses in the following list or from courses in Approved elective level I.

2141331 Quantum Mechanics for Engineers 3 (3-0-6)
2141347 Introduction to Pharmaceutical Nanotechnology 3 (3-0-6)
2141451 Bionanotechnology 3 (3-0-6)
2141474 Introduction to Lab-on-a-Chip 3 (3-0-6)
2141511 Special Topics in Nano Eng I 3 (3-0-6)
2141512 Special Topics in Nano Eng II 3 (3-0-6)
2182330 Linear Control Systems 3 (3-0-6)
2182443 Introduction to VLSI Technology 3 (3-0-6)
2182480 Semiconductor Devices II 3 (3-0-6)
2182580 Optoelectronics 3 (3-0-6)
2183412 Micro and Nano-Electro Mechanical Systems 3 (3-0-6)
2183431 Mechanical Vibrations 3 (3-0-6)
2185323 Intermediate Organic Chemistry 3 (3-0-6)
2185452 Biosystems and Biotransport 3 (3-0-6)
2185479 Nanopolymer Engineering 3 (3-0-6)
2189411 Mechanical Behavior of Materials 3 (3-0-6)
2189417 Composite Materials 3 (3-0-6)
2189450 Materials Design and Selection 3 (3-0-6)

3. Free Electives 6 credits
Select 6 credits from any courses offered in English by any International Programs in Chulalongkorn University.
# NANO ENGINEERING CURRICULUM (INTERNATIONAL PROGRAM)

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2190101</td>
<td>Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>2190151</td>
<td>Computer Programming Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2301107</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>2302103</td>
<td>General Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2302105</td>
<td>Chemistry for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304153</td>
<td>Physics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304193</td>
<td>Physics Lab. For Engineers</td>
<td>1</td>
</tr>
<tr>
<td>5501112*</td>
<td>Communicative English I</td>
<td>3</td>
</tr>
<tr>
<td>2140111</td>
<td>Exploring Engineering World</td>
<td>3</td>
</tr>
<tr>
<td>2183101</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td>2189101</td>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>2304154</td>
<td>Physics and Electronics for Eng</td>
<td>3</td>
</tr>
<tr>
<td>2304194</td>
<td>Physics and Electronics Lab. for Eng</td>
<td>1</td>
</tr>
<tr>
<td>5501123</td>
<td>Communicative English II</td>
<td>3</td>
</tr>
<tr>
<td>2182201</td>
<td>Mathematics for Nano-Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2182210</td>
<td>Electrical Circuit</td>
<td>3</td>
</tr>
<tr>
<td>2183211</td>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>2189201</td>
<td>Introduction to Material Science and Eng</td>
<td>3</td>
</tr>
<tr>
<td>2185220</td>
<td>Basic Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>2185221</td>
<td>Organic Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>5501214</td>
<td>Communication and Presentations Skills</td>
<td>3</td>
</tr>
<tr>
<td>2182213</td>
<td>Probability and Statistics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2182280</td>
<td>Semiconductor Devices I</td>
<td>3</td>
</tr>
<tr>
<td>2303111</td>
<td>Biology for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2303112</td>
<td>Biology Laboratory for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>2185222</td>
<td>Physical Chemistry for Nano-Eng</td>
<td>3</td>
</tr>
<tr>
<td>5501225</td>
<td>Technical Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

## TOTAL CREDITS FOR GRADUATION: **146**
### COURSES DESCRIPTIONS IN NANO ENGINEERING (B.ENG)

**General Education (Special)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2140111</td>
<td>Exploring Engineering World</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Engineering topics related to daily life: energy, resources, environment, manufacturing process, industry, material, automotive, infrastructure, information system and bioengineering.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2189336</td>
<td>Materials in Daily Life</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Different aspects of materials as found in daily life, in various occupations and in various applications; environmentally friendly materials; full utilization of materials in both efficient sense and artistic sense; topics related to materials for design.

**Foreign Language**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>5501112</td>
<td>Communicative English I</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Practice language skills in acquiring information and knowledge in subjects of students’ interest under selected themes; collecting information, summarizing and presenting important issues.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>5501123</td>
<td>Communicative English II</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students’ interest under selected themes; summarizing what they have learned, and presenting opinions from group discussion.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>5501214</td>
<td>Communication and Presentation Skills</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Practice using English for social communication and giving oral presentation on engineering-related topics.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>5501225</td>
<td>Technical Writing</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Practice in writing summaries composing different types and styles of writing in the field of engineering and writing reports of studies and experiments.

**Core Courses Basic Sciences**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2301107</td>
<td>Calculus I</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Limits; continuity; differentiation; applications of differentiation; integration; applications of definite integral; transcendental functions; techniques of integration; improper integrals; first-order differential equations.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Sequences and infinite series; convergence tests; power series; Taylor series; lines; planes, and quadric surface in three-dimensional space; calculus of vector-valued functions; line integrals; limits and continuity of functions of several variables; partial derivatives; directional derivatives and gradients; Lagrange multipliers; multiple integrals.

**Basic Engineering**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2140301</td>
<td>Industrial Training</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

- Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2182201</td>
<td>Mathematics for Nano-Engineering</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

2182203 Probability and Statistics for Engineers 3 (3-0-6)
Condition: PRER 2301108 Calculus II
Engineering basis in statistics and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: estimator, bias, consistency; point estimation; interval estimation; engineering applications in measurement and uncertainty, linear regression, introduction to random process; integration of statistics in engineering applications; case studies.

2183101 Engineering Graphics 3 (2-3-4)
Lettering; orthographic projections; sketching and drawing; pictorial drawing; dimensioning; tolerancing and geometrical tolerancing; section; working drawing; mechanical parts drawing; introduction to CAD.

2184303 Engineering Management 3 (3-0-6)
Modern management principles; methods of increasing productivity; human relations; industrial safety; pollution problems; commercial laws; basics of engineering economy, finance, marketing, and project management.

2185222 Physical Chemistry for Nano-Engineering 3 (3-0-6)
Basic concept of thermodynamics; thermodynamics laws; phase rule; phase equilibrium; principal of chemical kinetics; rate of chemical reactions; chemical equilibrium.

2185320 Inorganic Chemistry for Nano-Engineering 3 (3-0-6)
Atomic structure and periodicity; molecular geometry and symmetry; introduction to molecular orbital theory; reaction with electron transfer; inorganic solids.

2189101 Engineering Materials 3 (3-0-6)
Important engineering materials: metals, plastics, asphalt, wood and concrete; phase diagram and its interpretation; testing and meaning of various properties; macroscopic and microscopic structures which are correlating with properties of the engineering materials; production process of products from engineering materials.

2189201 Introduction to Materials Science and Engineering 3 (3-0-6)
Atomic structures and bonding in solids; crystallography; phase, surface and interface; defects and dislocations; diffusion in solids; phase equilibrium diagrams; mechanical properties; relationship between micro-and nano-structures and properties of engineering materials; classes of engineering materials; production and processing of engineering materials.

2190101 Computer Programming 3 (3-0-6)
Introduction to computer systems; problem-solving using computers; programming style and convention, control statements, data handling and processing; subprograms; classes and objects.

2190151 Computer Programming Laboratory 1 (0-3-0)
Computer programming in Engineering; reviews of computer programming concepts; hands-on experience on computer programming using contemporary engineering tools.

Compulsory

2141490 Nano Seminar 1 (1-0-2)
Seminar on interesting topics related to nano-engineering.
2185322 Thermodynamics for Nano-Engineering 3 (3-0-6)

Thermodynamics for Nano-Engineering covers the fundamental concepts of thermodynamics as they apply to nanomaterials. This course explores the laws and principles governing the synthesis and application of nanomaterials, focusing on the transport and thermodynamic properties of nanomaterials.

Transport Phenomena Material Characterization

2189341 Materials Characterization 3 (3-0-6)

Materials Characterization is a course that teaches students how to characterize materials at the nanoscale. Topics include optical microscopy, scanning probe microscopy, transmission electron microscopy, and other advanced techniques.

Fields Nanoelectronics

2182440 Introduction to Nanoelectronics 3 (3-0-6)

Introduction to Nanoelectronics covers the basics of nanoscale fabrication, including semiconductor devices and fabrication processes. It also introduces the fundamentals of nanoelectronics, such as nanoscale electronics and novel semiconductor devices.

2183411 Micro and Nano Fabrication Technology 3 (3-0-6)

Micro and Nano Fabrication Technology focuses on the techniques used for the fabrication of micro and nanoscale devices. This includes lithography, etching, and deposition technologies.

Fields Nanochemistry

2185324 Molecular Chemistry 3 (3-0-6)

Molecular Chemistry introduces the fundamental concepts of molecular chemistry and its applications in both organic synthesis and catalysis.

2185373 Reaction Engineering 3 (3-0-6)

Reaction Engineering covers the fundamentals of reaction engineering, including reaction kinetics, mechanisms of homogeneous and heterogeneous reactions, and reaction rate data analysis.

 Fields Biomedical Nanotechnology

2182241 Biomedical Electronics 3 (3-0-6)

Biomedical Electronics covers the electrical signals in human body, action potential in cells, electrodes, amplifiers, transducers, electronic monitoring systems, ECG, EEG, EMG; blood pressure and blood flow measurement; catheterization electrical hazards and prevention; medical instrumentation; computer in medicine.

2141350 Biological Interaction with Materials 3 (3-0-6)

Biological Interaction with Materials focuses on basic biological systems that interact with biomaterials and the range of materials currently used for biomedical applications. It includes appropriate analytical techniques pertinent to biomaterial research and evaluation; selected important medical fields in which biomaterials play a critical role.

Fields Nano Materials Science

2141400 Principles of Nanostructured material 3 (3-0-6)

Principles of Nanostructured material covers the laws and theories governing the synthesis and control of nanomaterial systems; free energy and kinetic principles involved in synthesis, assembly, structure, and performance of nanomaterials; diffusion and diffusionless transformations and kinetics.

2189301 Bonding, Crystallography and Defects 3 (3-0-6)

Bonding, Crystallography and Defects introduces atomic structure, hybridization, molecular orbital theory, covalency, ionicity, electronegativity; band structures of semiconductors; transition metals and ferromagnetism; crystal structures, group and symmetry and diffractions; structural features of materials; point defects, dislocations, and surfaces; pure elements, solid solutions, compounds and phase diagrams.

Approved Elective Level 2

2141331 Quantum Mechanics for Engineers 3 (3-0-6)

Quantum Mechanics for Engineers introduces the fundamental concepts of quantum mechanics; concepts of function spaces and Hermitian operators; superposition principles and compatible observables; Schrodinger equation and problems in one dimension; hydrogen atom; angular momentum; wave functions of electrons in confined potentials.

2141347 Introduction to Pharmaceutical Nanotechnology 3 (3-0-6)

Introduction to Pharmaceutical Nanotechnology covers the importance of nanotechnology in enhancing pharmaceutical technology; fundamental pharmacokinetics for engineers; reviews of the types and characteristics of physico-chemical properties of biomaterials produced in Thailand; fabrication technology of nanomaterials: nanoparticles, micelles, vesicles, liposomes, microemulsions, nanocapsules, polymer multilayers, nanoporous materials and nanocapsules, as well as experimental techniques to characterize these nanomaterials; pharmaceutical technologies.

2141451 Bionanotechnology 3 (3-0-6)

Bionanotechnology introduces nanosensors and nanodevices for clinical diagnostics; nanoscale structures for drug delivery; nannarrays; use of nananalytical devices and systems; methods and techniques for modification or functionalization of nanoparticles and nanostructures with biological molecules; potential use of DNA and other biomolecules for computing and ultra high-density data storage.

2141474 Introduction to Lab-on-a-Chip 3 (3-0-6)

Introduction to Lab-on-a-Chip introduces interesting topics in the field of nano-engineering.

2141451 Special Topics in Nano Engineering I 3 (3-0-6)

Special Topics in Nano Engineering I covers interesting topics in the field of nano-engineering.

2141512 Special Topics in Nano Engineering II 3 (3-0-6)

Special Topics in Nano Engineering II covers interesting topics in the field of nano-engineering.

2182330 Linear Control Systems 3 (3-0-6)

Linear Control Systems introduces open-loop and closed-loop control systems; mathematical models of physical systems; linearization; block diagrams; signal flow graphs; basic control actions and compensations; time-domain responses; Routh-Hurwitz stability test; control system design by the root method.
locus method; Body and Nyquist plots; Nyquist stability criterion; Nichols charts; control system design by frequency response method.

2182443 Introduction to VLSI Technology
INTRO VLSI TECH 3 (3-0-6)
Fundamentals of digital and analogue circuits.

2182480 Semiconductor Devices II
SEMICO DEVI II 3 (3-0-6)
CONDITION: PRER 2182280*
Semiconductor Devices I
Review of physics and properties of semiconductors; compound semiconductor; P-N junction; metal-semiconductor junctions; heterojunctions; MESFET; heterojunction transistors: HEMT and HBT; microwave devices; high speed photonic devices and integrated circuits.

2182580 Optoelectronics
OPTOELECTRONICS 3 (3-0-6)
Physics of optical radiation; interaction between optical radiation and matter; principles and applications of optoelectronic devices: sources, detectors as well as other optical materials, devices, components and equipment.

2183412 Micro and Nano-Electro Mechanical Systems
MEMS/NEMS 3 (3-0-6)
Overview of MEMs; scaling of micromechanical devices; behavior and modeling of micromechanical devices; mechanical properties of MEMs materials; review of microfabrication; bulk and surface micromachining; application of MEMs: pressure sensors, accelerometer; micromotors; micropumps and microvalves; thermal sensors and actuators; micromirror.

2183431 Mechanical Vibrations
MECH VIBRATIONS 3 (3-0-6)
Analysis of system with single and multi-degree of freedom; torsional vibration; free and forced vibration; determination of natural frequencies of structures; discrete system; Modal analysis; methods and techniques to reduce and control vibration; Lagrange’s equations.

2185479 Nanopolymer Engineering
NANOPOLY ENG 3 (3-0-6)
Definitions and basic concepts; crystalline and glassy polymer; molecular architecture; conformation and morphology; polymer synthesis; transition phenomena; mechanical properties affected by the transition phenomena; theory of rubber elasticity; polymer rheology; types of mechanical deformations; basic rheological response; viscoelastic properties of polymer; linear viscoelastic models; synthesis of controlled architecture polymers; morphological characterization; block copolymers; polymer surfaces and interfaces; nano-effects in polymer blends and composites; applications of polymer nanotechnology for electronics and photonics.

2189411 Mechanical Behavior of Materials
MECH BEHAV MAT 3 (3-0-6)
Elastic behavior; theory of plasticity; dislocation theory; mechanical failure: fractures, fatigue, creep, embrittlement; materials testing: tension, hardness, torsion, impact, fatigue, creep; fracture mechanics; mechanical behavior of composite materials.

2189417 Composite Materials
COMPOSITE MAT 3 (3-0-6)
Properties of engineering composite materials; types of composite materials; fiber and interfaces with matrix; geometrical properties; elasticity; case studies.

2189450 Materials Design and Selection
MAT DSGN SEL 3 (3-0-6)
Basic materials; concept of materials selection; steps in materials design; case studies.
Automotive design and manufacturing engineering is a highly demanded profession, which is linked to the national and global boosted growth of automotive industry. Automotive design involves the development of motor vehicles with a primarily concern on design of mechanical components and the creation of the product concept. Manufacturing engineering deals with all aspects of manufacture, from production control to materials handling to automation.

Our ADME graduates, being specialized, are trained in both automotive design and manufacturing engineering. Our program trains students to have a solid background in both fields with a flexibility to choose to specialize in either topic. This advantage doubles the job opportunities for our graduates, whilst serving the local and international automotive industry with qualified and versatile engineers with a broad academic background.

Each student is required to accumulate a minimum of 146 credits to graduate for Bachelor of Engineering Program in Automotive Design and Manufacturing Engineering (International Program) which also includes 2 credits of industrial training and 3 credits of senior project.

Curriculum board
Phulporn Saengbangpla M.Sc (Manchester,UK)
Pramote Dechaumphai Ph.D. (Virginia)
Ekachai Leelarasmee Ph.D. (California)
Asi Bunyajitrtradulya Ph.D. (California)
Siriporn Damrongsaokkul Ph.D. (London)
Atiwong Suchato Ph.D. (Massachusetts)
Patama Veesitpitukul Ph.D. (Tokyo)
Sunhapus Chartanuwathana Ph.D. (Michigan)
Chaidit Aswakul Ph.D. (London)
Yan Zhao Ph.D. (London)
Surapong Sirikulvadhana M.S (Michigan)
Varong Pavarajarn Ph.D. (Oregon)

Professors
Mechanical Engineering
Pramote Dechaumphai Ph.D. (Old Dominion)
Somsak Chaiyapinunt Ph.D. (Oregon State)
Viboon Sangveraphunsiri Ph.D. (Georgia Tech)

Associate Professors
Electrical Engineering
Ekachai Leelarasmee Ph.D. (California)
Chedsada Chirunrueng Ph.D. (California Berkeley (U.S.A.)

Mechanical Engineering
Asi Bunyajitrtradulya Ph.D. (UC Irvine)
Kuntinee Maneeratana Ph.D. (London)
Pongtorn Charunyakorn Ph.D. (Miami)
Kanit Wattanavichien Ph.D. (Melbourne)
Ratchatin Chanchareon D.Eng. (Chula)

Industrial Engineering
Somkiat Tangjitsitchareon D.Eng.(Kobe Japan)

Metallurgical and materials Engineering
Seksak Asavavisithchai Ph.D. (Nottingham)

Assistant Professors
Electrical Engineering
Wanchalerm Pora Ph.D. (London)
Suree Pumrin Ph.D.(Washington)

Mechanical Engineering
Boonchai Lertnuwat Ph.D. (Tokyo)
Sunhapus Chantranuwathana Ph.D. (Michigan)
Witaya Wannasuphoprasit Ph.D. (Northwestern)
Nopdanai Ajavakom Ph.D. (UC.Berkeley)
Niphon Wansophark D.Eng. (Chula)
Alongkorn Pimpin D.Eng. (Tokyo)
Chanat Ratanasumawong D.Eng. (Tokyo Tech)
Phongsaeen Pitakwatchara M.S.M.E.
Thanarat Singhanart Ph.D. (Tokyo) (Georgia Tech)

Industrial Engineering
Somchai Puajindanetr Ph.D. (London)
Haruetai Lohasiriwat MS. (VPI & SU)
## Metallurgical and materials Engineering

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itthipon Diewwanit</td>
<td>Lecturer</td>
<td>Sc.D. (MIT)</td>
<td></td>
</tr>
<tr>
<td>Boonchuay Supmonchai</td>
<td>Lecturer</td>
<td>M.Eng. (Chula)</td>
<td></td>
</tr>
<tr>
<td>Nuksit Noomwongs</td>
<td>Lecturer</td>
<td>D.Eng. (TUAT)</td>
<td></td>
</tr>
<tr>
<td>Chirdpun Vitooraporn</td>
<td>Staff</td>
<td>Ph.D. (MIT)</td>
<td></td>
</tr>
<tr>
<td>Tawan Paphapote</td>
<td>Staff</td>
<td>Ph.D.C. United States of America</td>
<td></td>
</tr>
<tr>
<td>Oran Kittithreerapronchai</td>
<td>Staff</td>
<td>Ph.D. Georgia</td>
<td></td>
</tr>
<tr>
<td>Phulporn Saengbangpla</td>
<td>Staff</td>
<td>M.Sc., ME (England)</td>
<td></td>
</tr>
<tr>
<td>Prabhath De Silva</td>
<td>Staff</td>
<td>Ph.D. (USA)</td>
<td></td>
</tr>
<tr>
<td>Suradej Voranuotsontorn</td>
<td>Guest Lecturer</td>
<td>Private Consultant</td>
<td></td>
</tr>
<tr>
<td>Somchai Peungperksuk</td>
<td>Visiting Professor (USA)</td>
<td>Ph.D.</td>
<td></td>
</tr>
<tr>
<td>Kaukeart Boonchakosol</td>
<td>Visiting Professor (USA)</td>
<td>Poitiers (France)</td>
<td></td>
</tr>
</tbody>
</table>

## Curriculum

**Total number of credits requirement:** 147 credits

<table>
<thead>
<tr>
<th>Section</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Education</strong></td>
<td>30</td>
<td>3 credits</td>
</tr>
<tr>
<td><strong>Core Courses</strong></td>
<td>111</td>
<td>21 credits Basic Sciences, 31 credits Basic Engineering, 50 credits Compulsory Courses, 9 credits Approved Electives</td>
</tr>
<tr>
<td><strong>Free Electives</strong></td>
<td>6</td>
<td>6 credits</td>
</tr>
</tbody>
</table>

### 1. General Education
- Social Science 3 credits
- Humanity 3 credits
- Science and Mathematics 3 credits
- Interdisciplinary 3 credits
- Foreign Language 12 credits

### 5501112 Communicative English I
- 3 (3-0-6)

### 5502124 Communication and Presentation Skills
- 3 (3-0-6)

### 5501225 Technical Writing
- 3 (3-0-6)

### 5501111 Exploring Engineering World
- 3 (3-0-6)

### 2. Core Course
- 111 credits
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Meeting HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2142492</td>
<td>And Data Acquisition</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2142493</td>
<td>Selected Topics in Automotive Engineering I</td>
<td>3</td>
<td>(2-3-4)</td>
</tr>
<tr>
<td>2142495</td>
<td>Selected Topics in Automotive Engineering II</td>
<td>3</td>
<td>(2-3-4)</td>
</tr>
<tr>
<td>2182430</td>
<td>System Dynamics and Controls</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2182442</td>
<td>Embedded Systems in Automotive Engineering</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2183431</td>
<td>Mechanical Vibrations</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2184401</td>
<td>Engineering Experimental Design</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2184404</td>
<td>Process Management and Lean Manufacturing</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2184405</td>
<td>Product Planning and Control</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2184406</td>
<td>Quality Control and Management For Automotive Industry</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2184407</td>
<td>Quality Design and Innovation Management</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2184409</td>
<td>Value Engineering</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2189102</td>
<td>Engineering Materials II</td>
<td>3</td>
<td>(3-0-6)</td>
</tr>
<tr>
<td>2190216</td>
<td>Information Technology for Professional Communications</td>
<td>2</td>
<td>(1-3-2)</td>
</tr>
</tbody>
</table>

3. Free Electives 6 credits
Select 6 credits from any courses offered in English by any International Programs in Chulalongkorn University.
## AUTOMOTIVE DESIGN AND MANUFACTURING ENGINEERING CURRICULUM (INTERNATIONAL PROGRAM)

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>FIRST SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2190101</td>
<td>Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>2190151</td>
<td>Computer Programming Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2301107</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>2302103</td>
<td>General Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2302105</td>
<td>Chemistry for Eng.</td>
<td>3</td>
</tr>
<tr>
<td>2304153</td>
<td>Physics for Eng.</td>
<td>3</td>
</tr>
<tr>
<td>2304193</td>
<td>Physics Lab for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>5501112</td>
<td>Communicative Eng I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td><strong>SECOND SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2140111</td>
<td>Exploring Engineering World</td>
<td>3</td>
</tr>
<tr>
<td>2183101</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td>2189101</td>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>2304154</td>
<td>Physics and Electronics for Eng.</td>
<td>3</td>
</tr>
<tr>
<td>2304194</td>
<td>Physics and Electronics Lab for Eng.</td>
<td>1</td>
</tr>
<tr>
<td>5501123</td>
<td>Communicative English II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td><strong>THIRD SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2142251</td>
<td>Manufacturing Process for Automotive Eng I</td>
<td>3</td>
</tr>
<tr>
<td>2183212</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>2183221</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>2183271</td>
<td>Automotive Engineering Workshop</td>
<td>1</td>
</tr>
<tr>
<td>2183281</td>
<td>Introduction to Automotive Eng.</td>
<td>3</td>
</tr>
<tr>
<td>2184201</td>
<td>Probability and Statistics for Auto Eng.</td>
<td>3</td>
</tr>
<tr>
<td>2301312</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td><strong>FOURTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2142201</td>
<td>Engineering First</td>
<td>3</td>
</tr>
<tr>
<td>2142252</td>
<td>Manufacturing Process for Auto Eng II</td>
<td>3</td>
</tr>
<tr>
<td>2182210</td>
<td>Electrical Circuit</td>
<td>3</td>
</tr>
<tr>
<td>2182213</td>
<td>Electrical Circuit Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2183213</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>2183231</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>5501214</td>
<td>Communication and Presentation Skills</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td><strong>FIFTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2182310</td>
<td>Electronics and Instrumentation for Auto</td>
<td>3</td>
</tr>
<tr>
<td>2183222</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>2183261</td>
<td>Mechanical Engineering Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>2183272</td>
<td>Automotive Instrument Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2183331</td>
<td>Mechanics of Machinery</td>
<td>3</td>
</tr>
<tr>
<td>2184302</td>
<td>Product Development Process</td>
<td>3</td>
</tr>
<tr>
<td>5501225</td>
<td>Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td><strong>SIXTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2142424</td>
<td>Vehicle Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>2183321</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>2183332</td>
<td>CAD/CAM/CAE</td>
<td>3</td>
</tr>
<tr>
<td>2183351</td>
<td>Mechanical Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>2184303</td>
<td>Engineering Management</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td><strong>SUMMER SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2140301</td>
<td>Industrial Training</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>SEVENTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2142498</td>
<td>Automotive Engineering Pre-Project</td>
<td>1</td>
</tr>
<tr>
<td>2183322</td>
<td>Internal Combustion Engine</td>
<td>3</td>
</tr>
<tr>
<td>2183352</td>
<td>Motor Vehicle Design</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Free Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td></td>
<td><strong>EIGHTH SEMESTER</strong></td>
<td></td>
</tr>
<tr>
<td>2142499</td>
<td>Automotive Engineering Project</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Approve Electives</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Free Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS FOR GRADUATION** 147
214111 Exploring Engineering World 3 (3-0-6)
Engineering topics related to daily life: energy, resources, environment, manufacturing, process, industry, material, automotive, infrastructure, information system and bio engineering.

2183281 Introduction to Automotive Engineering 3 (3-0-6)
Basic Principles of automotive systems, components, and design; internal combustion engine; transmission; chassis; suspension; steering; brake; body; vehicle aerodynamics and automotive electronics; basic vehicle dynamics; performance and handling.

550112 Communicative English I 3 (3-0-6)
Practice language skills in acquiring information and knowledge from different sources and media in subjects of students' interest under selected themes; collecting information, summarizing and presenting important issues.

5501123 Communicative English II 3 (3-0-6)
Condition: PRER 5501112*
Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students' interest under selected themes; summarizing what they have learned, and presenting opinions from group discussion.

5501214 Communication and Presentation Skills 3 (3-0-6)
Condition: PRER 5501123*
Practice using English for social communication and giving oral presentation on engineering related topics.

5501225 Technical Writing 3 (3-0-6)
Condition: PRER 5501123*
Practice in writing summaries composing different types and styles of writing in the field of engineering and writing reports of studies and experiments.

Core Course
230107 Calculus 1 3 (3-0-6)
Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals.

230108 Calculus 2 3 (3-0-6)
Condition: PRER 230107
Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three dimensional space; calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2301312 Differential Equations 3 (3-0-6)
Condition: PRER 2301108
Existence and uniqueness theorem of solution of first order equations; initial value problem; Laplace transform; Taylor series expansion of elementary functions; numerical methods; general linear equations; solution in series; linear partial differential equations boundary value problems.

2302103 General Chemistry Laboratory 1 (0-3-0)
Standard solution preparation; qualitative analysis; titration; electrochemistry, pH metric titration; spectroscopy; calculation and evaluation of data; calibration curve; introduction to polymer.

2302106 Chemistry for Engineers 3 (3-0-6)
Stoichiometry and basis of the atomic theory; properties of the three states of matter and solution; thermodynamics; chemical equilibrium; Oxidation-reduction; chemical kinetics; the electronic structures of atoms and the chemical bond; periodic table; nonmetal and transition metal.

2304153 Physics for Engineers 3 (3-0-6)
Mechanics of particles and rigid bodies; properties of matter; fluid mechanics; heat; vibrations and waves; elements of electromagenetism; optics; modern physics.

2304154 Physics and Electronics for Engineers 3 (3-0-6)
Electricity DC circuits; AC circuits; basic electronics; electrical actuators.

2304193 Physics Laboratory for Engineers 1 (0-3-0)
Measurement and precision; experiments on simple harmonic motion; radius of gyration; dynamics of rotation; velocity of sound; viscosity of fluids.

2304194 Physics and Electronics Laboratory for Engineers 3 (3-0-6)
Resistance and electromotive force measurements; experiments on ammeter; voltmeter; oscilloscope; AC circuit; transistor; lenses and mirrors; polarization; interference; diffraction.

2140301 Industrial Training 2 (0-6-0)
Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

2142251 Manufacturing Process for Automotive Engineering I 3 (2-3-4)
Condition: PRER 2142251*
Introduction to the principles of manufacturing as related to automotive engineering; relationship between manufacturing process, material properties and structure; fundamentals of metal deformation, sheet metal forming processes; fundamentals of solidification processing; fundamentals of metal joining; principles of heat treatment and surface modification.

2142252 Manufacturing Process for Automotive Engineering II 3 (2-3-4)
Condition: PRER 2142251*
Metal removal and machining processes; processes of non-metallic materials: glass, polymers, and ceramics; surface and tribological characteristics; application of automation and computer integrated manufacturing systems in automotive part manufacturing; fundamentals of automotive part designs and technology management.
supply chains and structure of automotive part manufacturing.

2182210 Electrical Circuit Laboratory 3 (3-0-6) DC circuit; analysis; Kirchhoff's laws; Thevenin’s and Babinet’s theorems; transistor amplifier circuit; semiconductor devices; op-amp circuits; digital circuits; DC motor.

2182213 Electrical Circuit Laboratory Eletronic instruments; multimeter; oscilloscope; DC circuit; Voltage regulators; filter circuit; transistor amplifier circuit; op-amp circuits; digital Circuits; DC motor.

2183101 Engineering Graphics 3 (2-3-4) Lettering; orthographic projections; sketching and drawing; pictorial drawing; dimensioning; tolerancing and geometrical tolerancing; section; working drawing; mechanical parts drafting; introduction to CAD.

2183212 Statics 3 (3-0-6) Force systems; resultants; equilibrium; structure; distributed force; friction; virtual work; stability.

2184201 Probability and Statistics for Automotive Engineering 3 (3-0-6) Engineering basis in statistics and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: esto,atpr. Bias, consistency; point estimation; interval estimation; automotive engineering applications in measurement and uncertainty, linear regression, introduction to random process; integration of statistics in automotive engineering applications; case studies.

2184303 Engineering Management 3 (3-0-6) Modern management principles; methods of increasing productivity; human relations; industrial safety; pollution problems; commercial laws; basics of engineering economy, finance, marketing, and project management.

2189101 Engineering Materials 3 (3-0-6) Important engineering materials: metals, plastics, asphalt, wood and concrete; phase diagram and its interpretation; testing and meaning of various properties; macroscopic and microscopic structure which are correlating with properties of the engineering materials; production process of products from engineering materials.

2190101 Computer Programming 3 (3-0-6) Introduction to computer systems; problem-solving using computers; programming in highlevel languages; program structure, programming style and convention; control statements, data handling and processing; subprograms; classes and objects.

2190151 Computer Programming Laboratory 1 (0-3-0) Condition: COREQ 2190101* Computer programming in Engineering; reviews of computer programming concepts; hands-on experience on computer programming using contemporary Engineering tools.

2142201 Engineering First 3 (3-0-6) Basic skills in engineering; problem solving, communication skills, team work skills through small class projects; dissection skills.

2142424 Vehicle Dynamics 3 (3-0-6) Condition: PRER 2183231 Dynamics of motor vehicles; properties of pneumatic tire; suspension and steering mechanism; vehicle longitudinal dynamics; linear bicycle models; stability; linear engine models; pleasure in driving.

2142499 Automotive Engineering Project 1 (0-3-0) Group or individual project on a subject related to automotive engineering and manufacturing.

2182310 Electronics and Instrument for Automobile 3 (3-0-6) Condition: PRER 2182210 Introduction to digital circuits; introduction to microprocessors and microprocessors based systems; basic instrumentation; application of different types of instrumentation to automotive systems.

2183213 Mechanics Material 3 (3-0-6) Condition: PRER 2183212 Force and stress; stresses and strains relationship; Hooke’s law; modulus of elasticity; stresses in beams; shear force; bending moment diagrams; deflection of beams; torsion; buckling of columns; Mohr’s circle; combined stresses; failure criterion; safety factors.

2183221 Thermodynamics 3 (3-0-6) Basic concepts; thermodynamic state and process; properties of pure substances and ideal gases; energy; the first law of thermodynamics and the first law analysis for isolated, closed, and open systems; entropy; the second law of thermodynamics and the second law analysis for isolated, closed, and open systems; gas power cycles; Carnot, Otto, and Brayton cycles; refrigeration cycle; introduction to gas mixtures; introduction to combustion.

2183222 Fluid Mechanics 3 (3-0-6) Basic concepts in physics: physical quantity and physical quantity relations, dimensions of physical quantity and the principle of dimensional homogeneity, dimensionless variables; basic concepts in fluid mechanics: continuum assumption, methods of description: Lagrangian and Eulerian descriptions, field quantity and classification of flow fields: geometric and kinematics of fluid motion: pathlines, streamlines, and streaklines; forces and stresses in fluids: pressure and pressure force, shear stress and shear force; convection flux and Reynolds’ transport theorem; physical laws of finite control volume: conservations of mass, linear momentum, and energy; conservation of angular momentum with application to turbomachines; physical laws of infinite control volume: conservation of mass and linear momentum, introduction toNavier-Stokes and Euler’s equations; Bernoulli’s equation from momentum and conservation of mechanical energy viewpoints; introduction to vorticity and vortex; dimensional analysis: Buckingham’s Pi theorem, similarity, and model testing; internal viscous flows, energy consideration in pipe flows and piping system; system; external flows, boundary layer, and
aerodynamic force and moment; applications: turbomachines, model testing, piping and pumping system, aerodynamic force and moment.

2183231 Dynamics 3 (3-0-6)  
Kinematics of three-dimensional curvilinear motion of a particle; kinetics of a particle; force and acceleration, work and energy, impulse and momentum; kinematics of planar motion of a rigid body; absolute and relative motion analysis; kinetics of planar motion of a rigid body; absolute and relative motion analysis; kinetics of planar motion at a rigid body; force and acceleration, work and energy, impulse and momentum; introduction to kinematics and kinetics of three-dimensional motion of a rigid body.

2183261 Mechanical Engineering Laboratory 2 (1-3-2)  
Experimentation and basic concepts; error and uncertainty analysis; measurement and instrumentation; data analysis; interpretation of experimental results; reporting of experimental results; basic experiments in solid mechanics, thermodynamics, fluid mechanics and basic engine testing.

2183271 Automotive Engineering Workshop 1 (0-3-0)  
Hand-on study of automotive systems and components; names and functions of components and parts; basic mechanical parts; engine; electronic systems; power train; brake systems; steering mechanism; basic diagnosis.

2183272 Automotive Instrument Laboratory 1 (0-3-0)  
Basic electronics; electronic systems in automobiles; engine performance testing; basic automotive diagnosis.

2183321 Heat Transfer 3 (3-0-6)  
Modes of heat transfer; general forms of heat conduction equations; steady one-dimensional heat conduction; steady two-dimensional heat conduction; transient one-dimensional heat conduction; introduction of convection and boundary layer; external flow; internal flow; free convection; heat exchangers; introduction of radiation of black body and gray surfaces; view factors; radiation exchange between gray, diffuse surfaces in an enclosure.

2183322 Internal Combustion Engine 3 (3-0-6)  
Internal combustion engines; basic principles; fluid flow; thermodynamics; fuels and combustion; ideal fuel air cycle; heat transfer; friction and lubrication; efficiency and emission; different types of engines; spark-ignition and compression-ignition; ignition systems; supercharging and scavenging; performance and testing.

2183331 Mechanics of Machinery 3 (3-0-6)  
Basic mechanisms; gear trains; displacements; velocity and acceleration in machines; statics and dynamics force analysis; balances of rotating and reciprocating masses; gyroscopic effects.

2183332 Computer Aided Design/Computer Aided Manufacturing and Computer Aided Engineering 3 (2-3-4)  
Introduction to CAD/CAM/CAE. 3D solid modeling, design concepts and implementation; link to manufacturing interface.

2183351 Mechanical Engineering Design 3 (3-0-6)  
Fundamentals of mechanical engineering design; properties of materials; theory of failure; fatigue; design of basic machine elements; design project of a simple mechanical machine.

2183352 Motor Vehicle Design 3 (3-0-6)  
Systematic approach to automotive design; space defining components; ergonomics; automotive safety and legal regulations.

2184302 Product Development Process 3 (3-0-6)  
Product requirements and specifications; reverse engineering; use of CMM; product design by CAD.

2142352 Finite Element Methods and Applications 3 (3-0-6)  
Basic principles of finite element methods; applications of finite elements in analysis using computer programs.

2142422 Vehicle Aerodynamics 3 (3-0-6)  
Effects of vehicle design on aerodynamics; wind tunnel testing; boundary layers and wakes; friction and pressure drag; aerodynamic forces and moments; center of pressure and vehicle stability.

2142423 Power Train Systems 3 (3-0-6)  
Manual and automatic transmission; basic operation of transmission; peripheral components.

2142426 Noise, Vibration and Harshness 3 (3-0-6)  

2142428 Automotive Diagnostics and Maintenance 2 (1-3-2)  
Basic knowledge in Automobile components and its functions; troubleshooting guides, diagnostic tools for automobiles; do-it-yourself car care; knowledge in maintenance services, maintenance and repair; defensive driving techniques.

2142433 Failure Analysis and Nondestructive Testing 3 (2-3-4)  
Analysis and diagnosis of the causes of failure; physics of failure; concepts of reliability, the use of failure analysis as part of the design process, time based/related failure modes, safety factors; case studies; elimination of failures through proper material
selection, treatment and use; case histories; examination of fracture surfaces; laboratory investigations of different failure mechanisms.

2142461 Automation and Robotics 3 (3-0-6)
Basic automation systems, equipment, sensors, actuators, material handling system, robots and their applications.

2142488 Measurement, Instrumentation and Data Acquisition 3 (3-0-6)
Basic electromechanical techniques used in modern instrumentation and control systems; use of transducers and actuators; signal conditioning, grounding, and shielding; signal processing and feedback control methods with emphasis on frequency domain techniques; low-level measurements; lock-in technique.

2142492 Selected Topics in Automotive Engineering I 3 (2-3-4)
Selected interesting topics in automotive engineering.

2142493 Selected Topics in Automotive Engineering II 3 (2-3-4)
Selected interesting topics in automotive engineering.

2142495 Independent Studies 3 (0-6-3)
Self study on topics related to automotive engineering with consent of the instructor, the study may be theoretical or experimental in nature.

2182430 System Dynamics and Controls 3 (3-0-6)
System dynamics modeling; responses; introduction to control systems; feedback control system characteristics; the performance of feedback control systems; the stability of linear feedback systems; essential principles of feedback; the root locus method; time-domain analysis and design of control systems; frequency response method; stability of the frequency domain and compensation; use of computer in the design of control systems.

2142442 Embedded Systems In Automotive Engineering 3 (3-0-6)
Microprocessor architecture; introduction to embedded systems; programming concepts in C; software engineering practices; buses; device drivers and interrupt; inter-process communication; real-time operating system; hardware/software co-design.

2183431 Mechanical Vibrations 3 (3-0-6)
Analysis of system with single and multi degree of freedom; torsional vibration; free and forced vibration; determination of natural frequencies of structures; discrete system; Model analysis; methods and techniques to reduce and control vibration; Lagrange's equations.

2184401 Engineering Experimental Design 3 (3-0-6)
Factorial design; 2k factorial design; blocking and confound; fractional factorial design; factorial experiments with random factors; nested and split-plot design; non-linear regression analysis; response surface analysis.

2184404 Process Management and Lean Manufacturing 3 (3-0-6)
Introduction to process management; key techniques and managing approaches commonly used in automotive industry; application and case studies.

2184405 Product Planning and Control 3 (3-0-6)
The role of production planning and control in the manufacturing system; strategic planning of manufacturing systems; demand forecasting; inventory control, planning, scheduling, and control of operation; capacity planning.

2184406 Quality Control and Management for Automotive Industry 3 (3-0-6)
Introduction to metrology and characterization; principles of destructive and non-destructive testing as applied in automotive part manufacturing. Concept of quality control, quality improvement, quality assurance, quality management, cost of quality; quality management systems: ISO series; failure mode and effects analysis; basic quality control tools; statistical process control: control charts, process capability analysis, measurement system analysis, acceptance sampling plans.

2184407 Quality Design and Innovation Management 3 (3-0-6)
Key issues and core concept of quality design and innovation management, innovation strategy; project management, concept formation and selection, quality design and innovation development processes, business plan, risk management, techniques and tools for effective implementation of innovation.

2184409 Value Engineering 3 (3-0-6)
Introduction to value engineering methodology; application of value engineering techniques to product design; procurement and manufacturing in order to reduce cost without the loss of quality.

2189102 Engineering Materials II 3 (3-0-6)
Advanced topics and other specific applications as related to automotive materials; specific automotive materials; introduction to engineered materials specifically developed for automotive applications; composite materials; tyre and rubber technology, modification of surface characteristics as related to tribological and corrosion properties.

2190218 Information Technology for Professional Communications 2 (1-3-2)
IT skills in professional communication; presentation skills; use of computer software for effective professional communication.
INFORMATION AND COMMUNICATION ENGINEERING CURRICULUM (INTERNATIONAL PROGRAM)

ICE is a new and exciting integration of Computer Engineering, Electrical Engineering, and Industrial Engineering, key subjects at the very core of Chulalongkorn's Engineering School. You will learn the fundamental of computing, become equipped with skills in communication, and complement all this with a solid grounding in management science. Our combination will prepare you for the many stimulating challenges of the IT world.

The ICE program offers students a chance to become hardcore programmers, serving the international community with IT architecture for enterprises, software on mobile devices, satellite communications, game programming, computer networking, and software engineering, to name but a few. The discipline will be strengthened with training in management science that will heighten your competency to an international level. ICE is your future.

Each student is required to accumulate a minimum of 140 credits to graduate for Bachelor of Engineering Program in Information and Communication Engineering (International Program) which has already includes 2 credits of industrial training and 3 credits of senior project.

= 140 Credits

Curriculum Board

Phulporn Saengbangpla M.Sc (Manchester, UK)
Pramote Dechaumphai Ph.D. (Virginia)
Ekachai Leelarasmee Ph.D. (California)
Asi Bunyaijtradula Ph.D. (California)
Sirporn Damrongtrakul Ph.D. (London)
Atiwong Suchato Ph.D. (Massachusetts)
Sunaporn Sirikulvdhana Ph.D.(Michigan)
Chaodit Aswakul Ph.D. (London)
Yan Zhao Ph.D. (London)
Surapong Sirikulvdhana M.S (Michigan)
Varong Pavarajarn Ph.D. (Oregon)

Professor
Prabhas Chongsitvittaya, Ph.D.(Edinburgh U.)

Associate Professors

Electrical Engineering
Chedsada Chirranrueng, Ph.D.(Berkeley and computer Science)
Luncharern Wuttisittikulji, Ph.D.(Essex)
Prasit Teekaput, Ph.D.(Virginia)
Watcharapong Khovihungji, Ph.D.(UCLA)
Nisachon Tangsangiumvisai, Ph.D.(London)
Duanggrudee Worasucheep, Ph.D.(Stanford)

Industrial Engineering
Parames Chutima, Ph.D.(Nottingham)

Computer Engineering
Pornsiri Muenschaisri, Ph.D. (Sydney)
Atiwong Suchato, Ph.D.(MIT)

Assistant Professors

Electrical Engineering
Chaiyachet Satwichit, Ph.D.(Communications Networking)
Chaodit Aswakul, Ph.D.(Communications Networking)
Charnchai Pluemphitiwiryawej Ph.D.(Carnegie Mellon and Computer Engineering)
Pasu Kaewplung, Ph.D.(Chula)
Supavadee Aramrith, Ph.D.(Washington)
Tuptim Angkaew, Ph.D. (Communications Networking)
Widhyakorn Asdornwisad, Ph.D.(Chula)

Computer Engineering
Athasit Surarerks, Dr.Inf.(Informatique)
Attawith Sudsang, Ph.D.(Illinois)
Charlemek Intanakornwiwat Ph.D.(Southern California)
Chotirat Ratnamahatana Ph.D.(Roversode)
Kerk Piromsopa Ph.D.(Michigan State)
Nakornthip Prompoon M.Sc.(George Washington)
Pizzanu Kanonchajios Ph.D.(Computer Graphics)
Sukree Sinthupinyo Ph.D.(Chula)
Vishnu Kotrajaras Ph.D.(London)
Natree Piparnan Ph.D.(Chula)

Manufacturing Engineering Operations Management
Natcha Thaweesaengsakulthai, Ph.D.(Nottingham)

Industrial Engineering
Wipawee Thammapornphilas, Ph.D.(Pittsburgh)
Seeronk Prichanont, Ph.D.(Biotechnology)
Surapong Sirikulvdhana M.S.(Michigan-Ann Arbor)
Kullida Rojiboonchaid Ph.D.(Computer Networks)

Lecturer

Electrical Engineering
Boonchayu Supmonchai, M.Eng.(Chula)

Computer Engineering
Chairat Phongphanpane, Ph.D.( Radio Frequenc Telecommunications)
Chate Patanothai, M.Sc.(Elec&comEng)
Thit Siriboon, Ph.D.(Oregon State)

Industrial Engineering
Oran Kittithreeraponchait Ph.D.(Georgia Institute of Technology)
### Curriculum

**Total number of credits requirement**: 146 credits

#### General Education

- **Social Science**: 3 credits
- **Humanity**: 3 credits
- **Science and Mathematics**: 3 credits
- **Interdisciplinary**: 3 credits

1. **General Education**

   - **30 credits**
   - **Foreign Language**: 12 credits
     - 5501112* Communicative English I 3(3-0-6)
     - 5501123* Communicative English II 3(3-0-6)
     - 5501214* Communication and Presentation Skills 3(3-0-6)
     - 5501225* Technical Writing 3(3-0-6)
   - **General Education (Special)**: 6 credits
     - 2140111* Exploring Engineering World 3(3-0-6)
     - 2143101 Introduction to ICE 3(3-0-6)

2. **Core Courses**

   - **110 credits**
   - **Basic Sciences**: 18 credits
     - 2301107 Calculus I 3(3-0-6)
     - 2301108 Calculus II 3(3-0-6)
     - 2302103 General Chemistry Laboratory 1(0-3-0)
     - 2302105 Chemistry for Engineers 3(3-0-6)
     - 2304153 Physics for Engineers 3(3-0-6)
     - 2304154 Physics and Electronics for Engineers 3(3-0-6)
   - **Basic Engineering**: 18 credits
     - 2140301 Industrial Training 2(0-6-0)
     - 2182203* Probability and Statistics for Eng. 3(3-0-6)
     - 2183101 Engineering Graphics 3(2-3-4)
     - 2184202* Technology and Eng. Management 3(3-0-6)
     - 2189101* Engineering Materials 3(3-0-6)
     - 2190101* Computer Programming 3(3-0-6)
     - 2190151* Computer Programming Laboratory 1(0-3-0)
   - **Compulsory Courses**: 59 credits
     - 2143399* ICE Capstone 3(3-0-6)
     - 2143491* ICE Pre-Project 1(0-2-1)
     - 2143499* ICE project 3(0-6-3)
     - 2182202* Advanced Mathematics Methods 3(3-0-6)
     - 2182204* Signals and Linear Systems 3(3-0-6)
     - 2182211* Electrical Circuit for ICE 2(2-0-4)
     - 2182212* Fundamental of Circuit and Digital Electronics Lab. 1(0-3-0)
     - 2182370* Introduction to Digital Communications 3(3-0-6)
     - 2182371* Principles of Data Communication 3(3-0-6)
     - 2182372* Principle of Telecommunications 3(3-0-6)
     - 2184301* Eng. Economy and Applications 3(3-0-6)
     - 2184304* Fundamental of Operations Management 3(3-0-6)
   - **Compulsory Courses**: 59 credits
     - 2182202* Advanced Computer Programming 2(2-0-4)
     - 2190152* Advanced Computer Programming Laboratory 1(0-3-0)

3. **Approved Electives**: 15 credits
   - 2143423 High Technology Entrepreneurship 3(3-0-6)
   - 2143480* Independent Study I 1(0-3-2)
   - 2143481* Independent Study II 1(0-3-2)
   - 2143482* Independent Study III 1(0-3-2)
   - 2143485* Special Topics in ICE I 2(2-0-4)
   - 2143486* Special Topics in ICE II 2(2-0-4)
   - 2143487* Special Topics in ICE III 2(2-0-4)
   - 2143495* Selected Topics in ICE I 3(3-0-6)
   - 2143497* Selected Topics in ICE II 3(3-0-6)
   - 2143498* Selected Topics in ICE III 3(3-0-6)
   - 2182420* Discrete-Time Signal Processing 3(3-0-6)
   - 2182421* Multimedia Engineering 3(3-0-6)
   - 2182470* Telecommunication Management 3(3-0-6)
   - 2182471* Optic Fiber Communications 3(3-0-6)
   - 2182472* Principle of Wireless Communications 3(3-0-6)
   - 2182473* Signal Transmission System 3(3-0-6)
   - 2182474* System Integration 3(3-0-6)
   - 2182475* Teletraffic Engineering and Network Optimization 3(3-0-6)
   - 2184402* Introduction to Stochastic Models 3(3-0-6)
   - 2184403* Theory and Applications of Optimization 3(3-0-6)
   - 2184408* Supply Chain Management 3(3-0-6)
   - 2190317* Fundamental of Distributed System 3(3-0-6)

4. **Free Electives**: 6 credits

Select 6 credits from any courses offered in English by any International Programs in Chulalongkorn University.
<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2190101*</td>
<td>Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>2190151*</td>
<td>Computer Programming Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2301107</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>2302103</td>
<td>General Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>2302105</td>
<td>Chemistry For Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304153</td>
<td>Physics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304193</td>
<td>Physics Laboratory for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>5501112*</td>
<td>Communicative English I</td>
<td>3</td>
</tr>
<tr>
<td>2190111*</td>
<td>Exploring Engineering World</td>
<td>3</td>
</tr>
<tr>
<td>2183101*</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td>2189101*</td>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>2304154</td>
<td>Physics and Electronics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304194</td>
<td>Physics and Electronics Lab. for Eng.</td>
<td>1</td>
</tr>
<tr>
<td>5501123*</td>
<td>Communicative English II</td>
<td>3</td>
</tr>
<tr>
<td>2143101</td>
<td>Introduction to ICE</td>
<td>3</td>
</tr>
<tr>
<td>2182202*</td>
<td>Advanced Mathematics Methods</td>
<td>3</td>
</tr>
<tr>
<td>2182211*</td>
<td>Electrical Circuit for ICE</td>
<td>2</td>
</tr>
<tr>
<td>2182212*</td>
<td>Fundamental of Circuit and Digital</td>
<td>1</td>
</tr>
<tr>
<td>2190102*</td>
<td>Advanced Computer Programming</td>
<td>2</td>
</tr>
<tr>
<td>2190152*</td>
<td>Advanced Computer Programming Lab.</td>
<td>1</td>
</tr>
<tr>
<td>2190200*</td>
<td>Discrete Structure</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2182203</td>
<td>Probability and Statistic for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2182204</td>
<td>Signals and Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>2184202</td>
<td>Technology and Eng. Management</td>
<td>3</td>
</tr>
<tr>
<td>2190221*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>2190250*</td>
<td>Computer Architecture and Organization</td>
<td>3</td>
</tr>
<tr>
<td>2190261*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2190102</td>
<td>Introduction to Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>2190152</td>
<td>Principles of Data communication</td>
<td>3</td>
</tr>
<tr>
<td>2190103</td>
<td>Engineering Economy and Application</td>
<td>3</td>
</tr>
<tr>
<td>2190213*</td>
<td>Principles of Information System</td>
<td>3</td>
</tr>
<tr>
<td>2190472*</td>
<td>Netcentric Architecture</td>
<td>3</td>
</tr>
<tr>
<td>5501214</td>
<td>Communication and Presentation Skills</td>
<td>3</td>
</tr>
<tr>
<td>2190111</td>
<td>Exploring Engineering World</td>
<td>3</td>
</tr>
<tr>
<td>2183101*</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td>2189101*</td>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>2304154</td>
<td>Physics and Electronics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304194</td>
<td>Physics and Electronics Lab. for Eng.</td>
<td>1</td>
</tr>
<tr>
<td>5501123*</td>
<td>Communicative English II</td>
<td>3</td>
</tr>
<tr>
<td>2143101</td>
<td>Introduction to ICE</td>
<td>3</td>
</tr>
<tr>
<td>2182202*</td>
<td>Advanced Mathematics Methods</td>
<td>3</td>
</tr>
<tr>
<td>2182211*</td>
<td>Electrical Circuit for ICE</td>
<td>2</td>
</tr>
<tr>
<td>2182212*</td>
<td>Fundamental of Circuit and Digital</td>
<td>1</td>
</tr>
<tr>
<td>2190102*</td>
<td>Advanced Computer Programming</td>
<td>2</td>
</tr>
<tr>
<td>2190152*</td>
<td>Advanced Computer Programming Lab.</td>
<td>1</td>
</tr>
<tr>
<td>2190200*</td>
<td>Discrete Structure</td>
<td>3</td>
</tr>
<tr>
<td>2182203</td>
<td>Probability and Statistic for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2182204</td>
<td>Signals and Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>2184202</td>
<td>Technology and Eng. Management</td>
<td>3</td>
</tr>
<tr>
<td>2190221*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>2190250*</td>
<td>Computer Architecture and Organization</td>
<td>3</td>
</tr>
<tr>
<td>2190261*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2182203</td>
<td>Probability and Statistic for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2182204</td>
<td>Signals and Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>2184202</td>
<td>Technology and Eng. Management</td>
<td>3</td>
</tr>
<tr>
<td>2190221*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>2190250*</td>
<td>Computer Architecture and Organization</td>
<td>3</td>
</tr>
<tr>
<td>2190261*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2190102</td>
<td>Introduction to Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>2190152</td>
<td>Principles of Data communication</td>
<td>3</td>
</tr>
<tr>
<td>2190103</td>
<td>Engineering Economy and Application</td>
<td>3</td>
</tr>
<tr>
<td>2190213*</td>
<td>Principles of Information System</td>
<td>3</td>
</tr>
<tr>
<td>2190472*</td>
<td>Netcentric Architecture</td>
<td>3</td>
</tr>
<tr>
<td>5501214</td>
<td>Communication and Presentation Skills</td>
<td>3</td>
</tr>
<tr>
<td>2190111</td>
<td>Exploring Engineering World</td>
<td>3</td>
</tr>
<tr>
<td>2183101*</td>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td>2189101*</td>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>2304154</td>
<td>Physics and Electronics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304194</td>
<td>Physics and Electronics Lab. for Eng.</td>
<td>1</td>
</tr>
<tr>
<td>5501123*</td>
<td>Communicative English II</td>
<td>3</td>
</tr>
<tr>
<td>2143101</td>
<td>Introduction to ICE</td>
<td>3</td>
</tr>
<tr>
<td>2182202*</td>
<td>Advanced Mathematics Methods</td>
<td>3</td>
</tr>
<tr>
<td>2182211*</td>
<td>Electrical Circuit for ICE</td>
<td>2</td>
</tr>
<tr>
<td>2182212*</td>
<td>Fundamental of Circuit and Digital</td>
<td>1</td>
</tr>
<tr>
<td>2190102*</td>
<td>Advanced Computer Programming</td>
<td>2</td>
</tr>
<tr>
<td>2190152*</td>
<td>Advanced Computer Programming Lab.</td>
<td>1</td>
</tr>
<tr>
<td>2190200*</td>
<td>Discrete Structure</td>
<td>3</td>
</tr>
<tr>
<td>2182203</td>
<td>Probability and Statistic for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2182204</td>
<td>Signals and Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>2184202</td>
<td>Technology and Eng. Management</td>
<td>3</td>
</tr>
<tr>
<td>2190221*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>2190250*</td>
<td>Computer Architecture and Organization</td>
<td>3</td>
</tr>
<tr>
<td>2190261*</td>
<td>Fundamental Data Structure and Algorithm</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2190102</td>
<td>Introduction to Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>2190152</td>
<td>Principles of Data communication</td>
<td>3</td>
</tr>
<tr>
<td>2190103</td>
<td>Engineering Economy and Application</td>
<td>3</td>
</tr>
<tr>
<td>2190213*</td>
<td>Principles of Information System</td>
<td>3</td>
</tr>
<tr>
<td>2190472*</td>
<td>Netcentric Architecture</td>
<td>3</td>
</tr>
<tr>
<td>5501214</td>
<td>Communication and Presentation Skills</td>
<td>3</td>
</tr>
<tr>
<td>2140301</td>
<td>Industrial Training</td>
<td>3</td>
</tr>
<tr>
<td>2143499*</td>
<td>ICE Project</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td>xxxxxxx</td>
<td>Free Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

TOTAL CREDITS FOR GRADUATION: 146
COURSES DESCRIPTIONS IN INFORMATION AND COMMUNICATION ENGINEERING (B.ENG)

2140111* Exploring Engineering Word 3 (3-0-6)
Engineering topic related to daily life: energy, resources, environment manufacturing, process, industry, material, automotive, infrastructure, information system and bio engineering.

2143101 Introduction to ICE 3 (3-0-6)
Essential basic computer and telecommunication concepts for Information System; Technology and trends underlying current and future uses of information and communication technology; Introduction to engineering management including important aspects of management science; Real-world experience sharing and tools related to each topic.

5501122* Communicative English I 3 (3-0-6)
Practice language skills in acquiring information and knowledge from different sources and media in subjects of students' interest under selected themes; collecting information, summarizing and presenting important issues.

5501123* Communicative English II 3 (3-0-6)
Condition: PRER 5501112*
Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students' interest under selected themes; summarizing what they have learned, and presenting opinions from group discussion.

5501214* Communication and Presentation Skills 3 (3-0-6)
Condition: PRER 5501113*
Practice using English for social communication and giving oral presentation on engineering related topics.

5501225* Technical Writing 3 (3-0-6)
Condition: PRER 5501113*
Practice in writing summaries composing different types and styles of writing in the field of engineering and writing reports of studies and experiments.

230107 Calculus 1 3 (3-0-6)
Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals.

230108 Calculus 2 3 (3-0-6)
Condition: PRER 2301107
Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three dimensional space calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2302103 General Chemistry Laboratory 1 (0-3-0)
Standard solution preparation; qualitative analysis; titration; electrochemistry; pH metric titration; spectroscopy; calculation and evaluation of data; calibration curve; introduction to polymer.

2302105 Chemistry for Engineers 3 (3-0-6)
Stoichiometry and basis of the atomic theory; properties of the three states of matter and solution; thermodynamics; chemical equilibrium; Oxidation-reduction; chemical kinetics; the electronic structures of atoms and the chemical bond; periodic table; nonmetal and transition metal.

2304153 Physics for Engineers 3 (3-0-6)
Mechanics of particles and rigid bodies; properties of matter; fluid mechanics; heat; vibrations and waves; elements of electromagnetism; optics; modern physics.

2304154 Physics and Electronics for Engineers 1 (0-3-0)
Electricity; DC circuit; AC circuit; basic electronics; solid state devices; electrical actuators.

2304193 Physics Laboratory for Engineers 1 (0-3-0)
Measurement and precision; experiments on simple harmonic motion; radius of gyration; dynamics of rotation; velocity of sound; viscosity of fluids.

2304194 Physics and Electronics Laboratory for Engineers 1 (0-3-0)
Resistance and electromotive force measurements; experiments on amp meter, voltmeter, oscilloscope, AC circuit, transistor, lenses and mirrors, polarization, interference, diffraction.

2140301 Industrial Training 2 (0-6-0)
Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

2182203* Probability and Statistic for Engineers 3 (3-0-6)
Condition: PRER 2301108
Engineering basis in statistic and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: estimator, bias, consistency; point estimation; interval estimation; engineering applications in measurement and uncertainty, linear regression, introduction to random process; integration of statistics in engineering application; case studies.

2183101* Engineering Graphics 3 (2-3-4)
Condition: PRER 2301108
Lettering; orthographic projections; sketching and drawing; pictorial drawing; dimensioning; tolerancing and geometrical tolerancing; section; working drawing; mechanical parts drawing; introduction to CAD.

2184202* Technology and Engineering Management 3 (3-0-6)
Condition: PRER 2301108
Technology and engineering management principles; SWOT analysis; operations strategy; organization and process design; cost and budget;
productivity management; marketing concept; quality system; human relationship; risk management; project management; innovation management.

2189101* Engineering Materials 3 (3-0-6)
Important engineering materials: metals, plastics, asphalt, wood and concrete; phase diagram and its interpretation; testing and meaning of various properties; macroscopic and microscopic structure which are correlating with properties of the engineering materials; production process of products from engineering materials.

2190101* Computer Programming 3 (3-0-6)
Introduction to computer systems; problem-solving using computers; programming in high-level languages; program structure, programming style and convention; control statements, data handling and processing; subprograms; classes and objects.

2190151* Computer Programming Laboratory 1 (0-3-0)
Computer programming in Engineering: reviews of computer programming concepts; hands-on experience on computer programming using contemporary Engineering tools.

2143399* Information and Communication Eng. Capstone 3 (3-0-6)
Culminating and applying of knowledge to develop information and communication systems; developing a software starting from gathering all the needs of the system to its application under the instructor’s supervision; peer collaboration; giving presentations.

2143491* Information and Communication Eng. Pre-project 1 (0-2-1)
Specifying topics or problems, scope, problem-solving methodologies and expected benefits from projects on information and communication engineering.

2143499 Information and Communication Eng. Project 3 (0-6-3)
Condition: PRER 2143491*
Group or individual projects on a subject related to information and communication engineering.

2182202* Advanced Mathematics Methods 3 (3-0-6)
Condition: PRER 2301108
Complex analysis: complex functions, analytic functions, line integral in complex plane, Cauchy Integral Theorem, Laurent Series, Residue Theorem; advanced matrix algebra: systems of linear equations, linear independence, Eigenvalues, Eigenvectors; Ordinary differential equations (ODE): First-order ODE, Second-order ODE, Higher-order linear ODE; Series solutions to linear ODE.

2182204* Signals and Linear Systems 3 (3-0-6)
Condition: PRER 2182202* Advanced Mathematics Methods
Classification of Signals and Systems; Linear-Time Invariant (LTI) System; Continuous-Time System; Discrete-time System; Linear Convolution; Frequency Response: Fourier Series, Fourier Transform, Laplace Transform, Z-Transform, Discrete-time Fourier Transform.

2182211* Electrical Circuit for ICE 2 (2-0-4)
Condition: PRER 2304154
Basic circuit elements: resistor, capacitor, inductor, diode and transistor; Kirchhoff’s laws; Node and Mesh analysis; DC and AC circuit analysis; Thevenin’s and Norton’s theorem; logic and digital circuits.

2182212* Fundamental of Circuit and Digital Electronics Laboratory 1 (0-3-0)
Condition: Co-requisite 2182211*
Electronic instruments: multimeter, oscilloscope, DC circuit, voltage regulators, filter circuit, transistor amplifier circuit, digital circuits.

2182370* Introduction to Digital Communications 3 (3-0-6)
Overview of digital communication systems; signal and noise analysis; PDM encoding and sampling theorem, quantization and companding; digital baseband systems: NRZ, RZ, bi-phase, bipolar RZ, AMI; digital bandpass system: ASK, PSK, FSK, MSK and QAM; information theory: entropy, source and channel models, channel capacity, Shannon’s theorem and introduction to source coding, error detection/correction codes; examples of communication systems in practice.

2182371* Principles of Data Communication 3 (3-0-6)
Introduction to data communication and networking: layer modeling protocols and architectural network; basic data transmission, physical layer transmission, data link layer protocols, review on network layer protocols and transport layer protocols, standardization, IP-based network protocols, delay models, performance analysis, system design and implementation issues.

2182372 Principles of Telecommunications 3 (3-0-6)
Introduction to telecommunication; layered communication architectures; transmission medium: wired and wireless; data link layer protocols: flow control and error control; medium access control; circuit switching and packet switching; throughput and delay performance analysis of communication link; introduction to network topology, flows and graph theory; routing principles in circuit-switched and packet-switched networks; introduction to queuing theory and basic simulation techniques; overviews of cellular mobile phone networks, optical networks, Internet and satellite systems.

2184301* Engineering Economy and Applications 3 (3-0-6)
Interest calculation; time value of money; equivalent value and rate of return; benefit-cost analysis and evaluation; break-even point; sensitivity analysis; decisions under risk and uncertainty; economic life and replacement analysis.
2184304* Fundamental of Operations Management 3 (3-0-6)
Nature of operations; production capacity management; aggregate planning; master production scheduling; material requirements planning; operation scheduling; inventory and distribution management; project time management; lean management.

2190102* Advanced Computer Programming 2 (2-0-4)
CONDITION: PRER 2190101*
Concepts and practice of object-oriented programming; usage of design patterns in object-oriented programming; programming in application development frameworks; graphical user interface and event-driven programming, collection framework, concurrent programming, socket programming, and/or frameworks of contemporary interest; hands-on practice in developing application software through the application of development frameworks.

2190152* Advanced Computer Programming Lab. 1 (0-3-0)
CONDITION: Co-requisite 2190102*
Hands-on experience in software development through the application of contemporary development frameworks.

2190200* Discrete Structures 3 (3-0-6)
Sets, relations, functions, theorem and proof; combinatorics; counting, principle of inclusion exclusion; recurrent relations, generating functions; graphs and trees; introduction to number theory.

2190213* Principles of Information System 3 (3-0-6)
Information system architecture; internet and web protocols; web application framework; MVC pattern; middleware, remote procedure call, message oriented middleware; authentication, authorization, directory services; information security, basic cryptography, digital signature.

2190221* Fundamental Data Structure and Algorithm 3 (3-0-6)
CONDITION: PRER 2190101*
Basic data types, trees, basic operations on sets, sorting and searching, algorithm design techniques, memory management.

2190250* Computer Architecture and Organization 3(3-0-6)
Computer evolution and performance; computer structure, function, and interconnection; memory hierarchy; cache memory; virtual memory; storage; input/output; operating system support; process; interrupt; system call; instruction set; processor structure and function; RISC vs CISC; pipelining; super-scalar processors; multi-core computers.

2190261* Fundamental Data Structure and Algorithm Laboratory 1(0-3-0)
CONDITION: Co-requisite 2190221*
Hands-on programming in high-level language to supplement the theoretical concepts of data structure and algorithm; practical application in writing and analyzing programs; data abstraction, modular program composition.

2190415* Enterprise Information Systems 3 (3-0-6)
Enterprise information systems; information technology infrastructure and integration; impact of information systems on organizations; information technology and business strategies; e-business and e-commerce; ethical and social issues related to technology; technology decisions; business value of information systems.

2190422* Database Systems 2 (2-0-4)
Database design and implementation: data models, database and schema design, relational algebra, relational calculus, query processing and optimization, constraints; storage and indexing: memory hierarchy, RAID, file organization and indexing, tree-structured/hash-based indexing; database design and tuning; schema refinement, functional dependencies, normal forms, physical design and tuning.

2190423* Software Engineering 3 (3-0-6)
Design tools and techniques; top-down design, modular design, software tools, debugging and test data; software reliability, theory and concepts, error and fault estimation, reliability models, availability models; management techniques, cost estimation, software maintenance.

2190462* Database Systems Lab. 1 (0-3-0)
CONDITION: Co-requisite 2190422*
Database design and implementation of Relational Database Management Systems (RDBMS); hands-on introduction to SQL Basics including RDBMS installation, configuration, troubleshooting, basic knowledge of relational databases and how to effectively maintain them.

2190472* Netcentric Architecture 3 (3-0-6)
CONDITION: PRER 2190101*

2143423 High Technology Entrepreneurship 3 (3-0-6)
Establishing technological or new businesses based on knowledge in technology and innovation, starting from basic ideas to ideas that can be implemented in terms of business; project analysis in terms of technical and business readiness; setting up business plan to prepare to investors who are interested; use of problem-based teaching to achieve results and exchange knowledge among all segments involved.
Numerical Effects.

Engineering.

Satellite crosslink; satellite system design.

Multiple access; frequency-hopped communications; Impulse Response (FIR) filters; Infinite Impulse Invariant (LTI) Systems; sampling Theory; Finite (FFT) algorithm; Decimation; Interpolation; Sampling Representation; Transversal Filters. Discrete-Time Response (IIR) filters; signal Flow Graph developments in information and communication engineering.

Discrete-time signal and systems; discrete-time processing of continuous-time signals; Linear Time Invariant (LTI) Systems; sampling Theory; Finite Impulse Response (FIR) filters, Infinite Impulse Response (IIR) filters; signal Flow Graph Representation; Transversal Filters. Discrete-Time Fourier Transform (DTFT), Fast Fourier Transform (FFT) algorithm; Decimation; Interpolation; Sampling Rate Conversion; Filter Bank; Aliasing; Finite Precision Numerical Effects.

Independent Study I 1 (0-3-2)

Independent study and investigation in topics related to information and communication engineering under the supervision of an instructor.

Independent Study II 1 (0-3-2)

Independent study and investigation in topics related to information and communication engineering under the supervision of an instructor.

Independent Study III 1 (0-3-2)

Independent study and investigation in topics related to information and communication engineering under the supervision of an instructor.

Special Topics in ICE I 2 (2-0-4)

Review and discussion of special topics in information and communication engineering.

Special Topics in ICE II 2 (2-0-4)

Review and discussion of special topics in information and communication engineering.

Special Topics in ICE III 2 (2-0-4)

Review and discussion of special topics in information and communication engineering.

Information and Communication Engineering Pre-project 1 (0-2-1)

Review and discussion of special topics in information and communication engineering.

Selected Topics in ICE I 3 (3-0-6)

Topics of current interest and in new development in information and communication engineering.

Selected Topics in ICE II 3 (3-0-6)

Topics of current interest and in new developments in information and communication engineering.

Selected Topics in ICE III 3 (3-0-6)

Topics of current interest and in new developments in information and communication engineering.

Discrete-Time Signal Processing 3 (3-0-6)

Condition: PRER 2182204

Discrete-time signal and systems; discrete-time processing of continuous-time signals; Linear Time Invariant (LTI) Systems; sampling Theory; Finite Impulse Response (FIR) filters, Infinite Impulse Response (IIR) filters; signal Flow Graph Representation; Transversal Filters. Discrete-Time Fourier Transform (DTFT), Fast Fourier Transform (FFT) algorithm; Decimation; Interpolation; Sampling Rate Conversion; Filter Bank; Aliasing; Finite Precision Numerical Effects.

Multimedia Engineering 3 (3-0-6)

Introduction to multimedia engineering; text coding standards image coding standards, video coding standards, audio coding standards; speech coding standards; IP networks, wireless networks; multimedia communication protocols; multimedia communication applications.

Telecommunication Management 3 (3-0-6)

Telecommunication technology and trends; telecommunication markets; telecommunication economics; telecommunication law and policy; telecommunication licensing; competition in telecommunication business; telecommunication project management.

Optical Fiber Communication 3 (3-0-6)

Overview of optical fiber communications; wave guiding in optical fibers, mode theory for dielectric circular waveguides; signal distortion in optical fibers due to loss and dispersion; optical sources, laser diodes; modulation techniques; photodetector, optical receiver operation; digital transmission system, power budget analysis; dispersion management; optical fiber amplifiers; principle and components in WDM system.

Principle of Wireless Communications 3 (3-0-6)

Introduction to design analysis and fundamental limits of wireless transmission systems; wireless channel and system model, multipath fading; equalization, channel coding and diversity; resource management and power control; multiple antenna and MIMO systems; space-time codes and decoding algorithms; multiple-access techniques and multilayer detection; ad-hoc network topologies; OFDM and ultrawideband systems; wireless LANs, MANs and cellular system standards.

Signal Transmission System 3 (3-0-6)

Transmission lines; transmission line equation; transmission line analysis for sinusoidal waveforms; transmission line analysis for pulse waveforms; basic of plane wave propagation in free space; basic of signal transmission in optical fiber; signal frequency dispersion in optical fiber, fundamental of antenna; basic antenna parameters; design of transmission link; link budget.

System Integration 3 (3-0-6)

System integration definition; communication systems; intelligent building automation; networking technology and cabling system management; introduction to communication system design; related standards for communication systems integration; compatibility and interoperability analysis; hardware vs. software integration; network integration; enterprise application integration; management of risk from Integration; interpersonal skills and communications for system engineer; case studies in system integration.

Teletraffic Engineering and Network Optimization 3 (3-0-6)

Teletraffic engineering overview; quality of service and network performance optimization; classification of teletraffic engineering systems and teletraffic parameters; teletraffic data collection techniques and statistics; modeling of non-queueing/loss-type system
and queueing/delay-type system; modeling of system with mobile users; fundamentals of modeling network of by computer program; simulation program; real-time network management and long-term network planning; application of optimization techniques in network controls; case studies in network design.

218402* Introduction to Stochastic Models 3 (3-0-6)
Unconditional and conditional probability; discrete and continuous random variables; moments; Poisson processes; discrete time Markov chain and applications; stochastic analysis and modeling.

2184403* Theory and Applications of Optimization 3 (3-0-6)
Introduction to theory, algorithms, and applications of optimization; optimization methodologies: linear programming, network optimization, and integer programming.

2184408* Supply Chain Management 3 (3-0-6)
Definition of supply chain; coordination difficulties; pitfalls and opportunities in supply chain management; inventory/service level tradeoffs; performance measurement and incentive; extensive supply chain management; mass customization; supplier management; design and redesign of products and process for supply chain management; analytical tools; industrial applications; current industry initiatives.

2190317* Fundamental of Distributed Systems 3 (3-0-6)
Interprocess communication and remote procedure call; logical clock and ordering; centralized transaction and concurrency control; distributed transaction; two-phase commit protocol; distributed concurrency control; deadlock and distributed deadlock; load distribution; fault tolerance; fault model; recovery; replication: view and vector clock; distributed transaction under failure conditions; security; distributed services.

2190332* System Analysis and Design 3 (3-0-6)
Data processing systems and system life cycle; analysis methodology, tools, cost analysis, problem specification; proposal, writing and feasibility study; design methodology; design tools, database approach, system design, file and form design, program design, documentation; implementation methodology; coding, program testing and software maintenance.

2190413* System Security 3 (3-0-6)
Techniques for achieving security in multi-user computer systems and distributed computer system; physical security; discretionary and mandatory access control; biometrics; information-flow models of security; covert channels; elementary cryptography; public-key cryptography; logic of authentication; electronic money; virus; firewall; electronic voting; risk assessment; secure web browsers.

2190414* Large-Scale Computing Systems 3 (3-0-6)
High-performance and large-scale computing infrastructure: cluster, peer-to-peer, grid, cloud; virtualization; software architecture and middleware; HPC applications and algorithms for highly competent computers; HPC software development for highly competent computers.

2190424* Software Project Management 3 (3-0-6)
Essence of software project management; scope of software projects; project management concepts; project estimation; software quality assurance; case studies on project life cycle.

2190425* Software Testing and Quality Assurance 3 (3-0-6)
Technical and managerial views of Software Testing and Software Quality Assurance (SQA) quality concepts; black and white box testing techniques; test coverage; test planning; levels of testing; the formation of a testing organization; testing-in-the-large; documentation for testing; inspections and walkthroughs; Quality Principle: Quality Assurance, Quality Control, Cost of Quality and Quality Models.

2190436* Data Warehousing 3 (3-0-6)
Introduction to data warehouse design including data modeling, database design and database access, issues in data warehouse planning, design, implementation, and administration; overview of OLAP (On-Line Analytical Processing) systems and data marts; components of data warehouse architecture and infrastructure; tools to build data warehouse.

2190442* Object-oriented Techniques 3 (3-0-6)
Techniques of Object-Oriented Analysis (OOA) and Design (OOD) covering managing complexity, using data and procedural abstraction, encapsulation, hierarchies, and decomposition of problems into classes and objects; concepts about overloading, multiple inheritance and polymorphism; analysis, design, implementation and software development. Use Case Driven object-oriented development methodology; design patterns and Unified Modeling Language (UML).

2190443* User Interface Design 3 (3-0-6)
Design, implementation, and evaluation of human-computer interfaces; human capabilities, including the human information processing, perception, Fitts’s Law, memory, attentions and colors; task analysis, user-centered design, design principles; low-fidelity prototyping; heuristic evaluation; formative evaluation; controlled experiments; model-view-controller; input models, output models; constraints, layout and toolkits; review of current literature, short assignments, and substantial programming projects.

2190473* Ubiquitous Computing and Networking 3 (3-0-6)
Introduction to ubiquitous computing, overview and basic terminologies; visions and fundamental challenges; wireless MACs; mobile IP; wireless ad hoc networks; wireless sensor networks; programming wireless networks of embedded systems; adaptive topology; time synchronization; localization; IPv6; internet of things; energy saving; smart grid.

2190479* Graphics Computing 3 (3-0-6)
Hierarchy of graphics software, use of graphics API; simple color models (RGB, HSB, CMYK); homogeneous coordinates, affine transformations: scaling, rotation and translation; viewing transformation clipping, raster and vector graphics system.
Game Design and Development Process for International Market 3 (3-0-6)
Player psychology; brainstorming techniques; game creation process; teamwork; design document; setting design; artificial intelligence; storytelling; gaming business in international market.
AEROSPACE ENGINEERING CURRICULUM
(INTERNATIONAL PROGRAM)

Aerospace engineers play an invaluable role in the development of modern aircraft and spacecraft. Ever since the advent of the first flying machines, new technologies have propelled us faster, further and more efficiently than ever before. Today there is an ever-increasing need for human resources with the capability to not only repair, maintain and construct today’s aircraft, but also to look to the future and design those of tomorrow.

Global air travel is expanding at an unprecedented pace, prompting the foundation of many new commercial airlines in Southeast Asia. What’s more, only aerospace engineers can provide the necessary innovation to advance strategic defence and satellite technologies. At a time when the big players in space travel are looking to set up lunar bases and manned missions to Mars, aerospace engineers are in high demand. Our AERO curriculum, developed by a collaboration of Chulalongkorn University with the Royal Thai Air Force, is tailor-made to meet this new hunger for aerospace expertise. Are you a high flyer?

Each student is required to accumulate a minimum of 139 credits to graduate for Bachelor of Engineering Program in Aerospace Engineering (International Program) which also includes 2 credits of industrial training and 3 credits of senior project.

Curriculum board
Phulporn Saengbangplia M.Sc (Machteche,UK)
Pramote Dechaumphai Ph.D. (Virginia)
Ekachai Leelarasmee Ph.D. (California)
Asi Bunyajitrudulya Ph.D. (California)
Siriporn Damrongakkul Ph.D. (London)
Aliwong Suchato Ph.D. (Massachusetts)
Patama Vichitpipitkul Ph.D. (Tokyo)
Sunhapos Chatranuwathana Ph.D. (Michigan)
Chaodit Aswakul Ph.D. (London)
Yan Zhao Ph.D. (London)
Surapong Sirikulvadhana M.S (Michigan)
Varong Pavarajam Ph.D. (Oregon)

Professors
Electrical Engineering
Pramote Dechaumphai, Ph.D.(USA)

Associate Professors
Mechanical Engineering
Asi Bunyajitrudulya Ph.D.(UC.Lrvine)
Kuntinee Maneeratana Ph.D.(London)
Pongtorn Charunyakorn Ph.D.(Miami)

Metallurgical Engineering
Seksak Asavavisithchai Ph.D.(Nottingham)

Computer Engineering
Aliwong Suchato Ph.D.(MIT)

Assistant Professors
Electrical Engineering
Thavatchai Tayjasanant Ph.D.(Alberta)
Manap Wongpaisuwon Ph.D.

Mechanical Engineering
Niphon Wansophark, D.Eng.(Chula)
Chittin Tangthieng, Ph.D.(Penn State)
Nopdanai Ajavakom Ph.D.(UC Berkeley)
Alongkorn Pimpin, Ph.D.(Tokyo)
Phongsen Pitakwatchara Ph.D.(Tokyo)
Thanyarat Singhanart Ph.D.(Tokyo)

Metallurgical and materials Engineering
Iththon Diewwant, Sc.D.(MIT)

Lecturer
Mechanical Engineering
Chirdpun Vitoonraporn Ph.D.
Tawan Papapote Ph.D.(LLlinois)
Sawat Luengruengrit D.Eng.(Tokyo)

ISE Staff
Prabhath De Silva Ph.D.(USA)
Pinunta Rojratsikul Ph.D.(Bath, UK)
Borndephong Ratanagraikanakorn Ph.D.(London)
Joshua Staub Ph.D.(Virginia)

Guest Lecturer
Boonchai Watjratakul Ph.D.
Wasunthara Manklasavadi Ph.D.
Pinanta Rojratsikul Ph.D.
Anurak Athast Ph.D.(France)
Jeerasak Pitakarn Ph.D.(France)
Sant Sangwormrachasup Ph.D.
Wicha Mektrakran B.Eng(USA)
Agaphas Teparagul
### Curriculum

Total number of credits requirement 146 credits

### General Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Science</td>
<td>3</td>
</tr>
<tr>
<td>Humanity</td>
<td>3</td>
</tr>
<tr>
<td>Science and Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td>3</td>
</tr>
<tr>
<td>Foreign Language</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicative English I</td>
<td>3</td>
</tr>
<tr>
<td>Communicative English II</td>
<td>3</td>
</tr>
<tr>
<td>Technical Communication I</td>
<td>2</td>
</tr>
<tr>
<td>Technical Communication II</td>
<td>2</td>
</tr>
<tr>
<td>Technical Communication III</td>
<td>2</td>
</tr>
<tr>
<td>Exploring Engineering World</td>
<td>3</td>
</tr>
</tbody>
</table>

### Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>Physics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>Physics Laboratory for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>Physics and Electronics for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>Probability and Statistics</td>
<td>2</td>
</tr>
<tr>
<td>Engineering Graphics</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>Computer Programming Laboratory I</td>
<td>1</td>
</tr>
<tr>
<td>Multivariable Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Linear Algebra and Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Methods of Applied Mathematics</td>
<td>3</td>
</tr>
</tbody>
</table>

### Compulsory

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Aerospace Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Aircraft Design</td>
<td>1</td>
</tr>
<tr>
<td>Aircraft Electricity and Electronics</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Engineering Seminar I</td>
<td>1</td>
</tr>
</tbody>
</table>

### Free Electives

Any two subjects at the university level that are taught in English

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avionics</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Computational Fluid Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Gas Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Independent Studies</td>
<td>3</td>
</tr>
<tr>
<td>Selected Topics in Aerospace Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>Selected Topics in Aerospace Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>Mechanical Vibrations</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Management</td>
<td>3</td>
</tr>
</tbody>
</table>
## AEROSPACE ENGINEERING CURRICULUM

<table>
<thead>
<tr>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
<th>COURSE NO.</th>
<th>SUBJECT</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2190101</td>
<td>Computer Programming</td>
<td>3</td>
<td>2145311</td>
<td>Aerodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>2190151</td>
<td>Computer Programming Laboratory</td>
<td>1</td>
<td>2145321</td>
<td>Aircraft Structure I</td>
<td>3</td>
</tr>
<tr>
<td>230107</td>
<td>Calculus I</td>
<td>3</td>
<td>2145324</td>
<td>Modeling and Control of Dynamic Systems</td>
<td>3</td>
</tr>
<tr>
<td>230203</td>
<td>General Chemistry Laboratory</td>
<td>1</td>
<td>2145361</td>
<td>Aerospace Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2302105</td>
<td>Chemistry for Engineers</td>
<td>3</td>
<td></td>
<td>Experimentation and Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>2304153</td>
<td>Physics for Engineers</td>
<td>3</td>
<td>2183381</td>
<td>Numerical Methods for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>2304193</td>
<td>Physics Laboratory for Engineers</td>
<td>1</td>
<td>5501315</td>
<td>Technical Communication III</td>
<td>2</td>
</tr>
<tr>
<td>5501112</td>
<td>Communicative English I</td>
<td>3</td>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2140111</td>
<td>Exploring Engineering World</td>
<td>3</td>
<td>2145312</td>
<td>Aerodynamics II</td>
<td>3</td>
</tr>
<tr>
<td>2183111</td>
<td>Engineering Graphics</td>
<td>3</td>
<td>2145322</td>
<td>Aircraft Structure II</td>
<td>3</td>
</tr>
<tr>
<td>2189101</td>
<td>Engineering Materials</td>
<td>3</td>
<td>2145325</td>
<td>Flight Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>2301108</td>
<td>Calculus II</td>
<td>3</td>
<td>5501326</td>
<td>Technical Communication IV</td>
<td>2</td>
</tr>
<tr>
<td>2304154</td>
<td>Physics and Electronics for Engineers</td>
<td>3</td>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2304194</td>
<td>Physics and Electronics Laboratory for Engineers</td>
<td>1</td>
<td>2145362</td>
<td>Aerospace Engineering</td>
<td>3</td>
</tr>
<tr>
<td>5501123</td>
<td>Communicative English II</td>
<td>3</td>
<td>2145390</td>
<td>Experimentation and Laboratory II</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2145390</td>
<td>Aerospace Engineering Seminar II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2145211</td>
<td>Introduction to Aerospace Engineering</td>
<td>3</td>
<td>2140301</td>
<td>Industrial Training</td>
<td>2</td>
</tr>
<tr>
<td>2183211</td>
<td>Engineering Mechanics</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2183221</td>
<td>Thermodynamics</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2301215</td>
<td>Multivariable Calculus</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2301216</td>
<td>Linear Algebra and Differential Equations</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5501213</td>
<td>Technical Communication I</td>
<td>2</td>
<td>xxxxxxx</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>xxxxxxx</td>
<td>General Education</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2145221</td>
<td>Introduction to Aircraft Design</td>
<td>1</td>
<td>2145499</td>
<td>Aerospace Engineering Project</td>
<td>3</td>
</tr>
<tr>
<td>2145230</td>
<td>Aircraft Electricity and Electronics</td>
<td>3</td>
<td>xxxxxxx</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td>2145290</td>
<td>Aerospace Engineering Seminar I</td>
<td>1</td>
<td>xxxxxxx</td>
<td>Free Elective</td>
<td>3</td>
</tr>
<tr>
<td>2182203</td>
<td>Probability and Statistics for Eng.</td>
<td>3</td>
<td>xxxxxxx</td>
<td>Free Elective</td>
<td>3</td>
</tr>
<tr>
<td>2183222</td>
<td>Fluid Mechanics</td>
<td>3</td>
<td>xxxxxxx</td>
<td>General Education</td>
<td>3</td>
</tr>
<tr>
<td>2183231</td>
<td>Dynamics</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2301317</td>
<td>Methods of Applied Mathematics</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5501224</td>
<td>Technical Communication II</td>
<td>2</td>
<td>2145490</td>
<td>Aerospace Engineering Seminar III</td>
<td>1</td>
</tr>
</tbody>
</table>

TOTAL CREDITS FOR GRADUATION | 146
1. General Education

Foreign Language
550112 Communicative English I 3 (3-0-6)
Practice language skills in acquiring information and knowledge from different sources and media on topics of students' interest under selected themes; collecting information, summarizing and presenting important issues.

5501123 Communicative English II 3 (3-0-6)
CONDITION: PRER 5501112*
Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students' interest under selected themes; summarizing what they have learned, and presenting opinions from group discussion.

5501213 Technical Communication I 2(2-0-4)
Students are to practice academic writing at paragraph level. Selected readings in the related field are included. Discussion and presentation skills are to be taught including listening input.

5501224 Technical Communication II 2(2-0-4)
CONDITION: PRER 5501123
Students are to practice extensive academic writing at paragraph level. Selected readings in the related field are included. More discussion and presentation skills are to be taught including listening input.

5501315 Technical Communication III 2(2-0-4)
CONDITION: PRER 5501224*
Students are to develop ability in technical writing and academic essay writing. Selected readings in the related field are included. Academic presentation skills are to be taught including listening input in the related field.

5501326 Technical Communication IV 2(2-0-4)
CONDITION: PRER 5501315*
Students are to write technical reports and do academic presentations. Selected readings in technical discourse and listening input are included.

5501417 Technical Communication V 2(2-0-4)
CONDITION: PRER 5501326*
Students are to write academic articles and do academic presentations. Students are to develop their writing processes and presentation skills to bring their proficiency to the highest level in the related field.

General Education (Special)
2140111 Exploring Engineering World 3 (3-0-6)
Engineering topics related to daily life: energy, resources, environment manufacturing, process, industry, material, automotive, infrastructure, information system and bio engineering

2. Core Courses

Basic Sciences

2301107 Calculus I 3 (3-0-6)
Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals

2301108 Calculus II 3 (3-0-6)
CONDITION: PRER 2301107
Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three dimensional space; calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2302103 General Chemistry Laboratory 1 (0-3-0)
Standard solution preparation; qualitative analysis; titration; electrochemistry; pH metric titration; spectroscopy; calculation and evaluation of data; calibration curve; introduction to polymer.

2302105 Chemistry for Engineers 3 (3-0-6)
Stoichiometry and basis of the atomic theory; properties of the three states of matter and solution; thermodynamics; chemical equilibrium; Oxidation; chemical kinetics; the electronic structures of atoms and the chemical bond; periodic table; nonmetal and transition metal.

2142153 Physics for Engineers 3 (3-0-6)
Mechanics of particles and rigid bodies, properties of matter, fluid mechanics, heat, vibrations and waves, elements of electromagnetism, optics, modern physics.

2304154 Physics and Electronics for Engineers 3 (3-0-6)
Electricity; DC circuit; AC circuit; basic electronics; solid state devices; electrical actuators.

2304193 Physics Laboratory for Engineers 1 (0-3-0)
Measurement and precision; experiments on simple harmonic motion, radius of gyration, dynamics of rotation, velocity of sound, viscosity of fluids.

2304194 Physics and Electronics Laboratory for Engineers PHYS ELEC LAB ENGS 1 (0-3-0)
Resistance and electromotive force measurements; experiments on amp meter, voltmeter, oscilloscope, AC circuit, transistor, lenses and mirrors, polarization, interference, diffraction.

Compulsory Courses (55)

2140301 Industrial Training 2(0-6-0)
Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

2182203 Probability and Statistics for Engineers 3 (3-0-6)
CONDITION: PRER 2301108
Engineering basis in statistics and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: estimator, bias, consistency; point estimation; interval estimation;
2183101 Engineering Graphics 3 (2-3-4)
Lettering; orthographic projections; sketching and drawing; pictorial drawing; dimensioning; to lerancing and geometrical tolerancing; section; working drawing; mechanical parts drawing; introduction to CAD.

2183211 Engineering Mechanics 4 (4-0-8)
Analysis of force systems and their equilibrium as applied to engineering systems; stresses and strains; mechanical properties of materials; Hooke’s law, elastic modulus, stress in beam, shear force, bending moment diagram, torsion, buckling of columns, Mohr’s circle.

2183231 Dynamics 3 (3-0-6)
Kinematics of three-dimensional curvilinear motion of a particle; work and energy, impulse and momentum; kinematics of planar motion of a rigid body; force and acceleration, work and energy, impulse and momentum; introduction to kinematics and kinetics of three-dimensional motion of a rigid body.

2189101 Engineering Materials 3 (3-0-6)
Important engineering materials: metals, plastics, asphalt, wood and concrete; macroscopic and microscopic structure which are correlating with properties of the engineering materials; production process of products from engineering materials.

2190101 Computer Programming 3 (3-0-6)
Introduction to computer systems; problem-solving using computers; programming in high-level languages; program structure, programming style and convention; control statements, data handling and processing; subprograms; classes and objects.

2190151 Computer Programming Laboratory 1 (0-3-0)
Computer programming in Engineering; reviews of computer programming concepts; hands on experience on computer programming using contemporary engineering tools.

2301215 Multivariable Calculus 3 (3-0-6)
CONDITION: PRER 2301108
Vector; curves, planes and surfaces; derivatives of vector-valued functions; partial, total and directional derivatives; implicit differentiation; maxima-minima; gradient, divergence, curl; scalar and vector fields; line integral; surface integral and volume integral; integral theorems of vector analysis.

2301216 Linear Algebra and Differential Equations 3 (3-0-6)
CONDITION: PRER 2301108
System of linear algebraic equations; linear space; eigenvalues and eigenvectors; principal axic theorem; higher-order linear differential equations; method of variation of parameters; system of first-order linear differential equations; qualitative analysis and dynamical system.

2301317 Methods of Applied Mathematics 3 (3-0-6)
CONDITION: PRER 2301215
Series solution; special functions; Laplace transforms; Fourier series and Fourier transforms; convergence theory; boundary value problems; linear partial differential equations; introduction to tensors; complex variables; analytic functions; line and contour integral; Laurent series; residue theorem.

Compulsory

2145211 Introduction to Aerospace Engineering 3 (3-0-6)
Basic aerodynamic phenomena and simplified theory, elementary aerospace vehicle performance, stability and control, and design.

2145221 Introduction to Aircraft Design 1 (0-0-4)
Introduction to aircraft systems, fundamental to aircraft systems, elements of aerodynamics, airfoils, and wings, aspect of vehicle conceptual design.

2145230 Aircraft Electricity and Electronics 3 (3-0-6)
DC and AC circuits analysis, electrical control devices, analog and digital electronics, electric measuring instruments, electric motors, aircraft electrical systems, radio theory, aircraft communication and navigation systems, aitolight systems.

2145290 Aerospace Engineering Seminar I 1 (1-0-2)
Discussion on the topics of aerospace engineering

2145311 Aerodynamics I 3 (3-0-6)
CONDITION: PRER 2183222*
Properties of air, standard atmosphere, conservation principles, continuity, momentum, Euler’s Equation, rotationality, circulation, vortex, lift, drag, potential flow, airfoil characteristics, thin airfoil theory, cambered and flapped airfoil, high lift devices, finite wing theory, panel and vortex lattice methods.

2145312 Aerodynamics II* AERODYNAMICS II 3 (3-0-6)
CONDITION: PRER 2183221*
and 2145311
Fundamental of compressible flow, acoustic waves, normal and oblique shock waves, expansion waves, Prandtl-Meyer flow, convergent-divergent nozzle, flow with friction and heat transfer, unsteady wave motion, perturbation theory, linearized flow and theory of characteristics.

2145321 Aircraft Structure I 3 (3-0-6)
Introduction to design of aerospace structures, review of concepts of stress, deformation, strain, and displacement and the equations of elasticity, two-dimensional problems in elasticity, energy methods of structural analysis, principles of virtual displacements and virtual forces, bending of thin plates, structural instability, introduction to finite element.

2145322 Aircraft Structure II 3 (3-0-6)
CONDITION: PRER 2145321
Principles of stressed skin construction, thin-walled beam, bending, shear and torsion of open and closed thin-walled beam, stress analysis of aircraft components, tapered beam, fuselage, wings, fuselage frames and wing rib, airworthiness and aerelasticity, factors of safety flight envelop, load factor determination, fatigue.
2145324  Modeling and Control of Dynamic Systems 3 (3-0-6)

Introduction to modeling, analysis, and control of dynamic systems; modeling of mechanical, electrical and electromechanical system; Laplace Transforms and transfer function techniques; frequency response and Bode diagrams; analysis and design of feedback control systems; control system representation and characteristics; system performance specifications; stability analysis and conditions; Root-Locus and frequency response analysis and design; systems compensation and controller design.

2145325  Flight Mechanics 3(3-0-6)
CONDITION: PRER 2183231 and 2145324

Performance, stability, and control of aircraft; general equations of motion for rigid aircraft; aerodynamic forces and moments; flight paths; small disturbance theory; stability derivatives, longitudinal and lateral stability; response to control inputs and to atmospheric disturbances; automatic flight control.

2145361  Aerospace Engineering Experimentation and Laboratory I 2 (1-3-2)

Concepts in experimentation; introduction to systematic design of an experiment using data reduction diagram (DRD); setting up objectives of an experiment, constructing the set of data reduction diagrams (DRDs) of the experiment according to the objectives; measurement and instrument; uncertainty analysis; basic experiments and laboratories in thermodynamics; fluid mechanics and aerodynamics; dynamics; solid mechanics.

2145362  Aerospace Engineering Experimentation and Laboratory II 2 (1-3-2)
CONDITION: PRER 2145361

Experiments and laboratories in aerodynamics, structure, propulsion, performance, dynamics and control.

2145363  Aerospace Engineering Experimentation and Laboratory III 2 (1-3-2)
CONDITION: PRER 2145362

Concepts in experimentation and design of an experiment; setting up specifications and objectives of an experiment; systematic design of an experiment according to the specifications and objectives using different kinds of tools; outlining the process of extracting experimental results and conclusions from the designed experiment; outlining data collection and data analysis schemes; outlining experimental project phases, tasks, and schedule; design documentation and review by oral and written presentation; practices in the design of an experiment in the project-based setting; introduction to modern instrumentation and data acquisition through demonstration.

2145390  Aerospace Engineering Seminar II 1(1-0-2)

Discussion on the topics of aerospace engineering.

2145402  Aircraft Propulsion 4 (4-0-8)
CONDITION: PRER 2183221 and 2183222

Introduction to propulsion, air-breathing and non-air-breathing engines; brief review of the thermodynamics and compressible flow; basic thrust equation of aircraft gas turbine engines; Brayton cycle, propellers, momentum theory and blade element theory; gas turbine component performance, inlet, compressor, turbine and nozzle; cycle analysis of gas turbine engines, ramjet, turbojet, turboprop.

2145451  Aircraft Design 4 (4-0-8)
CONDITION: PRER 2145221

Fundamentals of aircraft design process, wing design consideration, tail design consideration, undercarriage arrangement consideration, initial take-off mass estimation, detailed mass calculation, mission fuel requirement; center of gravity calculation, basic aerodynamics estimation, static stability and control analysis, propulsion consideration and analysis, performance analysis, aircraft cost prediction, preliminary and detailed design concepts, quality control of aircraft design.

2145490  Aerospace Engineering Seminar III 1 (1-0-2)

Discussion on the topics of aerospace engineering.

2145499  Aerospace Engineering Project 3 (0-6-3)

Group or individual projects on a subject related to aerospace engineering.

2183221  Thermodynamics 3 (3-0-6)

Basic concepts; thermodynamic state and process; properties of pure substances and ideal gases; energy; the first law of thermodynamics and the first law analysis for isolated, closed, and open systems; entropy; the second law of thermodynamics and the second law analysis for isolated, closed, and opens systems; gas power cycles; Carnot, Otto, and Brayton cycles; refrigeration cycle; introduction to gas mixtures; introduction to combustion.

2183222  Fluid Mechanics 3 (3-0-6)

Basic concepts in physics: physical quantity and physical quantity relations, dimensions of physical quantity and the principle of dimensional homogeneity, dimensionless variables; basic concepts in fluid mechanics: continuum assumption, methods of description; Lagrangian and Eulerian descriptions, field quantity and classification of flow fields; geometric and kinematics of fluid motion: pathlines, streamlines, and streaklines; forces and stressed in fluids: pressure and pressure force, shear stress and shear force: convection flux and Reynolds's transport theorem; physical laws of finite control volume: conservation of mass, linear momentum, and energy; conservation of angular momentum with application to turbomachines; physical laws of infinite control volume: conservation of mass and linear momentum, introduction to Navier-Stokes and Euler's equations; Bernoulli's equation from momentum and conservation of mechanical energy viewpoints; introduction to vorticity and vortex; dimensional analysis: Buckingham's PI theorem, similarity, and model testing; internal viscous flows, energy consideration in pipe flows and piping system; external flows, boundary layer, and aerodynamic force and moment; applications: turbomachines, model testing, piping and pumping system, aerodynamic force and moment.

2183381  Numerical Methods for Engineers 3 (3-0-6)

Basic methods for obtaining numerical solutions by a digital computer, including methods for the solutions of
algebraic and transcendental equations, simultaneous linear equations, ordinary and partial differential equations, and curve fitting techniques, comparison of various methods with respect to computational efficiency and accuracy.

Approved Electives

2145420 Avionics 3 (3-0-6)
Basic avionic system, air data systems, flight instruments, terrestrial en-route - radio navigation systems, terrestrial landing aids, satellite navigation system, radar systems, indicators and displays, airborne radio communications, autopilot and flight-management system, avionic systems integration.

2145421 Introduction to Computational Fluid Dynamics 3 (3-0-6)
Physical and mathematical foundations of computational fluid mechanics with emphasis on applications; solution methods for model equations, the Euler and the Navier-Stokes equations; classification of partial differential equations and solution techniques.

2145422 Gas Dynamics 3 (3-0-6)
Introduction to gas dynamics, covering fundamental concepts in thermodynamics and fluid dynamics; molecular and continuum concepts for fluids, first and second laws of thermodynamics, conservation laws for moving fluids, one-dimensional compressible flows, shock and expansion waves, flows in nozzles, and two- and three-dimensional compressible flows.

2145497 Selected Topics in Aerospace Engineering I 3 (2-3-4)
Selected interesting topics in aerospace engineering.

2145498 Selected Topics in Aerospace Engineering II 3 (2-3-4)
Selected interesting topics in aerospace engineering.

2183431 Mechanical Vibrations 3 (3-0-6)
Analysis of system with single and multi degree of freedom; torsional vibration; free and forced vibration; determination of natural frequencies of structures; discrete system; Modal analysis; methods and techniques to reduce and control vibration; Lagrange’s equations.

2184303 Engineering Management 3 (3-0-6)
Modern management principles; methods of increasing productivity; human relations; industrial safety; pollution problems; commercial laws; basics of engineering economy, finance, marketing and project management.
The Regional Centre for Manufacturing Systems Engineering

The Regional Centre for Manufacturing Systems Engineering was established in the Faculty of Engineering, with the initial support of the Federation of Thai industries and the British Council, to be the focal point of graduate-level teaching and research in engineering management and manufacturing systems engineering in the South-East Asian region. Since the first group in January 1996, the Centre has graduated several hundred master degree graduates in its unique dual-degree programme with the University of Warwick.

Established in 1996 the Regional Centre for Manufacturing Systems Engineering offers a postgraduate programme leading to the degree of Master of Engineering in Engineering Management. It is based on the successful model at the University of Warwick which is supported by a number of leading international companies. The current programme in Thailand is supported by The Federation of Thai industries. It allows the transfer of leading edge technologies and manufacturing strategies to Thai companies.

Academic staff from both the Warwick Manufacturing Group and Chulalongkorn University contribute to teaching of the programme. The Master of Engineering award is granted by Chulalongkorn University and the Master of Science award is granted, concurrently, by the University of Warwick providing truly international credibility.

ENGINEERING MANAGEMENT
(International Program)

NAME OF THE DEGREE
: Master of Engineering
: M. Eng.

ADMISSION

1. The applicant must hold a Bachelor’s Degree of Engineering or equivalent with the minimum TOEFL score of 550 or with the certificate of proficiency in English (IELTS 6.0) from the British Council or with WELT B.C.C.
2. The Applicant must meet other qualifications set by the regulations of the Graduate School, Chulalongkorn University, which will be annually announced. Otherwise the applicant must earn the approval by the graduate study committee of the Faculty of Engineering.

DEGREE REQUIREMENTS

Number of credits for curriculum not less than 42 credits: 4 credits for required courses, (non-credit) 24 credits for elective courses, 18 credits for thesis.

PROFESSORS :

Parames Chutima, Ph.D. (Nottingham)

ASSOCIATE PROFESSORS :

Damrong Thaveersakthuthi, B.Eng. Hons. (Chula) M.Eng. (A.I.T)
Jeerapat Ngaporatwong, B.Eng. Hons. (Chula) M.S. M.A. (Iowa)
Manit Thongprasert, Ph.D. (Texas tech.)
Parames Chutima, Ph.D. (Nottingham)
Viboon Sangveraphunsiri, Ph.D. (Georgia Tech.)

ASSISTANT PROFESSORS :

Boonwa Thampitakkul, B.E. (N.S.W.) M.S. (Iowa) D.E.A., Docteur de3e cycle (Sciences de gestion) AIX-SEILLE III
Napassavang Osothsilp Ph.D. (Wisconsin-Madison) MS. (wisconsin-adison) B.Eng. (Chula)
Prasert Akkharapathamphong, M.Eng. (Keio)
Rein Boondiskulchok, License es Sciences, Maîtrise es Sciences, Economiques (D.E.S.S Toulouse)
Somchai Puajindanetr, Ph.D. (Imperial London)

INSTRUCTORS :

Jirdsak Tscheikuna, Ph.D.
Somboon Chongchaikit, B. Eng. Hons M.Eng. (Chula) D.E.S. (ESE France) Dr.Ing. (Electronique) (Paris XI)
COURSE REQUIREMENTS

1) Required Courses 2 credits
2163601 Fundamentals of Integrated Engineering Business Management 2(2-0-6)

2) Approved Electives 10 credits
2163610 Service Support Technologies 2(2-0-6)
2163620 Logistics and Operation Management 2(2-0-6)
2163630 Business Strategy and Strategic Management 2(2-0-6)
2163631 Project Planning Management and Control 2(2-0-6)
2163632 Organisations, People and Performance 2(2-0-6)

3) Elective Courses 10 credits

Technology
2163611 Computer Aided Design and Manufacture 2(2-0-6)
2163612 Automation and Robotics 2(2-0-6)
2163613 E-Commerce Technologies 2(2-0-6)
2163614 Metallic Materials: Properties and Applications 2(2-0-6)
2163615 Polymer Materials: Processes and Applications 2(2-0-6)
2163616 Information and Communication Technologies 2(2-0-6)
2163617 Manufacturing Process Technology 2(2-0-6)
2163618 Design for the Environment 2(2-0-6)

Operation
2163621 Supply Chain Management 2(2-0-6)
2163622 Technology Management 2(2-0-6)
2163623 Product Design and Development Management 2(2-0-6)
2163624 Quality Management and Techniques 2(2-0-6)
2163625 Applied Statistical Methods 2(2-0-6)

Management
2163633 Operations Strategy for Industry 2(2-0-6)
2163634 Strategic Marketing 2(2-0-6)
2163635 Information System Strategy 2(2-0-6)
2163636 Innovative Strategy 2(2-0-6)
2163637 Financial Analysis and Control Systems 2(2-0-6)
2163638 Financial Strategy 2(2-0-6)
2163639 Management of Change 2(2-0-6)
2163640 International Joint Venture 2(2-0-6)
2163641 Establishing New Business 2(2-0-6)
2163642 Business Environment and Economics 2(2-0-6)

General
2163691 Advanced Topics in Engineering Management I 2(2-0-6)
2163692 Advanced Topics in Engineering Management II 2(2-0-6)
2163693 Advanced Topics in Engineering Management III 2(2-0-6)

2163694 Advanced Topics in Engineering Management IV 2(2-0-6)
2163695 Advanced Topics in Engineering Management V 2(2-0-6)
2163696 Advanced Topics in Engineering Management VI 2(2-0-6)

3) Thesis 18 credits
2163813 Thesis 18 credits

COURSE DESCRIPTIONS

2163601 Fundamentals of Integrated Engineering Business Management 2(2-0-6)
Introduction to engineering business management; manufacturing and engineering industry today; international challenge; the change of management process; IEBM programmer rationale; introduction to manufacturing operations strategy; manufacturing operations strategy formulation process; systems approach; product strategy and innovation; role of technology; tools and techniques of operational management.

2163610 Service Support Technologies 2(2-0-6)
The Service Support Technologies looks at the technologies available to both deliver and support service. It will consider diagnostic tools both in terms of healthcare diagnostics and machinery diagnostics. The secondary level of technological support in terms of information systems and global business implications will also be covered.

2163620 Logistics and Operation Management 2(2-0-6)
The logistics function in the supply chain; establishing a logistics strategy; customer and supplier relationship; operations planning and control; material requirements planning; just-in-time philosophies; the use of computers in logistics and operations management; distribution networks; measuring logistics performance.

2163630 Business Strategy and Strategic Management 2(2-0-6)
Introduction and International economic background; economic and business trends in the Asia Pacific area; the strategic management process; analysis of the external environment; analysis of the internal environment; Alternative approaches to strategic thinking; financial aspects of strategic management; organizational and human resource aspects; global business strategies; Cross-cultural aspects of strategic management; Case studies.

2163631 Project Planning Management and Control 2(2-0-6)
Project organization, planning and content analysis; estimating; and tendering; budgeting and cost control; network planning; project monitoring; partnership/contractor relationships.
2163632 Organisations People and Performance 2(2-0-6)
Company organization, cultures and management styles; payment schemes; trade unions and industrial relations; legislation; the role of the individual, career and personal development; technological implications; manpower and succession planning, selection and motivation; communications; conflicts between company and individual objectives.

2163611 Computer Aided Design and Manufacture 2(2-0-6)
Basis CAD concepts; 3-D concepts; 2 ½ axis NC. Programming; finite element analysis; surface modeling; coding and classification; cell control; computer aided inspection; 3 axis NC. Programming; computer aided process planning; parametric; knowledge based systems in CAD/CAM; CAD/CAM-design to manufacture demonstration; role of CAD/CAM; introduction to computer integrated manufacture (CIM); emerging technologies; case study.

2163612 Automation and Robotics 2(2-0-6)
Principles and implementation of automatic and robotics systems; automatic process control logic and sequence; automated materials handling and storage; economic justification for AMT projects; flexible manufacturing systems; vision engineering; robots at work; importance of design in automation; case studies, syndicate exercises and a visit.

2163613 e-Commerce Technologies 2(2-0-6)
E-Commerce in perspective; the application of E-Commerce tools and techniques; Internet, Intranet and Extranet; communication and network technologies; privacy and security; collaborative product commerce; data warehouses, mining and knowledge engineering; evaluation of e-commerce in functional operations; legal implications; virtual enterprises; the future of e-commerce technologies.

2163614 Metallic Materials: Properties Processes and Applications 2(2-0-6)
The structure/property relationship - mechanical properties of metals and alloys, methods of measuring and increasing them, and their influence on process ability and application; Properties and selection of steels; heat treatment; effect of alloying; Properties and selection of cast irons; introduction to tool materials; properties and selection of non-ferrous metals; failure investigation; introduction to engineering ceramics; electronic and optical materials; metal matrix composites; introduction to primary production processes.

2163615 Polymer Materials: Processes and Applications 2(2-0-6)
Polymers as an engineering material; manufacturing technologies for polymeric materials; economics of material selection and aspects of environmental considerations; computer simulation; component, tooling and manufacturing techniques; high and low volume production manufacturing technologies; plastic component market opportunities; case study; laboratory visit

2163616 Information and Communication Technologies 2(2-0-6)
Systematic project management methodology; data modeling; database design and management; computer architectures and operating environments; system development tools and programming; data communication and network technologies; internet and world-wide-web technologies; emerging technologies; human aspects of systems implementation.

2163617 Manufacturing Process Technology 2(2-0-6)
An appreciation of the application capabilities and limitation of primary and secondary manufacturing processes.

2163618 Design for the Environment 2(2-0-6)
Train a new generation of product designers and managers who will play a major role in the move towards sustainable development. Integrate the needs of the customer with those of the environment to ensure that the society can reach a more balanced trade-off between economy and environment. An appreciation of sustainable business practice, energy, design, materials and life cycle analysis is key. New eco-friendly products and clean production technologies need to be developed and utilised in our drive towards sustainable development at national and global level.

2163621 Supply Chain Management 2(2-0-6)
Meaning of supply chain management; designing the supply base and selecting suppliers; supply chain relationships; measuring suppliers and the supply chain; supplier development and continuous improvement; organization design; technology in supply chain management.

2163622 Technology Management 2(2-0-6)
Technology and its importance; case studies on the benefits/consequences of adopting/ignoring technology; how business needs and product strategy drive technological requirements; evaluation of capability of the competitors, companies to deliver technology; SWOT and benchmarking exercises; formulating company technology strategy - accessing technology; justifying technological investment - persuading decision makers; tools and techniques for assessing technology and delivering it at acceptable risk; implementation of strategy for technological change; future opportunities and developments.

2163623 Product Design and Development Management 2(2-0-6)
The role of the marketing organization; methods to turn concepts into engineering solutions; content of a design specifications; sources of costs associated with introduction of a new product; prevention of defects and scrap of rejects during manufacture and assembly; cost of ownership concept; design for simple maintenance.

2163624 Quality Management and Techniques 2(2-0-6)
Management for Quality: Motivation and Employee Involvement; Economics of Quality; Design for Quality; Basic Tools of Quality Improvement; Variability in Processes; Product Liability; Quality Systems; Failure Modes, Effects and Criticality Analysis; Quality Function Deployment.
2163625 Applied Statistical Methods 2 (2-0-6)
Descriptive statistics; probability; distributions: binomial, Poisson, exponential and normal; exploratory data analysis; sampling and testing; analysis of variance; regression analysis; goodness of fit; distribution-free (non parametric) statistics; design of experiments; statistics on computer.

2163633 Operations Strategy for Industry 2 (2-0-6)
The company and corporate strategy; the market requirements; products and product design; subcontracting, sourcing, make and buy decision; technology, processes, plant replacement and investment; total quality; manufacturing operations organization; diversification factoring and acquisition; joint venture and collaboration; human factors; company structure; external factors; financial controls.

2163634 Strategic Marketing 2 (2-0-6)
Introduction to marketing; types of market; marketing research and analysis; managing the marketing mix regarding product, price, place and promotion as well as the impact of information technology; strategic market planning perquisites and methods and management.

2163635 Information System Strategy 2 (2-0-6)
Information systems evolution; data and information presentation and management; business activity and information analysis; organizational implications; information systems architecture and selection; strategy development; legal and financial implications; industrial sector comparisons.

2163636 Innovative Strategy 2(2-0-6)
Environments for learning and innovation; The barriers to creative thinking; Understanding mind-sets through a manufacturing strategy role play; the design/development of business processes for innovation; an innovation strategy workshop; approaches to business strategies; the world of systems thinking; a business systems simulation; national issues for innovation policy; leadership styles; development of innovation action plans.

2163637 Financial Analysis and Control Systems 2(2-0-6)
Financial objectives; profitability and liquidity; analysis and interpretation of published financial statements; cost behavior analysis; profit/volume analyses; budget preparation and control; standard costing; divisional/segmental performance measurement; capital investment; risk and uncertainty analysis; effects of inflation and taxation; introduction to computer-based financial modeling.

2163638 Financial Strategy 2(2-0-6)
Capital expenditure appraisal and present value concept; taxation. Inflation and life cycle costing; financial modeling; risk and return on investment; sources of finance and market efficiency; mergers and acquisitions; international financial markets.

2163639 Management of Change 2(2-0-6)
Concept and consideration of mapping the organization, people’s used in reaction to changes, concepts and consideration of individual territories, journeys to success, tools and techniques, major change programs, planning and implementing change, model for change, continuous learning and change, planning for the future.

2163640 International Joint Ventures 2(2-0-6)
Collaboration strategy, concepts and types of collaborative venture, international joint venture management, guidelines for practice and culture, low and finance, negotiation and international joint venture exercises.

2163641 Establishing New Business 2(2-0-6)
Explores the personal motivators and implementation issues in setting up a new business. It explores options on the types of businesses, and the resulting legal requirements and operational regulations that may apply and how these impact on the operational structure of the business. It explores the personal compromises that will be required.

2163642 Business Environment and Economics 2(2-0-6)
Economics data; econometrics; demand/supply and the market; national and international level of economic activity; microeconomic at industry level; markets and efficiency; market failure; industry structure.

2163691 Advanced Topics in Engineering Management I 2(2-0-6)
Study of current interesting topics and new development in engineering management I.

2163692 Advanced Topics in Engineering Management II 2(2-0-6)
Study of current interesting topics and new development in engineering management II.

2163693 Advanced Topics in Engineering Management III 2(2-0-6)
Study of current interesting topics and new development in engineering management III.

2163694 Advanced Topics in Engineering Management IV 2(2-0-6)
Study of current interesting topics and new development in engineering management IV.

2163695 Advanced Topics in Engineering Management V 2(2-0-6)
Study of current interesting topics and new development in engineering management V.

2163696 Advanced Topics in Engineering Management VI 2(2-0-6)
Study of current interesting topics and new development in engineering management VI.

2146813 Thesis 18 Credits
BIOMEDICAL ENGINEERING PROGRAM (INTERDISCIPLINES)

Biomedical Engineering (BME) Program was founded in 2006 with the main purpose to educate the graduates who are interested in BME.

BME program involved in application of principle and practice for engineer in order to create the novel knowledge for medicine purposes and to develop the diagnosis and the treatment of diseases. For examples, the applications of sound wave and electromagnetic wave for diagnosis, the applications of nanotechnology for tissue transplantation and artificial organs.

After year 2010, BME was transferred the administration from Graduate School to the Faculty of Engineering. Nowadays, BME program provides Master of Science (M.Sc.), Master of Engineering (M.Eng.), and Doctor of philosophy (Ph.D.) degrees.

HEAD:
Siriporn Damrongakkul, Ph.D. (London)

PROFESSORS:
Areerat Suputtittada M.D. (Mahidol)
Prabhas Chongsritivatana, Ph.D. (Edinburgh)
Suthiluk Patumraj Ph.D. (New Jersey)

ASSOCIATE PROFESSORS:
Chedsada Chinruengrueng, Ph.D. (U.C. Berkeley)
Mana Siryudthasak, D.Eng. (T.I.T.)
Siriporn Damrongakkul, Ph.D. (London)
Somporn Sanguanrungriruk, M.D., M.Sc. (Chula)
Watcharapong Khovidhungij, Ph.D. (UCLA)

ASSISTANT PROFESSORS:
Arporn Teeramongkonrasmee, Ph.D. (Chula)
Chamchai Pluempritwiriyawej, Ph.D. (Carnegie Mellon)
Cherdkul Sopavanit, M.Eng. (Chula)
Sorada Kanopanont, Ph.D. (Drexel)
Tanom Bunaprasert M.D. (Prince of Songkla)
Tayar Desudchit M.D. (Chula)

INSTRUCTORS:
Apiwat Lek-Uthai Dr. Ing. (Karlsruhe)
Bunchay Suporn Chai, M.Eng. (Chula)
Juthamas Ratanavaraporn Ph.D. (Chula)
Pakpum Somboon Ph.D. (T.I.T.)
Pairat Tangpornprasert D.Eng. (Tokyo)

NAME OF THE DEGREE:
Master of Science
M.Sc.

ADMISSION

The applicants must hold a Bachelor degree in any fields of Science, Health Science (Medicine, Dentistry, Veterinary Medicine, Pharmacy, Nursing, or Allied Health Sciences), or Engineering and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS

1. The students have to pass a minimum of 6 credits of required course, 12 credit of elective courses, and 18 credits of thesis, a total of them not less than 36 credits.
2. The students have to pass an oral thesis examination. Some part of thesis has to be published or accepted for publication in a journal or was presented in an academic conference having proceedings.
3. The degree will be awarded for the student who has fulfilled the requirements as followed; G.P.A. not less than 3.00, and period of study not less than 4 semesters and not more than 8 semesters.

STUDY PROGRAM

The First Semester
2100600 Introduction to Biomedical Engineering 3
2100601 Basic Engineering Knowledge for Biomedical Engineering 3

The Second Semester
XXXXXXX Free Elective 3
2100791 Biomedical Engineering Seminar I (2)* 9

The Third Semester
2100813 Thesis 9

The Fourth Semester
2100813 Thesis 9

COURSE REQUIREMENTS

1) Required Courses 6 credits
2100600 Introduction to Biomedical Engineering 3(2-3-7)
2100601 Basic Engineering Knowledge for Biomedical Engineering 3(2-3-7)
2100791 Biomedical Engineering Seminar I 2(2-0-6)
2100792 Biomedical Engineering Seminar II 2(2-0-6)
DEGREE REQUIREMENTS

1. The students have to pass a minimum of 6 credits of required course, 12 credit of elective courses, and 18 credits of thesis, a total of them not less than 36 credits.
2. The students have to pass an oral thesis examination. Some part of thesis has to be published or accepted for publication in a journal or was presented in an academic conference having proceedings.
3. The degree will be awarded for the student who has fulfilled the requirements as followed: G.P.A. not less than 3.00, and period of study not less than 4 semesters and not more than 8 semesters.

STUDY PROGRAM

The First Semester

2100600 Introduction to Biomedical Engineering
3
3017767 Human Body for Biomedical Engineering
3
XXXXXX Free Elective
3
2100791 Biomedical Engineering Seminar I (2)*
9

The Second Semester

2100792 Biomedical Engineering Seminar II (2)*
9

Remarks:
* No credit will be granted, evaluation will be only S/U

The Third Semester

2100813 Thesis
9

The Fourth Semester

2100813 Thesis
9

COURSE REQUIREMENTS

1) Required Courses 6 credits

2100600 Introduction to Biomedical Engineering
3(2-3-7)
3017767 Human Body for Biomedical Engineering
3(2-3-7)
2100791 Biomedical Engineering Seminar I
2(2-0-6)
2100792 Biomedical Engineering Seminar II
2(2-0-6)

2) Elective Courses 12 credits

2100612 Basic Engineering Knowledge for Biomedical Engineering
3(2-3-7)
2100603 Research Methodology and Research Instrumentation
3(3-0-9)
2109556 Biomaterials
3(3-0-9)
3000748 Tissue and Cell Engineering
3(3-0-9)
3000749 Biosystems and Biotransport
3(3-0-9)
3000750 Drug Delivery System
3(3-0-9)
2102611 Medical Instrumentation
3(3-0-9)
2102646 Power Electronics for Biomedical Engineering Applications
3(3-0-9)
2102678 Advanced Sensor Theory
3(3-0-9)
2102676 Adaptive Signal Processing
3(3-0-9)
2105641 Biodegradable Material Engineering
3(3-0-9)
2111602 Radiation Physics for Medical Science
2(2-0-6)
2100604 Strategic Tissue Engineering and Controlled Release System
3(3-0-9)
2100605 Biomedical Embedded System
3(3-0-9)

3) Thesis

2100813 Thesis
18 credits

NAME OF THE DEGREE

: Master of Engineering
: M.Eng.

ADMISSION

The applicant must hold a Bachelor degree in Engineering and also passed the requirements of the Graduate School or got approval from the program committee for admission.
2102631 Mathematical Modeling and Analysis of Physiological Systems 3(3-0-9)
2102523 Biomedical Signal Processing 3(3-0-9)
2102524 Medical Imaging Technology 3(3-0-9)
2110675 Biomedical Information and Communication Systems 3(3-0-9)
3016725 Biomechanics 3(3-0-9)
2100636 Biomedical Analytical Technique 3(3-0-9)
2100696 Special Problems in Biomedical Engineering 3(0-0-12)
2100697 Individual Study 3(0-0-12)
2100796 Advanced Topics in Biomedical Engineering I 3(3-0-9)
2100797 Advanced Topics in Biomedical Engineering II 3(3-0-9)
2102505 Introduction to Optimization Techniques 3(3-0-9)
2102507 Computational Techniques for Engineers 3(3-0-9)
2102531 System Identification 3(3-0-9)
2102635 Control System Theory 3(3-0-9)
2102668 Biosensors 3(3-0-9)
2102546 Analog Integrated Circuits 3(3-0-9)
2102784 Measurement System Design and Simulation 3(3-0-9)
2102785 Advanced Sensor Theory 3(3-0-9)
2102876 Adaptive Signal Processing 3(3-0-9)
2105541 Biodegradable Material Engineering 3(3-0-9)
2111602 Radiation Physics for Medical Science 2(2-0-6)
2100604 Strategic Tissue Engineering and Controlled Release System 3(3-0-9)
2100605 Biomedical Embedded System 3(3-0-9)

3) Thesis
2100813 Thesis 18 credits

NAME OF THE DEGREE
: Doctor of Philosophy
: Ph.D.

ADMISSION
The applicants have to pass the following basic requirements:

For Pattern 1:
For applicants who held the Master degree in Biomedical Engineering and have got the thesis qualification as the excellence level and also passed the requirements of the Graduate School or got approval from the program committee for admission.

For Pattern 2:
Pattern 2(1) for applicants who held a Master degree in Biomedical Engineering, Master degree in Engineering or Science and have got the thesis qualification as the good level, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

Pattern 2 (2) for applicants who held a Bachelor degree in Engineering or Science and have got the second honor degree or have G.P.A. not less than 3.25 based on 4 point grading system, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS
For Pattern 1:
The students have to get 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in a journal of 2 papers, at least 1 paper has to be published in an international journal.

For Pattern 2(1):
The students have to get 12 credits of elective courses and 48 credits of thesis, total of 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

For Pattern 2(2):
The students have to get 24 credits of elective courses and 48 credits of thesis, total of 72 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

Remark:
For Pattern 1 may require additional courses or other academic activities (no credit will be granted, evaluation will be only S/U) that will benefit for the thesis, under consent of the advisor and the program committee.

STUDY PROGRAM
Pattern 1
The First Semester
2100791 Biomedical Engineering Seminar I (2)*
2100829 Dissertation 12

The Second Semester
2100792 Biomedical Engineering Seminar II (2)*
2100829 Dissertation 12

The Third Semester
2100793 Biomedical Engineering Seminar III (2)*
2100829 Dissertation 12

The Fourth Semester
2100794 Biomedical Engineering Seminar IV (2)*
2100829 Dissertation 12

NAME OF THE DEGREE
: Doctor of Philosophy
: Ph.D.

ADMISSION
The applicants have to pass the following basic requirements:

For Pattern 1:
For applicants who held the Master degree in Biomedical Engineering and have got the thesis qualification as the excellence level and also passed the requirements of the Graduate School or got approval from the program committee for admission.

For Pattern 2:
Pattern 2(1) for applicants who held a Master degree in Biomedical Engineering, Master degree in Engineering or Science and have got the thesis qualification as the good level, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

Pattern 2 (2) for applicants who held a Bachelor degree in Engineering or Science and have got the second honor degree or have G.P.A. not less than 3.25 based on 4 point grading system, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS
For Pattern 1:
The students have to get 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in a journal of 2 papers, at least 1 paper has to be published in an international journal.

For Pattern 2(1):
The students have to get 12 credits of elective courses and 48 credits of thesis, total of 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

For Pattern 2(2):
The students have to get 24 credits of elective courses and 48 credits of thesis, total of 72 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

Remark:
For Pattern 1 may require additional courses or other academic activities (no credit will be granted, evaluation will be only S/U) that will benefit for the thesis, under consent of the advisor and the program committee.

STUDY PROGRAM
Pattern 1
The First Semester
2100791 Biomedical Engineering Seminar I (2)*
2100829 Dissertation 12

The Second Semester
2100792 Biomedical Engineering Seminar II (2)*
2100829 Dissertation 12

The Third Semester
2100793 Biomedical Engineering Seminar III (2)*
2100829 Dissertation 12

The Fourth Semester
2100794 Biomedical Engineering Seminar IV (2)*
2100829 Dissertation 12

NAME OF THE DEGREE
: Doctor of Philosophy
: Ph.D.

ADMISSION
The applicants have to pass the following basic requirements:

For Pattern 1:
For applicants who held the Master degree in Biomedical Engineering and have got the thesis qualification as the excellence level and also passed the requirements of the Graduate School or got approval from the program committee for admission.

For Pattern 2:
Pattern 2(1) for applicants who held a Master degree in Biomedical Engineering, Master degree in Engineering or Science and have got the thesis qualification as the good level, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

Pattern 2 (2) for applicants who held a Bachelor degree in Engineering or Science and have got the second honor degree or have G.P.A. not less than 3.25 based on 4 point grading system, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS
For Pattern 1:
The students have to get 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in a journal of 2 papers, at least 1 paper has to be published in an international journal.

For Pattern 2(1):
The students have to get 12 credits of elective courses and 48 credits of thesis, total of 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

For Pattern 2(2):
The students have to get 24 credits of elective courses and 48 credits of thesis, total of 72 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

Remark:
For Pattern 1 may require additional courses or other academic activities (no credit will be granted, evaluation will be only S/U) that will benefit for the thesis, under consent of the advisor and the program committee.

STUDY PROGRAM
Pattern 1
The First Semester
2100791 Biomedical Engineering Seminar I (2)*
2100829 Dissertation 12

The Second Semester
2100792 Biomedical Engineering Seminar II (2)*
2100829 Dissertation 12

The Third Semester
2100793 Biomedical Engineering Seminar III (2)*
2100829 Dissertation 12

The Fourth Semester
2100794 Biomedical Engineering Seminar IV (2)*
2100829 Dissertation 12
The Fifth Semester
2100894 Doctoral Dissertation Seminar (0)*
2100829 Dissertation 12

The Sixth Semester

Remarks:
* No credit will be granted, Evaluation will be only S/U

Pattern 2(1)

The First Semester
2100791 Biomedical Engineering Seminar I (2)*
XXXXXX Free Elective 9

The Second Semester
2100792 Biomedical Engineering Seminar II (2)*
XXXXXX Free Elective 9

The Third Semester
2100793 Biomedical Engineering Seminar III (2)*
2100828 Dissertation 3
XXXXXX Free Elective 6

The Fourth Semester
2100794 Biomedical Engineering Seminar IV (2)*
2100828 Dissertation 9

The Fifth Semester
2100894 Doctoral Dissertation Seminar (0)*
2100829 Dissertation 12

The Sixth Semester
2100894 Doctoral Dissertation Seminar (0)*
2100829 Dissertation 12
## COURSE REQUIREMENTS

### Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100600</td>
<td>Introduction to Biomedical Engineering</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2100601</td>
<td>Basic Engineering Knowledge for Biomedical Engineering</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2111602</td>
<td>Radiation Physics for Medical Science</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>2100604</td>
<td>Strategic Tissue Engineering and Controlled Release System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2100791</td>
<td>Biomedical Engineering Seminar I</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>2100792</td>
<td>Biomedical Engineering Seminar II</td>
<td>2(2-0-6)</td>
</tr>
<tr>
<td>3017767</td>
<td>Human Body for Biomedical Engineering</td>
<td>3(2-3-7)</td>
</tr>
<tr>
<td>2100603</td>
<td>Research Methodology and Research Instrumentation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2109556</td>
<td>Biomaterials</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>3000748</td>
<td>Tissue and Cell Engineering</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>3000749</td>
<td>Biosystems and Biotransport</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>3000750</td>
<td>Drug Delivery System</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102611</td>
<td>Medical Instrumentation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102646</td>
<td>Power Electronics for Biomedical Engineering Applications</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2100623</td>
<td>Technology for Seniors and the Disabled</td>
<td>3(3-9)</td>
</tr>
<tr>
<td>2102631</td>
<td>Mathematical Modeling and Analysis of Physiological Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102523</td>
<td>Biomedical Signal Processing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102524</td>
<td>Medical Imaging Technology</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2110675</td>
<td>Biomedical Information and Communication Systems</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>3016725</td>
<td>Biomechanics</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2100636</td>
<td>Biomedical Analytical Technique</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2100696</td>
<td>Special Problems in Biomedical Engineering</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td>2100697</td>
<td>Individual Study</td>
<td>3(0-0-12)</td>
</tr>
<tr>
<td>2100796</td>
<td>Advanced Topics in Biomedical Engineering I</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2100797</td>
<td>Advanced Topics in Biomedical Engineering II</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102505</td>
<td>Introduction to Optimization Techniques</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102507</td>
<td>Computational Techniques for Engineers</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102531</td>
<td>System Identification</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102635</td>
<td>Control System Theory</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102668</td>
<td>Biosensors</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102546</td>
<td>Analog Integrated Circuits</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102784</td>
<td>Measurement System Design and Simulation</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102785</td>
<td>Advanced Sensor Theory</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2102876</td>
<td>Adaptive Signal Processing</td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td>2105641</td>
<td>Biodegradable Material Engineering</td>
<td>3(3-0-9)</td>
</tr>
</tbody>
</table>

### Pattern 2.1 = 12 credits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100600</td>
<td>Introduction to Biomedical Engineering</td>
<td>3(2-3-7)</td>
</tr>
</tbody>
</table>

### Pattern 2.2 = 12 credits and Pattern 2.2

### Current topics in biomedical engineering.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100828</td>
<td>Thesis</td>
<td>48 credits</td>
</tr>
<tr>
<td>2100829</td>
<td>Thesis</td>
<td>60 credits</td>
</tr>
</tbody>
</table>

### COURSE DESCRIPTIONS in BIOMEDICAL ENGINEERING (M.Eng., M.Sc., Ph.D.)

#### 2100600 Introduction to Biomedical Engineering 3(2-3-7)

Definition of biomedical engineering and other related fields; role of biomedical engineers; introduction to technology, instruments and basic application programs required for biomedical engineering; ethics in biomedical engineering; case studies: problem and application in biomedical engineering fields; hospital and laboratory visit, and assigned projects to explore the breadth and depth of the biomedical engineering field.

#### 2100601 Basic Engineering Knowledge for Biomedical Engineering 3(2-3-7)

Review of differential equations and transform techniques; signals, circuits and electronics; feedback mechanism, biomaterials; biomedical measurements and instrumentation; technological applications in medical practices; computer applications in biomedical engineering.

#### 2100791 Biomedical Engineering Seminar I 2(2-0-6)

Current topics in biomedical engineering.

#### 2100792 Biomedical Engineering Seminar II 2(2-0-6)

Current topics in biomedical engineering.

#### 3017767 Human Body for Biomedical Engineering 3(3-0-9)

Anatomy, physiology and biochemistry of the human body, including the musculoskeletal, nervous, respiratory, cardiovascular, alimentary, urinary, endocrine and reproductive systems; physiological laboratories of systems related to biomedical engineering.

#### 2100603 Research Methodology and Research Instrumentation 3(3-0-9)

Experimental and research methods; experimental design; statistics analysis of experimental results; operating principles of biomedical engineering tools and equipment.

#### 2100604 Strategic Tissue Engineering and Controlled Release System 3(3-0-9)

Basic principle, strategies and components of tissue engineering and controlled release system; combination and interaction of biomaterial scaffolds, cells, and biological signaling molecules; requirements and criteria of material design for strategic tissue engineering and controlled release system; functions, applications and limitations of materials in strategic tissue engineering and controlled release system; biological response to biomaterials; mechanism of material-induced tissue regeneration and material-governed controlled release.

#### 2100605 Biomedical Embedded System 3(3-0-9)

Embedded system technology and its biomedical applications: types and selection of embedded system for biomedical applications; basic design of embedded system; hardware and sensor interface; real-time processing based on embedded system; advanced, design of embedded system for biomedical applications.
Critical role. Important medical fields in which biomaterials play a key role.

3000748 Tissue and Cell Engineering 3(3-0-9)
Basic concept for engineering of new cells and tissues: components, tissue and organ healing and regeneration processes, ligands and receptors, adhesion and migration of cells; roles of hormones, proteins, stem cells, and immunology on organ transplantation; technology for cell and tissue engineering, scaffolds, nanomaterials, controlled release of metabolites and proteins, surface modification, cell culture in 2- and 3-dimensions; including current clinical applications and future trends.

3000749 Biosystems and Biotransport 3(3-0-9)
Applications of fundamental chemical engineering principles to the study of biological systems with emphasis on current bioengineering research.

3000750 Drug Delivery System 3(3-0-9)
Applications of physical principles and modern methods of analysis to pharmaceutical systems; a conceptual introduction to the way that drugs act and are processed in vivo, including receptor theory, ligand-macromolecule binding, biopharmaceutics, drug metabolism, pharmacokinetics and pharmacodynamics.

2102611 Medical Instrumentation 3(3-0-9)
Basic concepts of amplifiers, signal processing, electrodes, biotransducers, sensors, medical devices, therapeutic devices, medical imaging, electrical safety; measurement of blood pressure, blood flow, and biopotential signals; designing and constructing simple medical instruments.

2102646 Power Electronics for Biomedical Engineering Applications 3(3-0-9)
Fundamental theories of power electronics for biomedical equipment; ac-dc and dc to dc converters as well as inverters circuit topologies and operations; converter and inverter control techniques and circuits; switching and control characteristics of semiconductor power devices; diodes, transistors and thyristors; power and control circuit components; inductors, transformers, capacitors, resistors; converter and inverter applications for biomedical equipment: switching power supplies, dc and ac motor drive.

2100623 Technology for Seniors and the Disabled 3(3-0-9)
Limitations of the seniors and the disabled; geriatric ergonomics and ergonomics of the disabled; classification of tools and equipment for seniors and the disabled; design and construction technology of tools and equipment for daily life, education and work of the seniors and the disabled.

2102631 Mathematical Modeling and Analysis of Physiological Systems 3(3-0-9)
Cellular physiology; biochemical reactions and enzyme kinetics; cellular homeostasis; ion channel; cell excitation; electrical conductions in nerve cells and cardiac muscles; mathematical modeling and analysis of physiological systems.

2102523 Biomedical Signal Processing 3(3-0-9)
Nature of biomedical signals; impulse response; frequency response; noise removal and signal compensation; modeling of continuous-time signals, discrete-time signals and stochastic signals; non-linear models of signals.

2102524 Medical Imaging Technology 3(3-0-9)
Introduction to the formation of various medical imaging modalities: computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography; image reconstruction, image enhancement, image segmentation, image representation and analysis, image registration, and image visualization.

3016725 Biomechanics 3(3-0-9)
Review of basic solid and fluid mechanics: statics and dynamics, strength of material and basic of rheology; characteristics of skeletal system, muscular system, blood circulation system: modeling in biomechanics, with applications in various areas: human movement, artificial organs, sports, sports science; applications of biomechanics in human system and prosthetics.

2100636 Biomedical Analytical Technique 3(3-0-9)
Principles of analytical techniques for Biomedical samples related to drug delivery system.

2100696 Special Problems in Biomedical Engineering 3(0-0-12)
Literature review in the field of interest from basic to new innovation, summarizing and presenting reports.

2100697 Individual Study 3(0-0-12)
Literature review, asking research questions, conducting preliminary studies, summarizing and presenting reports.

2100796 Advanced Topics in Biomedical Engineering I 3(3-0-9)
Interesting problems or new development in Biomedical Engineering I

2100797 Advanced Topics in Biomedical Engineering II 3(3-0-9)
Interesting problems or new development in Biomedical Engineering II

2102505 Introduction to Optimization Techniques 3(3-0-9)
Review of linear algebra; solution of nonlinear equations; optimality conditions for unconstrained optimization; numerical methods for unconstrained optimization: steepest descent, Newton’s, variable metric, and conjugate gradient methods; optimality conditions for constrained optimization; penalty and barrier functions, and sequential quadratic programming; solution of linear programming by simplex method.

2102507 Computational Techniques for Engineers 3(3-0-9)
Mathematical preliminaries; computer arithmetic; solution of nonlinear equations; solving systems of linear equations; approximating functions; numerical differentiation and integration; numerical solution of ordinary differential equations.

2102531 System Identification 3(3-0-9)
Models for linear time-invariant and time-varying systems; nonparametric time- and frequency-domain methods; parameter estimation methods; convergence and consistency; asymptotic distribution of parameter estimates computing the estimate; recursive identification methods; experiment design; choice of identification criterion; model structure selection and model validation.

2102635 Control System Theory 3(3-0-9)
Mathematical descriptions of dynamic systems; solutions of linear dynamic equations; stability, controllability and observability; internal stability of interconnected systems; state feedback; optimal regulation; observers and observer-based compensation; introduction to optimal control.

2102668 Biosensors 3(3-0-9)
Necessary concepts relevant to the principle of measuring chemical and biological phenomena with emphasis on integrating these concepts of development to apply and to construct novel instruments for observing, examining and controlling various phenomena in the field of biotechnology, medical sciences and chemical engineering for both fundamental research and process development in 'industrial production.'

2102546 Analog Integrated Circuits 3(3-0-9)
IC Technology; analog circuit modeling; device characterization; analog subcircuits; amplifiers; comparators; operational amplifiers; digital-analog and analog-digital converters; other analog circuits and systems; reference sources; multipliers.

2102784 Measurement System Design and Simulation 3(3-0-9)
Analysis of measuring system; design of measuring system for sensors; remote sensing and non-invasive measurement; automation system; flow injection analysis; modeling of sensor system; numerical modeling; simulation of the sensor response.

2102785 Advanced Sensor Theory 3(3-0-9)
Principle and theory of physical and chemical sensors; thermodynamics and sensor operation; sensor fabrication technology; micro-machining; sensor fusion; intelligent sensors; data processing and analytical methods.

2102876 Adaptive Signal Processing 3(3-0-9)
Performance analysis of the linear and non-linear adaptive filtering; the linear filtering: method of steepest descent, least-mean square algorithm; non-linear filtering: artificial neural network using the back-propagation algorithm, radial basis function network, and (unsupervised learning based on) k-means clustering.

2105641 Biodegradable Material Engineering 3(3-0-9)
Types of biodegradable materials: synthetic and natural materials, sources and production, properties, biocompatibility, biodegradation mechanism, test methods for biodegradable plastics: polysaccharides, biopolyester, and protein (collagen, gelatin), biodegradable polymers for tissue engineering and controlled release.

2111602 Radiation Physics for Medical Science 2(2-0-6)
Atomic structure and atomic radiation, and particles, radioisotope, radioactivity, interaction of radiation and particles with matters, principles of radiation dosimetry, exposure dose, absorbed dose, radiation protection; radiation effects on humans, X-ray equipment, radiation measurement; radiation counting statistics, phosphorescence and fluorescence screen, factors affecting radiation image quality, calculation of X-ray room shielding.

2100894 Doctoral Dissertation Seminar 0(0-0-0)
2100897 Qualifying Examination 0(0-0-0)
DEFENSE ENGINEERING AND TECHNOLOGY

This curriculum was created according to Her Royal Highness Princess Sirinthorn’s wish to establish the academic collaborations between Chulachomkloa Royal Military Academy and Chulalongkorn University. The Memorandum of Understanding between two institutes was signed on September 23rd, 2013 with 5-year duration. The faculty of engineering has initiate the academic collaborations by co-developing Master Program in Defense Engineering and Technology which is the result of merging engineering and military defense technologies. Now, the program is open in 7 majors; Civil Engineering and Explosives, Electrical Engineering for Defense, Mechanical Engineering for Defense, Metallurgy Engineering for Defense, Computer Engineering for Defense, Environment Engineering for Defense, and Nuclear Engineering for Defense.

HEAD:

Withit Pansuk, Ph.D. (Hokkaido)
Col.Chuan Chuntavan Ph.D. (Cincinnati)

ASSOCIATE PROFESSIONALS:

Withit Pansuk, Ph.D. (Hokkaido)
Sunchai Nilsuwankosit, Ph.D. (Wisconsin)

ASSISTANT PROFESSIONALS:

Col.Chuan Chuntavan Ph.D. (Cincinnati)
Wisdomorn Widhakorn Ph.D. (Chula)
Suksomboon Suebskul Ph.D. (AuBurn)
Chaodit Asawakul Ph.D. (London)
Alongkorn Pimpin D.Eng. (Tokyo)
Pichaya Rachdawong Ph.D. (Wisconsin-Milwaukee)
Panyawat Wangyao Ph.D. (Kosice)
Kerk Piromsopa Ph.D. (Michigan)
Col.Phaderm Nangsue Ph.D. (Clarkson)
Col.Anontai Suksanapanomrong Ph.D. (Victoria)
Col.Preecha Apiwanrattagoon Ph.D. (Wisconsin)
Col.Nuthaporn Nittayasakol Ph.D. (Virginia Polytechnic)

INSTRUCTORS:

Kanok Weerawong Ph.D. (Purdue)
Maj.Banchachit Saensanun Ph.D. (New South Wales)

NAME OF THE DEGREE:

: Master of Engineering
: M.Eng.

ADMISSION

The applicants must hold a Bachelor degree in Engineering, Science, or equivalent and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS

1. Pattern 1(1) program consists of
   1.1 Thesis 36 credits
   1.2 2120601 Defense Engineering and Technology Principles S/U
   1.3 Seminar (2 credits) S/U

2. Pattern 1(2) program consists of
   2.1 Core course 3 credits
      2120601 Defense Engineering and Technology Principles
   2.2 Approve elective course 0-9 credits
      1) Explosive and civil engineering 6 credits
      2) Nuclear Engineering for Defense 9 credits
   2.3 Free Elective 6-15 credits
      1) Explosive and civil engineering 9 credits
      2) Nuclear Engineering for Defense 6 credits
      3) Electrical Engineering for Defense 15 credits
      4) Mechanical Engineering for Defense 15 credits
      5) Environmental Engineering for Defense 15 credits
      6) Metallurgy Engineering for Defense 15 credits
      7) Computer Engineering for Defense 15 credits

    Students in Electrical Engineering for Defense/Mechanical Engineering for Defense/Metallurgy Engineering for Defense/Computer Engineering for Defense/Environment Engineering for Defense must take signified course for their major at least 9 credits and take other course this program for 6 more credits.

   2.4 Thesis 18 credits
   2.5 Seminar (2 credits) S/U

COURSE REQUIREMENTS

1. Required Courses
   1) Pattern 1(1)
      2120601 Defense Engineering and Technology S/U
      2120603 Defense Engineering and Technology S/U Seminar I
      2120604 Defense Engineering and Technology S/U Seminar II
   2) Pattern 1(2)
      2120601 Defense Engineering and Technology S/U Seminar I
      2120603 Defense Engineering and Technology S/U Seminar II

2. Approve Elective course 0-9 credits
   1.1 Explosive and civil engineering 6 credits
      2101607 Advanced Mechanics of Materials 3(3-0-9)
      2121677 Principles of Explosives Engineering 3(2-3-7)
   1.2 Nuclear Engineering for Defense 9 credits
Engineering

2111610 Nuclear Security 3(3-0-9)
2111651 Weapon Mass Destruction 3(3-0-9)
Nonproliferation
2131501 Nuclear Technology for Military 3(3-0-9)

1.3) Electrical Engineering for Defense/
Mechanical Engineering for Defense/
Metallurgy Engineering for Defense/
Computer Engineering for Defense/
Environment Engineering for Defense

No prerequisite requirement

3) Free Elective Courses 6-15 credits

2.1) Explosive and civil engineering 9 credits

2101535 Tunnel Engineering 3(3-0-9)
2101566 Dynamics of Structures 3(3-0-9)
2101567 Rail Transport System 3(3-0-9)
2101615 Advanced Prestressed Concrete Structures 3(3-0-9)
2101617 Structural Building Components 3(3-0-9)
2101619 Seismic Design of Structures 3(3-0-9)
2121670 Explosives Handling and safety 3(3-0-9)
2121671 Blasting Design and Technology 3(2-3-7)
2121672 Demolition of Building and Structures 3(2-3-7)
2121673 Scientific Instrumentation for Explosives Testing & Blasting 3(2-3-7)
2121674 Theory of High Explosive 3(3-0-9)
2121675 Advanced Explosives Engineering 3(3-0-9)
2121676 Exterior Ballistics 3(3-0-9)

2.2) Nuclear Engineering for Defense Engineering 6 credits

2111613 Radiation Safety and Shielding 3(3-0-9)
2111642 Nuclear Reactor Engineering 3(3-0-9)
2111646 Radioactive Waste Management 3(3-0-9)
2111653 Nuclear Safeguards 3(3-0-9)
2111654 Nuclear Fuel Cycle and Environmental Impacts 3(3-0-9)
2111656 Physical Protection of Nuclear Materials and Facilities I 3(3-0-9)
2111657 Advanced Detection Technologies of Radioactive and Nuclear materials 3(3-0-9)
2111658 Methods and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)
2111678 Nuclear Materials Engineering 3(3-0-9)

2.3) Students in Electrical Engineering for Defense/Mechanical Engineering for Defense/Metallurgy Engineering for Defense/Computer Engineering for Defense/Environment Engineering for Defense must take signified course for their major at least 9 credits and take other course this program for 6 more credits.

2.3.1) Electrical Engineering for Defense Engineering 15 credits

2102505 Introduction to Optimization Techniques 3(3-0-9)
2102531 System Identification 3(3-0-9)
2102544 Advanced Embedded Systems 3(3-0-9)
2102571 Multimedia Communication 3(3-0-9)
2102601 Electrical Power and Energy Technology in Smart Grids 3(3-0-9)
2102602 Information and Communication Technologies in Smart Grids 3(3-0-9)

2102620 Electromagnetic Theory 3(3-0-9)
2102623 Antennas and Rader Systems 3(3-0-9)
2102627 Reliability and Survivability of Communication Networks and Systems 3(3-0-9)
2102631 Optimal Control Systems 3(3-0-9)
2102635 Control System Theory 3(3-0-9)
2102642 Computer Vision and Video Electronics 3(3-0-9)
2102645 Embedded System Design 3(3-0-9)
2102668 Biosensors 3(3-0-9)
2102675 Pattern Recognition 3(3-0-9)
2102676 Digital Image Processing 3(3-0-9)

2.3.2) Mechanical Engineering for Defense 15 credits

2103510 Mechanics of Composite Materials 3(3-0-9)
2103511 Introduction to Continuum Mechanics 3(3-0-9)
2103532 Computer Aided Design and Manufacturing 3(2-3-7)
2103535 Mechatronics 3(3-0-9)
2103540 Failure Analysis and Nondestructive Testing 3(2-3-7)
2103566 Compressible Fluid Dynamics 3(3-0-9)
2103571 Micro and Nano Electromechanical Systems 3(3-0-9)
2103601 Advanced Engineering Mathematics 3(3-0-9)
2103625 Advanced Finite Element Method 3(3-0-9)
2103631 Control of Dynamic Systems 3(3-0-9)
2103664 Design of Thermal Systems 3(3-0-9)
2103665 Advanced Computational Fluid Dynamics 3(3-0-9)

2.3.3) Environmental Engineering for Defense Engineering 15 credits

2107607 Environmental Analysis 3(3-0-9)
2107616 Air Quality Management 3(3-0-9)
2107630 Treatment and Disposal of Industrial Wastes 3(3-0-9)
2107641 Air Pollution Control Technology 3(3-0-9)
2107642 Engineering Practices for Solid Wastes Disposal 3(3-0-9)
2107657 Energy and Environment 3(3-0-9)
2107658 Theory and Design of Advanced Water Treatment Processes 4(3-3-10)
2107659 Theory and Design of Advanced Wastewater Treatment Processes 4(3-3-10)
2107661 Fundamental Chemistry for Environmental Engineering 3(3-2-7)
2127675 Military Waste Management 3(3-0-9)
2107676 Management of Environmental Emergencies 3(3-0-9)

2.3.4) Metallurgy Engineering for Defense 15 credits

2109509 Stainless Steel Technology 3(3-0-9)
2109510 Instrumental Analysis 3(2-3-7)
2109516 Advanced Topics in Physical Metallurgy 3(3-0-9)
2109517 Composite Materials I 3(3-0-9)
2109518 Surface Technology 3(3-0-9)
2109519 Solidification of Casting 3(3-0-9)
2109525 Welding Engineering 3(3-0-9)
2109527 High Temperature Materials 3(3-0-9)
2109533 Powder Metallurgy 3(3-0-9)
2109535 Cellular Metal 3(3-0-9)
2109536 Advanced Topics in Production Metallurgy 3(3-0-9)
2109537 Tribology of Materials 3(3-0-9)

### 2.3.5) Computer Engineering for Defense 15 credits

2108532 Satellite Surveying and Modern Techniques 3(2-3-7)
2108556 Online Spatial Information Technologies 3(2-3-7)
2108557 Spatial Data Structure and Models 3(3-0-9)
2108558 Spatial Data Handling and Analysis 3(2-3-7)
2108627 Geoimage Processing 3(2-3-7)
2108628 Radar Remote Sensing 3(2-3-7)
2108632 Advanced GNSS Surveying 3(2-3-7)
2110622 Data Management 3(3-0-9)
2110639 Computer System Security 3(3-0-9)
2110661 Computer Network 3(3-0-9)
2110678 Mobile Computing 3(3-0-9)
2110681 Computer Algorithm 3(3-0-9)
2110682 Embedded and Real-time Systems 3(3-0-9)
2110741 Robotics 3(3-0-9)
2110743 Machine learning 3(3-0-9)
2110745 Cryptography 3(3-0-9)

### Other Free Elective Courses

2120602 Advanced Topics in Defense Engineering and Technology 3(3-0-9)
2120603 Defense Engineering and Technology Seminar I S/U
2120816 Thesis 9

---

**Pattern 1(1)**

The First Semester

2120601 Defense Engineering and Technology Principles 3
2100829 Thesis 9

**The Second Semester**

2120604 Defense Engineering and Technology Seminar II S/U
2100829 Thesis 9

**The Third Semester**

2120816 Thesis 9

**The Fourth Semester**

2120816 Thesis 9

Remarks:
* No credit will be granted, Evaluation will be only S/U

---

**Pattern 1(2)**

The First Semester

2120601 Defense Engineering and Technology Principles 3
2120603 Defense Engineering and Technology Seminar I S/U
210XXXX Approve Elective and/or Free Elective 6

**The Second Semester**

2120604 Defense Engineering and Technology Seminar II S/U
210XXXX Approve Elective and/or Free Elective 9

**The Third Semester**

2120813 Thesis 9

**The Fourth Semester**

2120813 Thesis 9
2120601 Defense Engineering and Technology Principles
Principles of defense and military development; national security and national strategy; organization, responsibilities, management and work operation of the Royal Thai Armed Forces; military standards, and national disaster relief and prevention.

2120602 Advanced Topics in Defense Engineering and Technology
Recent interesting topics and technology development in various field of defense and engineering technology.

2120603 Defense Engineering and Technology Seminar I
Analysis of research products or quality research papers; presentation of research papers or research findings of individual researchers, and discussions.

2120604 Defense Engineering and Technology Seminar II
Analysis of research products or quality research papers; presentation of research papers or research findings which are parts of students’ thesis, and discussions.

2121670 Explosive Handling and Safety
Basic knowledge about the equipment, techniques and processes required for the demolition and remediation of mine plants and mining equipment sites and non-mining structures.

2121671 Blasting Design and Technology
Advanced theory and application of explosives in excavation; detailed underground blast design; specialization in blasting, including blast casting, construction and pre-splitting; introduction to blasting research and examination of applications in other fields.

2121672 Demolition of Building and Structures
Basic knowledge about the equipment, techniques and processes required for the demolition and remediation of mine plants and mining equipment sites and non-mining structures.

2121673 Scientific Instrumentation for Explosives Testing and Blasting
Application of scientific principles, details of the equipment and the use of instruments for explosives including blasting; related topics: blast chamber design, equipment set up, high-speed photography, motion detection and measurement, explosives sensitivity testing, explosives properties testing, vibration measurement and analysis, destruction in both the civil and the military sectors.

2121674 Theory of High Explosive
Applications of chemical thermodynamics and the hydrodynamics theory to determine properties of high explosives; kinetics and reaction rate; application of the above theory to the blasting of explosives.

2121675 Advanced Explosives Engineering
Detonation of non-ideal explosives; equation of the state of porous media; explosively driven mechanical systems; shock compaction of powders and desensitization and experimental methods used in the evaluation of explosives and their applications.

2121676 Exterior Ballistics
Benefits and uses of exterior ballistics; related background theories; trajectory; forces and moments acted on the projectile; projectile coefficients; various trajectory models; wind effect; mass asymmetries and swerve motion.

2121677 Fundamental Principles of Explosive Engineering
Theory and application of explosives in the mining industry; explosives, initiating systems, characteristics of explosive reactions and rock breakage, fundamentals of blast design, drilling and blasting, regulatory and safety considerations.

2101535 Tunnel Engineering
History of tunneling; soil tunneling methods; types of linings and face support; stand-up times and tunnel man’s ground classification; groundwater control and soil modification methods; lining behavior and design; ground movements and changes of pore water pressure caused by tunnel construction; field observations, monitoring, and instrumentation; building distortion/damage and relation to ground movements; fundamentals of tunnel engineering related to soil types and construction techniques; design of tunnel lining in various subsoil conditions; applications and techniques of tunnel construction for infrastructure system.

2101566 Dynamics of Structures
Analysis of structural systems with single and multi-degree of freedom; equations of motions; free and forced vibrations; vibration natural frequencies and mode shapes of systems; numerical evaluation of dynamic response; response spectrum; modal response history and response spectrum analysis; response of inelastic SDF system; building codes on seismic design of structures.

2101567 Rail Transport System
This course covers the following topics: History of Rail Transport Development, Fundamental and Characteristics of Rail Operation, Rules of Safety, Composition of Rail System: Infrastructure, Rolling Stocks, Signaling and Communication, Case Studies of Rail Transport Development in Thailand and Neighboring Countries.

2101607 Advanced Mechanics of Materials
Stress, strain, and displacement relationship; energy theorems; equilibrium and compatibility conditions; plane stress and plane strain problems; beams on elastic foundation; beam-columns, flexure of curve members; torsion of non-circular and thin-walled members; shear center; shear flow; introduction to theorems of limit analysis.

2101615 Advanced Prestressed Concrete Structures
Prestressing systems; behavior of prestressed concrete beams; moment curvature relationship; load deflection curves, ductility and fatigue, analysis and design of composite members, continuous flexural members, prestressed frames and segmental bridges.
2101617 Structural Building Components 3(3-0-9)
Analysis and design of structural components for buildings considering various types of construction materials: timber, metal, concrete and synthetics; the components include floor systems, roof member, tilt-up walls, sandwich panels, precast, precast member, bearing walls, shear walls and light-gauge steel members.

2101619 Seismic Design of Structures 3(3-0-9)
Elementary engineering seismology; seismic waves; intensity and magnitude; response spectrum and design earthquakes; earthquake codes and analysis; response spectrum analysis; random vibrations; artificial generation of earthquake records; structural design and detailing for earthquake resistance; special structures: bridges, dams, nuclear power plants.

2102505 Introduction to Optimization Techniques 3(3-0-9)
Condition: PRER 2102205 or Consent of Faculty
Review of linear algebra; solution of nonlinear equations; optimality conditions for unconstrained optimization; numerical methods for unconstrained optimization: steepest descent, Newton’s, variable metric and conjugate gradient methods; optimality conditions for constrained optimization; numerical methods for constrained optimization: penalty and barrier function, and sequential quadratic; solutions of linear programming by the simplex method.

2102531 System Identification 3(3-0-9)
Condition: PRER 2102332 or Consent of Faculty
Models for linear time-invariant and time-varying system; nonparametric time- and frequency-domain methods; parameter estimation methods; convergence and consistency; asymptotic distribution of parameter estimates; computing the estimate; recursive identification methods; experiment design; choice of identification criterion; model structure selection and model validation.

2102544 Advanced Embedded Systems 3(3-0-9)
Condition: Consent of Faculty
Hardware and software platforms for embedded systems; devices and buses; embedded programming; real time operating system; hardware-software co-design in an embedded system; testing.

2102571 Multimedia Communication 3(3-0-9)
Condition: Consent of Faculty
Introduction to multimedia communication; image coding standards; video coding standards; audio coding standards; speech coding standards; IP networks; wireless networks; multimedia communication protocols; multimedia communication applications.

2102601 Power and Energy Technology in Smart Grids 3(3-0-9)
Condition: Consent of Faculty
Introduction to Smart Grids; fundamentals of power system operation and control; distributed generation, microgrid and active networks; introduction to wide area monitoring and wide area protection systems; renewable energy generation; grid connection codes; renewable energy policy and regulation; energy storage; electric vehicle.

2102602 Information and communication technologies in Smart Grids 3(3-0-9)
Condition: Consent of Faculty
Substation operation and related communication within substation; equipment in distribution system; communication between control center Architecture and components of AMI/AMR including phasor measurement unit, digital fault recorder and interoperability. Energy efficiency within home, building and factory. Communication channels in smart grid: wire, wireless, optical fiber, including network layer, sensing/control and control protocol. Database management and cyber security.

2102620 Electromagnetic Theory 3(3-0-9)
Maxwell’s equations; theorem of electromagnetic energy and power; properties of materials in electromagnetic fields; boundary conditions; theorems of electromagnetic fields: duality principle, uniqueness, image theory, equivalence principle, induction theorem, reciprocity; potential functions; electromagnetic wave equations, plane wave functions, cylindrical wave functions, spherical wave functions mathematical tools for electromagnetic fields, separation of variables technique, transverse resonance method, perturbation and variational techniques, Green’s functions, geometric algebra; solution methods for electrostatic, magnetostatic, for electrostatic, magnetostatic, and quasi-static fields problems; plane wave propagation problems, propagation in unbounded medium, multilayered medium, and anisotropic medium; wave guidance problems, field analysis in typical waveguides, modal expansion method; resonators and filters; radiation problems, radiation from current sources and apertures; scattering problems, scattering by cylinder, wedge, and sphere; optical waves, optical waveguides, optical wave propagation in photonic crystal.

2102623 Antennas and Radar Systems 3(3-0-9)
Condition: Consent of Faculty
Introduction and fundamental parameters of antennas; Transmitting and receiving antennas; Friis transmission equation; Basic antenna types; Phased array antennas; Smart antennas and multiple-input/multiple-output (MIMO) systems; Introduction and basic principle of radar systems; Radar cross section; Radar equation; Continuous wave radar; Pulsed radar; Target tracking radar.

2102627 Reliability and Survivability of Communication Networks and Systems 3(3-0-9)
Condition: Consent of Faculty
Fundamental probability; network reliability; approaches to calculating network reliability; generic reliability and maintainability concepts; network survivability; fiber transport system components and signals; APS; dual homing; self healing rings; SONET analysis; DCS networks; survivable network design; IP and ATM network survivability.
2102631 Optimal Control Systems 3(3-0-9)
Condition: PRER 2102505 or Consent of Faculty
- Discrete-time linear quadratic: calculus of variations; continuous-time linear quadratic regulator; time-optimal control; constrained control input problem; the Pontryagin's maximum principle; singular control; dynamic programming; optimal controller design; computational methods in optimal controller synthesis.

2102635 Control System Theory 3(3-0-9)
Condition: Consent of Faculty
- Review of linear algebra; least-squares methods and minimum norm methods; mathematical descriptions of dynamic systems; solutions of linear dynamic equations; stability, observability; internal stability of interconnected systems; state feedback; linear quadratic regulation; observers and observer-based compensation; introduction to nonlinear systems.

2102642 Computer Vision and Video Electronics 3(3-0-9)
Condition: Consent of Faculty
- Human vision; geometric camera models; image segmentation; object recognition; video signals and standards; video input and output circuits; computer vision and digital video applications.

2102645 Embedded System Design 3(3-0-9)
Condition: Consent of Faculty
- Practical examples; performance evaluation; complex system designs: automotive, multimedia, biomedical instrumentation, measurement instrumentation, and robot.

2102668 Biosensors 3(3-0-9)
Condition: Consent of Faculty
- Necessary concepts relevant to the principle of measuring chemical and biological phenomena with emphasis on integrating these concepts of develop to apply and to construct novel instruments for observing, examining, and controlling various phenomena in the field of biotechnology, medical science, chemical engineering for both fundamental research and process development in industrial production.

2102675 Pattern Recognition 3(3-0-9)
Condition: PRER 2102282 or Consent of Faculty
- Statistical pattern recognition: linear discriminant functions, Bayesian decision theory, maximum-likelihood and Bayesian parameter estimation.

2102676 Digital Image Processing 3(3-0-9)
- Image perception; image digitization; image enhancement; image restoration; image segmentation; image compression; morphological image processing; image representation and description.

2103510 Mechanics of Composite Materials 3(3-0-9)
- Basic concepts of fiber reinforced composite materials and their application, stress and strain analysis of continuous fiber composite materials; Hooke's law and hygrothermal behavior of orthotropic lamina; classical lamination theory, failure criterion, and design concepts, as applied to composite structures; analysis of composite beams and plates; introduction to material fabrication and testing.

2103532 Computer Aided Design and Computer Aided Manufacturing 3(2-3-7)
- Introduction to CAD/CAM; Basic Concept of CAD/CAM/CAE; Product Design and Strategy; 3D Modeling Concept; Techniques for Geometry Modeling; Surface Design, Design Analysis; Mechanism Design and Animation; Computer Aided Manufacturing Concept; The Design and Manufacturing Interface; The Total Approach to Product Development; NC Programming.

2103535 Mechatronics 3(3-0-9)
- Introduction to mechanical system interfacing; combinational digital logic; industrial electronic components; industrial sensors; simple computer structure; low level programming technique; embedded control computers; microcontroller; stepping motors; DC motors; Analog/Digital conversion; position and velocity measurement; amplifiers; project related to mechatronics.

2103540 Failure Analysis and Nondestructive Testing 3(2-3-7)
- Stress at crack tip and related parameters; failure phenomena; crack propagation creep; corrosion; failure surface; life assessment; case studies; nondestructive testing; practice in NDT techniques.

2103556 Compressible Fluid Dynamics 3(3-0-9)
- Thermodynamics of motion; physical acoustics; wave equation; speed of sound; quasi-one dimensional flow with friction and heat addition; shock dimensional steady flow; method of characteristics; nozzle design; linearized flow visualization using optical techniques.

2103571 Micro and Nano Electromechanical Systems 3(3-0-9)
- Overview of MENS-NEMS, review of engineering mechanics and thermo-fluid engineering, electromechanics and light phenomena, micro system design, scaling of micromechanical devices, MEMS materials, review of micro fabrication, applications of MEMS, and future trends in technology development.

2103601 Advanced Engineering Mathematics 3(3-0-9)
- Numerical and graphical methods of approximate solution; finite difference methods; calculus of variations, solution of classical partial differential equations of mathematical physics including application of conformal mapping and the Laplace transformation.

2103625 Advanced Finite Element Method 3(3-0-9)
- Procedures of the finite element method for structural, thermal and fluid differential equations; nonlinear structural static and dynamic problems with discrete and continuum structures; transient nonlinear heat transfer problems with conduction, and radiation; and radiation; steady and unsteady nonlinear heat transfer problems with conduction, and radiation; steady and unsteady nonlinear incompressible and compressible fluid flow problems.
Control of Dynamic Systems 3(3-0-9)
Introduction; Mathematical Representation of Dynamic Systems; Response of Linear Systems; Stability of Linear Systems; System Theory, Control of Linear Systems: Root-Locus Design, Frequency Response analysis and design, State Variable Feedback, Observer Design; Multivariable Control Systems.

Design of Thermal Systems 3(3-0-9)
Engineering design, design of a workable system, consideration; Equation fitting and mathematical modeling, system simulation, optimization, Lagrange multipliers search methods, dynamic programming, linear programming.

Advanced Computational Fluid Dynamics 3(3-0-9)
Mathematical and numerical aspects of heat transfer and fluid mechanics, finite difference and finite volume methods for solving basic governing equations of fluid flow and heat transfer: continuity, momentum and energy, discretization methods for two and three dimensional problems, boundary conditions, numerical schemes and solvers, consistency stability and convergence, advanced numerical techniques for CFD, application of the methods to some engineering problems.

Environmental Analysis 3(3-0-9)
Procedures and details of environmental sample analysis; methods of sample collection, sample handling; analytical method selection; details of analysis and data presentation.

Air Quality Management 3(3-0-9)
Interaction among air, water and land pollutions, effects of air pollutants, standards and regulations, technical aspects of air pollution control programs, the organization and management of control programs in governmental and private sectors.

Treatment and Disposal of Industrial Wastes 3(2-3-7)
Industrial waste problems; categories of waste; nature and characteristics of liquid waste; effect of waste on environment; laws for disposal of waste in Thailand and other countries; method of treatment of various kinds of waste; preventive measures.

Air Pollution Control Technology 3(3-0-9)
Overview of air pollution control methods. Control of particulates and gaseous emissions by settling chambers, cyclones, scrubbers, filters and electrostatic precipitators. Design of equipment, maintenance and evaluation of control efficiency.

Engineering Practices for Solid Wastes Disposal 3(3-0-9)

Energy and Environment 3(3-0-9)
Energy resources and utilization in the global context and a case studies in Thailand; fossil-based energy, environmental impact of mining and fuel processing; air pollution, greenhouse gas, and global warming from fuel utilization; energy conservation and renewable energy technologies; hydro energy harnessing and its environmental impact and mitigation; other non-fossil fuel options: biomass, solar, and wind energy; synthetic fuel conversion technology including pyrolysis and gasification; biogas from fermentation; prospect of hydrogen economy.

Theory and Design of Advanced Water Treatment Processes 4(3-3-10)
Water sources; water chemistry and quality; aeration, coagulation, sedimentation, filtration, ion exchange, membrane processes, disinfection absorption, neutralization and stabilization; water conditioning for boiler and cooling system; design criteria for water sources, lines distribution and storage facilities, water treatment and softening, engineering design of water distribution system, functional and hydraulic design of complete water treatment.

Theory and Design of Advanced Wastewater Treatment Processes 4(3-3-10)
Development of wastewater technology; wastewater collection and transportation; design of sewers and appurtenances; advanced wastewater treatment by microbial and biological control techniques, law related to effluent disposal; wastewater law relating to effluent disposal, wastewater treatment plant organization and management; combined and separate system pumping stations; functional and hydraulic design of complete wastewater treatment system.

Fundamental Chemistry for Environmental Engineering 3(2-3-7)
Chemical and physical characteristics of water and wastewater, general considerations, methods for determination and application of date to environmental engineering practice; instrumentation; sample collection and preservation; laboratory analysis of water; interpretation of water analysis results as related to their treatment; neutralization, precipitation, coagulation, water softening, ion exchange, corrosion, absorption, chlorination; determinations of solids, Do, BOD, COD, nitrogen (in all forms related to environmental engineering practice), phosphorus and phosphates, grease and oil, volatile acids, sulfides and gas analysis.

Military Waste Management 3(3-0-9)
Management of solid and hazardous wastes from military activities; waste reuse and recycling; characteristics of wastes from military activities; site remediation; site remediation; environmental impact assessment.

Management of Environmental Emergencies 3(3-0-9)
Classification and identification of susceptible sites for environmental emergencies; protection of important infrastructures in industries, in industrial estates, in fuel distribution and storage and in water supply from terrorist activities in the form chemical or biological threats; planning for emergency handling; public handling; coordinating with various work units, and training related people.

Satellite Surveying and Modern Techniques 3(2-3-7)
Satellite datum, coordinate systems, concept of satellite positioning, global positioning system, observable in GPS, errors in GPS measurements, survey.
planning, field procedures, data processing, principles of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

2108556 Online Spatial Information Technologies 3(2-3-7)

Introduction to GIS; and internet GIS; fundamental of computer networking; client/server computing; technology evolutions of web-GIS; standards for distributed geospatial services (ISO & OGC), XML, GML and SVG, mobile GIS case studies and web GIS applications.

2108557 Spatial Data Structure and Models 3(3-0-9)

Conceptual model of space: entities and fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadtree, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; introduction to geo-spatial relational database system, graph theory; optimal path.

2108558 Spatial Data Handling and Analysis 3(2-3-7)

Data capture techniques, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflations, feature editing; feature alignment; generalization: densification; topology construction; surface modeling; viewsheds; intervisibility; contouring.

2108627 Geoinformation Processing 3(2-3-7)

Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation; stereophotogrammetry; photogrammetric triangulation; orthorectification.

2108628 Radar Remote Sensing 3(2-3-7)

Characteristics of microwave, microwave interaction with atmosphere and target, radar equation and radar section, principles of imaging radar, measureable phase/amplitude/polarization in radar imagery, geometric and radiometric properties of radar imagery, synthetic Aperture Radar, airborne/spaceborne SAR systems, interferometric SAR, processing stages in interferogram generation, differential interferometric SAR, In SAR/DinSAR as measurement tools, geodetic and geophysical applications of InSAR/DinSAR, polarimetric SAR, classification and analysis of polarimetric SAR, landuse/landcover mapping applications using polarimetric SAR.

2108632 Advanced GNSS Surveying 3(2-3-7)

GPS system, coordinate and reference system, GPS observations and equations, GPS error mitigation techniques, computation of GPS satellite positions, principles of least-squares estimation, mathematical models for GPS positioning, standard format of GPS data, GPS data processing by least-squares method, interpretation of baseline results, GPS network adjustment, quality control for GPS surveying, GPS heighting, trends and applications of GNSS technology.

2109509 Stainless Steel Technology 3(3-0-9)

Stainless steel development; stainless steel grades; phase equilibrium diagram; microstructure and metallography; passive film; martensitic, ferritic, austenitic, duplex and precipitation hardening stainless steels; production technology; improvement of mechanical and corrosion properties and selection.

2109510 Instrumental Analysis 3(2-3-7)

Operation principles of transmission electron microscopy and scanning electron microscopy, X-ray diffraction, X-ray fluorescence, atomic absorption and spectro analysis, ESCA and Auger electron spectrometer; interpretation of instrumental results in terms of mechanical properties.

2109516 Advanced Topics in Physical Metallurgy 3(3-0-9)

Advanced topics of current research interests in physical metallurgy.

2109517 Composite Materials I 3(3-0-9)

Properties of engineering composite materials; types of composite materials; fiber and their interfaces; geometrical properties; elasticity; case studies.

2109518 Surface Technology 3(3-0-9)

Carburizing, nitriding, flame hardening, diffusion hardening; chemical vapor deposition and physical vapor deposition; electro-plating; hot dip coating; metal spraying and ion implantation.

2109519 Solidification of Casting 3(3-0-9)

Study of solidification of metal in molds; characteristics of liquid-solid phase transformations; Sand and metal thermal behavior; macroscopic structures; mechanical properties, and casting defects.

2109525 Welding Engineering 3(3-0-9)

Type and process of welding; mass and heat flow during welding; metallurgical effects of heat thermal cycle; solid-phase welding and joining of ceramic; welding of ferrous and non-ferrous metals; behavior of welds in service.

2109527 High Temperature Materials 3(3-0-9)

Theory of alloying and relationship among temperature, structure, and mechanical properties in nickel, cobalt, and iron base alloys; effect of thermomechanical processing; analysis of microstructures by transmission electron microscopy, scanning electron microscopy, X-ray diffraction, and X-ray microprobe.

2109533 Powder Metallurgy 3(3-0-9)

Preparation and fabrication of metal powder; engineering properties and industrial uses; theory of compaction and sintering.

2109535 Cellular Metal 3(3-0-9)
The structure, manufacturing methods, characterization techniques, mechanics. Physical and mechanical properties of cellular metals; energy absorption; sandwich structures and case studies.

2109536 Advanced Topics in Production Metallurgy 3(3-0-9)
Advanced topics of current research interests in production metallurgy.

2109537 Tribology of Materials 3(3-0-9)
Solid lubrication and surface treatment; fundamentals of contacts between solids; abrasive, erosive, and cavitation wear; adhesion and adhesive wear; corrosive and oxidative wear; fatigue wear; fretting and minor wear mechanism; wear of non-metallic materials; case study.

2110622 Data Management 3(3-0-9)
List structures: list, stacks, queues; table and hash in tree structures: binary search trees, AVL trees, B-trees, heaps; searching and sorting; fundamental of file structures.

2110639 Computer System Security 3(3-0-9)
Security system planning and administration; access control; data encryption; computer crime protection; disaster recovery planning; security models; including Orange book, and RACF.

2110661 Computer Network 3(3-0-9)
Introduction to network and network components; transmission links and protocols; design and analysis of network; WAN; IMP to topology; network protocols; flow control and routing techniques.

2110678 Mobile Computing 3(3-0-9)
Principles, technologies and applications of mobile computing and wireless networks; mobile and wireless environment; protocols and architecture of mobile computing; mobile device technology; mobile computing security; application of distributed system in mobile computing; mobile middleware; mobile information and database access; mobile platforms; Web-based mobile application development.

2110681 Computer Algorithm 3(3-0-9)
Analysis and design of efficient algorithms; divide and conquer, recursion, dynamic programming and greedy algorithm; selection of appropriate data abstraction; analysis and correctness of algorithms; algebraic algorithms; combination problems; providing techniques for complexity analysis.

2110682 Embedded and Real-Time Systems 3(3-0-9)
Microcontroller architecture (RAM, ROM, CPU), I/O, and peripheral devices, I/O interfacing, real-time operating systems, real-time constraints, scheduling theory, real-time system design methodology, case studies.

2110741 Robotics 3(3-0-9)
A broad view of robotics: robot control, sensors and interfacing, robot intelligence and programming; a broad spectrum of disciplines: mechanical, electrical, industrial, and computer engineering; current topics: planning, subsumption architecture, reactive systems.

2110743 Machine Learning 3(3-0-9)
Computing with logic; using logic set theory, number theory, algebras, graph theory, automata; language of first order logic, model theory and logic programming; problems of inductive inference in the framework of first-order predicate calculus and the probability calculus; introduction of computational learning theory.

2110745 Cryptography 3(3-0-9)
Introduction; symmetric encryption; block ciphers; block ciphers; pseudorandom permutations and pseudorandom functions; one-way functions; pseudorandom generators; hash functions; message authentication; authenticated encryption; asymmetric encryption; digital signatures; authenticated key exchange; interactive proofs and zero knowledge.

2131501 Nuclear Technology for Military 3(3-0-9)
Radioactive and nuclear materials; measurement of nuclear radiation; principles of radiation safety, detection of radioactive and nuclear materials; radiation imaging; elemental analysis using nuclear techniques, nuclear techniques for explosive detection; other uses of radioactive and nuclear materials; nuclear non-proliferation.

2111610 Nuclear Security 3(3-0-9)
Nuclear security; overview of related legal framework; interrelationships between nuclear safety, security and safeguards; nuclear and radiation threat by non-State actors; counterterrorism; chemical biological, radiological and nuclear (CBRN) weapons; basic elements of nuclear security; planning nuclear security at the state level; planning nuclear security of nuclear and radiological facility; introduction to detection of and response to, crimes and unauthorized acts involving nuclear material and other radioactive material outside regulatory control; information security; security culture.

2111613 Radiation Safety and shielding 3(3-0-9)
Definition and basic concepts in radiation safety; biological effects of radiation; basic radiation protection, dose limits; regulation concerning radioactive materials; transportation of radioactive materials; accidents and emergency procedure; gamma radiation and x-ray shielding; radiation shielding from nuclear reactor.

2111642 Nuclear Reactor Engineering 3(3-0-9)
Production and characteristics of neutrons; the fission process; neutron diffusion theory; slowing-down theory; Fermi theory of the bare thermal reactor; one-and multi-group diffusion methods; basic principles of nuclear reactor reactor kinetics and nuclear reactor control.

2111646 Radioactive Waste Management 3(3-0-9)
Nature of radioactive wastes; origin of low-high radioactive wastes; characteristics, forms and quantity of radioactive wastes; storage and transportation; waste management technologies; radioactive waste management plans in various countries.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2111651</td>
<td><strong>Weapon Mass Destruction Nonproliferation</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Issues concerning the proliferation of nuclear, chemical, and biological weapons; introduction to nuclear and radiological terrorism; international nuclear nonproliferation framework; weapon technologies of mass destruction; nuclear proliferation issues in South Asia.</td>
<td></td>
</tr>
<tr>
<td>2111653</td>
<td><strong>Nuclear Safeguards</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Safeguarding nuclear material and facilities; monitoring principles and technologies; safeguards issues; international framework of nuclear material safeguard; nuclear material safeguard; nuclear proliferation threat; radiological threat; detecting nuclear and other radioactive materials; roles of intelligence; A Q. Khan’s network; counter-proliferation of nuclear weapons; nuclear material safeguard in various countries.</td>
<td></td>
</tr>
<tr>
<td>2111654</td>
<td><strong>Nuclear Fuel Cycle and Environmental Impacts</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Technology of nuclear fuel cycle; technologies used in manufacturing, safety handling, and disposing of nuclear materials and by-products; social environmental, and health impacts of materials used in each major step in the fuel cycle; potential of nuclear proliferation.</td>
<td></td>
</tr>
<tr>
<td>2111656</td>
<td><strong>Physical Protection of Nuclear Materials and Facilities I</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Principles of physical protection of nuclear materials and facilities: detection, delay, response; threat identification and analysis; vital area analysis; international physical safeguard framework; internal threats.</td>
<td></td>
</tr>
<tr>
<td>2111657</td>
<td><strong>Advanced Detection Technologies for Radioactive and Nuclear Material</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Detection and identification of the types of nuclear materials; chemical and radiological characteristics of nuclear materials from raw materials to various finished products; detection technologies; nuclear forensics.</td>
<td></td>
</tr>
<tr>
<td>2111658</td>
<td><strong>Method and Instrumentation for Nuclear Security and Safeguards</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Counting statistics; radiation detectors; gamma detection; neutron detection; detection of charged particles; gamma spectroscopy; activation analysis; destructive analysis; non-destructive analysis; quantitative nuclear material measurements; survey devices; use of detectors at port,</td>
<td></td>
</tr>
<tr>
<td>2111678</td>
<td><strong>Nuclear Materials Engineering</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Nuclear fuel cycle; materials and thermal aspects of nuclear reactors; crystal structures of solids; point defects; diffusion in solids; elastic behavior of solids; dislocations in solid and creep deformation; grain and grain boundaries; cavities in solids; fission product behavior in nuclear fuel; radiation damage and fast-neutron irradiation effects in metals; introduction to the High-Temperature Gas-Cooled Reactor Technology.</td>
<td></td>
</tr>
<tr>
<td>2120602</td>
<td><strong>Advanced Topics in Defense Engineering Technology</strong></td>
<td>3(3-0-9)</td>
</tr>
<tr>
<td></td>
<td>Study of recent topic and technology development in various fields of defense and engineering technology.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX

FOUNDATION ENGLISH COURSES

5500111 Experiential English I 3(2-2-5)
Practice language skills in acquiring information and knowledge from different sources and media in subjects of student’ interest under selected themes collecting information summarizing and presenting important issues.

5500112 Experiential English I 3(2-2-5)
Condition : Prerequisite 5500111
Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students interest under selected themes summarizing what they have learned and presenting opinions from group discussion.

5500208 Communication and Presentation skills 3(2-2-5)
Condition : Prerequisite 5500116,500112
Practice using English for social communication and giving oral presentation on engineering-related topics.

5500308 Technical Writing for Engineering 3(2-2-5)
Condition : Prerequisite 5500208
Practice in writing summaries composing different types and styles of writing in the field of engineering and writing reports of studies and experiments.

5500115 Foundation English I 3(2-2-5)
Practice in reading and writing based on selections of about 300 words from newspapers, encyclopedias, magazines, announcements, handbooks, notes and letters for general purposes as well as dialogues and materials from other sources such as tape recordings, radio, and television.

5500116 Foundation English II 3(2-2-5)
Condition : Prerequisite 5500115
Practice in reading and writing based on selections of about 450 words from newspapers, encyclopedias, magazines, announcements, handbooks, notes and letters for general purposes as well as dialogues and materials from other sources such as tape recordings, radio, and television.

BASIC SCIENCES AND MATHEMATICS

2301107 Calculus I 3(3-0-6)
Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals.

2301108 Calculus II 3(3-0-6)
Condition : Prerequisite 2301107
Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three dimensional space; calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2301207 Calculus III 3(3-0-6)
Condition : Prerequisite 2301108
Lines; planes; quadric surfaces; normal lines and tangent planes to a surface, arc length; calculus of real-valued functions of several variables; Taylor’s formula and its applications.

2301208 Calculus IV 3(3-0-6)
Condition : Prerequisite 2301207
Sequences and series of functions; uniform convergence; improper integrals; multiple integration; line integrals; surface integrals and integral theorems.

2301276 Engineering Mathematics I 3(3-0-6)
Condition : Prerequisite 2301108
Linear algebra; surfaces in three dimensional spaces; polar coordinate system; real-valued functions of several variables; multiple integrals.

2301277 Engineering Mathematics II 3(3-0-6)
Condition : Prerequisite 2301276
Differential vector calculus; integral vector calculus; tensors; functions of complex variables; improper integrals.

2301312 Differential Equations 3(3-0-6)
Condition : Prerequisite 2301102 or 2301108 or 2301241
Existence and uniqueness theorems for first-order equations, numerical methods, general linear equations, solution in series form, linear partial differential equations, boundary value problems.

2301366 Numerical Analysis 3(3-0-6)
Condition : Consent of Faculty
Numerical solutions of systems of linear equations, interpolation, approximation functions, least square approximation, numerical differentiation and integration; numerical solutions of algebraic and transcendental equations; numerical solutions of ordinary differential equations.

2301374 Applied Mathematical Methods 3(3-0-6)
Condition : Prerequisite 2301207
Linear algebra; introduction to the theory of approximations; solution of algebraic and transcendental equations; solutions of linear systems; first and second order differential equations; Fourier transforms and Laplace transforms; vector calculus.

2302127 General Chemistry 3(3-0-6)

2302163 General Chemistry Laboratory 1(0-3-0)
Qualitative analysis techniques, Graham’s law of gas diffusion, structure of metals and crystals, chemical equilibrium, indicators, acid-base titration, pH of solution and hydrolysis.
2304103 General Physics I 3(3-0-6)
Basic mathematics for general physics; mechanics and its applications; gases and kinetic theory; thermodynamics; transport phenomena and heat transfer; physical properties of matter.

2304104 General Physics II 3(3-0-6)
Electrostatic; direct current; alternating current; electrical circuits; electromagnetism and magnetic materials; mechanical and electromagnetic waves; modern physics; nuclear physics; relativity.

2304183 General Physics Laboratory I 1(0-3-0)
Measurement and precision; statistical analysis and accuracy; experiments on simple harmonic motion and physical pendulum, elasticity of springs and rubber bands, module of metals, rolling and radius of gyration, dynamics of rotation, velocity of sound and Meld's experiment, viscosity of fluids.

2304184 General Physics Laboratory II 1(0-3-0)
Resistance and electromotive force measurements; experiments on ammeter, voltmeter, oscilloscope, AC circuit, transistor, lenses and mirrors, polarization, interference, diffraction, and radioactivity.

2307207 Physical Geology 3(3-0-6)
Basic principles and geological concepts; origin, evolution, and history of the Earth; geological processes; geological materials; earth’s features and structures and their relationships in space and time.

2603284 Statistics for Physical Science 3(3-0-6)
The scope and uses of statistics in physical science; elementary principles of probability theory; random variables and some probability distributions; introduction to statistical inference; introduction to analysis of variance; regression and correlation; statistical quality control

BASIC ENGINEERING PRACTICE

2100301 Engineering Practice 2(0-35-0)
Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

GENERAL EDUCATION, SPECIAL

2100111 Exploring Engineering World 3(3-0-6)
Engineering topics related to daily life: Energy, Resources, Environment, industrial, automotive, manufacturing, infrastructure, process, material, Information System and bio engineering

2100303 Creative Design for Community 3(2-3-4)
Creative design for community, creating concepts in design processes by taking need users and community into consideration; design for sustainability; prototyping, testing and refining of the prototype, project management; case studies.

2100311 Engineering Essentials 3(3-0-6)
Topics related to engineering: management, ethics, good governance, public responsibility, intellectual property, finance, investment, economics, and green technology.
<table>
<thead>
<tr>
<th>กลุ่มวิชาศึกษาทั่วไป</th>
<th>รายวิชาศึกษาทั่วไป จุฬาลงกรณ์มหาวิทยาลัย</th>
<th>รายวิชาศึกษาทั่วไป จุฬาลงกรณ์มหาวิทยาลัย</th>
<th>รายวิชาศึกษาทั่วไป จุฬาลงกรณ์มหาวิทยาลัย</th>
<th>รายวิชาศึกษาทั่วไป จุฬาลงกรณ์มหาวิทยาลัย</th>
</tr>
</thead>
<tbody>
<tr>
<td>0123101</td>
<td>PARAGRAP WRITING</td>
<td>0201152 PROD PROMOTION SCI</td>
<td>0201102 THAI WISDOM</td>
<td>0201170 MILITARY SCIENCE</td>
</tr>
<tr>
<td>0123104</td>
<td>UNIV THAI READING</td>
<td>2100111 EXPL ENG WORLD</td>
<td>0201103 OUR CU</td>
<td>0201171 EFFECT CAREER MGT</td>
</tr>
<tr>
<td>0123105</td>
<td>THAI WRIT WORK</td>
<td>2101251 CE PROF CONDUCT</td>
<td>0201106 ART SCI FIND HAP</td>
<td>0201172 SELF/CAREER MGT</td>
</tr>
<tr>
<td>02010105</td>
<td>CU SMART BUD GRAD</td>
<td>2102041 ICT TELECOM MGT</td>
<td>0201107 LRN STUD ACT</td>
<td>2400104 GOVT POL THAI</td>
</tr>
<tr>
<td>0201211</td>
<td>MEDITAT LIFE DEV</td>
<td>2100311 ENG ESSENTIALS</td>
<td>0201108 FAMILY RELATIONS</td>
<td>2403183 SOCIETY &amp; CULTURE</td>
</tr>
<tr>
<td>2200222</td>
<td>VERN ARCH TH SOC</td>
<td>2105261 CHEM PROF IND</td>
<td>0201109 INTRO EU INTEGRAT</td>
<td>2403184 SOC DIVER JUS THAI (inter)</td>
</tr>
<tr>
<td>2200223</td>
<td>PNTG TH SOC</td>
<td>2107219 URBAN ENVIRONMENTS</td>
<td>0201110 SICHANG STUDY</td>
<td>2403284 CROSS CULT MGT</td>
</tr>
<tr>
<td>2200226</td>
<td>FOLK MUS TH SOC</td>
<td>2107220 ENV DAILY LIFE</td>
<td>0201111 INNOV THOUGHT</td>
<td>2403185 JUV DEL</td>
</tr>
<tr>
<td>2200227</td>
<td>TH CL MUS DRAM</td>
<td>2107221 ENV STUD</td>
<td>0201117 ART RATANAKOSIN</td>
<td>2403471 ANTH RSCH METH</td>
</tr>
<tr>
<td>2200183</td>
<td>THAI CIV</td>
<td>2110191 INNOV THOUGHT</td>
<td>0201121 LIFE REFL FILM</td>
<td>2404300 IT/SOC</td>
</tr>
<tr>
<td>2200185</td>
<td>SURV ART ARCH THAI</td>
<td>2110221 COMP ENG ESS</td>
<td>0201122 MGT PUB DISASTER</td>
<td>2404301 SEL TOP PAX DIGI</td>
</tr>
<tr>
<td>2200201</td>
<td>ACAD REPORT WRI (inter)</td>
<td>2111201 GEN RAD NUCLEAR</td>
<td>0201123 CULT TRAD TH LIFE</td>
<td>2541160 CREATE URB LIVING (inter)</td>
</tr>
<tr>
<td>2200330</td>
<td>TIPITAKA LIFE</td>
<td>2111330 MOD MAP PROT RAD</td>
<td>0201125 MGT DIFF CULT</td>
<td>2601111 BUS ACCTG</td>
</tr>
<tr>
<td>2200387</td>
<td>ARCHAEO THAI</td>
<td>2112210 WATER / SOC</td>
<td>0201127 QAL WORK MGT</td>
<td>2602121 INTRO BUSINESS</td>
</tr>
<tr>
<td>2200389</td>
<td>ICONOGRAPHY</td>
<td>2142109 AUTO STUDIES (inter)</td>
<td>0201129 UNDERWATER WORLD</td>
<td>2602171 BUS CPTS/ETHICS (inter)</td>
</tr>
<tr>
<td>2200390</td>
<td>FOR CULT TH ART</td>
<td>2300150 NATURAL SCIENCE</td>
<td>0201130 IND BUS MGT</td>
<td>2602240 INTRO IT/IS (inter)</td>
</tr>
<tr>
<td>2200391</td>
<td>CONT ART TH SEA</td>
<td>2300152 SCIENCE TODAY</td>
<td>0201131 THAI COAST COM DEV</td>
<td>2603244 GEN PRIN INSURANCE</td>
</tr>
<tr>
<td>2200392</td>
<td>ANC ART SIAM SEA</td>
<td>2300200 SCI TECH SOC</td>
<td>0201141 COAST ENV</td>
<td>2604362 PERSONAL FINANCE</td>
</tr>
<tr>
<td>2200393</td>
<td>Language and Culture for Art</td>
<td>2301170 COMP PROG</td>
<td>0201151 OUR ENVIRONMENT</td>
<td>2604364 FIN COMM</td>
</tr>
<tr>
<td>2200394</td>
<td>and Archaeology</td>
<td>2302190 Chemistry for Modern Life (inter)</td>
<td>0201153 WASTE MANAGEMENT</td>
<td>3(3-0-6)</td>
</tr>
<tr>
<td>2200395</td>
<td>CUST/ESTH TH SOC</td>
<td>2303150 BIRDWATCH CONSERV</td>
<td>0201154 URB GLOB WRMG</td>
<td>2722178 THAI CULTURE</td>
</tr>
<tr>
<td>2200396</td>
<td>ROY TRADECERE</td>
<td>2303165 MAN &amp; ENVIRONMENT</td>
<td>0201200 STUD THO TH SOC</td>
<td>2800210 ART APPRE COMM (inter)</td>
</tr>
<tr>
<td>2200418</td>
<td>CIVILIZATION</td>
<td>2304274 PHYS BIO SYS</td>
<td>0201201 IDEAL GRADUATE 1</td>
<td>2800211 THAI CULT/COMM (inter)</td>
</tr>
<tr>
<td>2206101</td>
<td>RES ACAD REP WRIT</td>
<td>2305103 PL BETTER LIFE</td>
<td>0201202 IDEAL GRADUATE 2</td>
<td>2800212 HUMAN COMM</td>
</tr>
<tr>
<td>2206248</td>
<td>BSC RES SKILLS (inter)</td>
<td>2305107 PLANT WORLD</td>
<td>0201203 IDEAL GRADUATE 3</td>
<td>2800218 VIS MED STUDIES (inter)</td>
</tr>
<tr>
<td>2206247</td>
<td>ONLINE INFO COMM (inter)</td>
<td>2305108 BIOTECH DAILY LIFE</td>
<td>0201204 IDEAL GRADUATE 4</td>
<td>2800219 CROSS CULT COMM (inter)</td>
</tr>
<tr>
<td>2206247</td>
<td></td>
<td>2305109 PL GROW TECH</td>
<td>0201205 IDEAL GRADUATE 5</td>
<td>2800221 INTER COMM ETI PRO (inter)</td>
</tr>
</tbody>
</table>

www.gened.chula.ac.th
<table>
<thead>
<tr>
<th>รหัส</th>
<th>กลุ่มวิชาสามัญ</th>
<th>รหัส</th>
<th>กลุ่มวิชาพื้นฐาน</th>
<th>รหัส</th>
<th>กลุ่มวิชาที่เลือก</th>
<th>รหัส</th>
<th>กลุ่มวิชาเสริมทักษะ</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>PHILOS LOGIC</td>
<td>2305151 ORGANIC GARDENING</td>
<td>0201206 THAI IDEAL GRAD</td>
<td>2600314 ART PUB SPKG (inter)</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>REASONING</td>
<td>2305161 GENETICS FOR LIFE</td>
<td>0201209 VALUE URB ENV</td>
<td>2801321 NEWS INFO/SOC</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>HIST WEST PHILOS</td>
<td>2306416 MGT SYS TECH</td>
<td>0201210 MAT MGT GREEN</td>
<td>2900151 FOUNDATION ECON</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>PHILOS FILMS</td>
<td>2307205 INTRO GEM SCI</td>
<td>0201230 MAN/PEACE</td>
<td>2900152 INTRO THAI ECON</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>SYMBOLIC LOGIC</td>
<td>2307206 EARTH SCIENCES</td>
<td>0201231 URB COMM STUD</td>
<td>2900154 ECON INNO</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>AESTHETICS</td>
<td>2308200 SCI LOGIST SYS</td>
<td>0201232 MULTI STUD RUR DEV</td>
<td>3401124 INTRO IP LAW</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>ETHICS</td>
<td>2308303 HISTORY OF SCI</td>
<td>0201234 LOCAL GLOB ISS</td>
<td>3402103 INTRO CRIM LAW</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>POLITICAL PHILOS</td>
<td>2308354 STRATEGY OF LIFE</td>
<td>0201251 P2 CONTROL</td>
<td>3404103 LAW LAND MGT</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>PHILOS LITERATURE</td>
<td>2309201 GEN OCEANOLOGY</td>
<td>0201252 ALT ENGY CONS</td>
<td>3404109 LAW COMP TECH</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>INDIAN PHILOS</td>
<td>2310201 HEALTH/BEAUTY</td>
<td>0201254 GLOB WARM ADAP</td>
<td>3404113 INTRO WTO LAW</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>AMERICAN PHILOS</td>
<td>2312100 MICROB FRIEND</td>
<td>0201255 ICT STRATEGIC MGT</td>
<td>3404115 INTRO PUBLIC LAW</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>PHILOS WOMEN</td>
<td>2313213 DIGITAL PHOTO</td>
<td>0201256 LIV DIGI WORLD</td>
<td>3404117 INTRO TO LAW</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>PHILOS LANG</td>
<td>2313221 PHOTO SCI</td>
<td>0201270 NAT SECURITY DEV</td>
<td>3404122 LEGAL LOGICS</td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>JAPANESE PHILOS</td>
<td>2313226 PRINS MEDIA TECH</td>
<td>0201281 TEAM/ORG DEV</td>
<td>3404123 LEGAL HISTORY</td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>CHINESE PHILOS</td>
<td>2314255 ELEMENT FOOD TECH</td>
<td>0201282 NAT SKB JOUR</td>
<td>3404124 LAW AND SOCIETY</td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>PS TOP ETHICS</td>
<td>2314265 INTRO PACK TECH</td>
<td>0201283 BEAUTIFUL DEATH</td>
<td>3404201 LAW ACCTG</td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>LANG THAI SOC</td>
<td>3010101 DRUG DAILY LIFE</td>
<td>0201284 JWL DES ENTRE</td>
<td>3404202 LAW ECON ANAL</td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>LANG CULTURE</td>
<td>3141102 ANIMAL BEHAVIOR</td>
<td>2104181 HF ERGO DAILY LIFE</td>
<td>3405102 INTRO INTL LAW</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>LANG ASEAN PLUS</td>
<td>3141105 COMP APP PROF</td>
<td>3(3-0-6)</td>
<td>3800101 GENERAL PSYCHOLOGY</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>LIT/ENVIRON</td>
<td>3141213 BIOSTATISTICS</td>
<td>3(3-0-6)</td>
<td>3800105 INTRO PSY (inter)</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>LIT/WOMEN</td>
<td>3200106 FUN ORAL BIO HLTH</td>
<td>3(3-0-6)</td>
<td>3800202 PSY LIFE WORK</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>MAG REAL LIT</td>
<td>3200109 CALCIUM HLTH</td>
<td>3(3-0-6)</td>
<td>3800250 HUMAN RELATIONS</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>CONTEM FICT</td>
<td>3200110 TRAV HUMAN BODY</td>
<td>3(3-0-6)</td>
<td>3800251 MENTAL HEALTH</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>REL/SPIRIT LIT</td>
<td>3301102 COSMETICS DLY LIFE</td>
<td>3(3-0-6)</td>
<td>3800351 PSY THINK CREAT</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>MYSTERY FICTION</td>
<td>3304102 DRUG EDUCATION</td>
<td>3(3-0-6)</td>
<td>4000203 INTRO SUF ECON</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>LITERATURE AND FILM ADAPTATIONS</td>
<td>3306101 USEFUL PLANTS</td>
<td>3(3-0-6)</td>
<td>4000204 INTRO AGRO FOOD CH</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>LIT/DISABILITY</td>
<td>3307101 BASIC AROMATHERAPY</td>
<td>3(3-0-6)</td>
<td>4000206 HIST THAI AGR</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>HUMOUR/LIT</td>
<td>3308100 MICRO ORGAN/LIFE</td>
<td>3(3-0-6)</td>
<td>4000208 INTRO AGR ECON</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>JUVILE LIT</td>
<td>3308101 HYG ENV MICROBIO</td>
<td>3(3-0-6)</td>
<td>4000209 INTRO AGR RES MGT</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>2210315 LIT/ETHN IDENTITY</td>
<td>3(3-0-6)</td>
<td>3309101 LIFE/HEALTH</td>
<td>3(3-0-6)</td>
<td>3000281 HUMAN LIFE</td>
<td>1(1-0-2)</td>
<td>5100101 POP DEV</td>
</tr>
<tr>
<td>56</td>
<td>2221433 BUDDHIST TEACHING</td>
<td>3(3-0-6)</td>
<td>3600205 FAM HLTH CARE</td>
<td>3(3-0-6)</td>
<td>330191 CHEM DRUG DAILY</td>
<td>3(3-0-6)</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>2221485 BUDDHIST CIV</td>
<td>3(3-0-6)</td>
<td>3600206 COM HLTH DEV</td>
<td>3(3-0-6)</td>
<td>3600252 LEADER PER DEV</td>
<td>3(3-0-6)</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>2223243 JAPAN TODAY</td>
<td>3(3-0-6)</td>
<td>3600207 HLTH LIVING</td>
<td>3(3-0-6)</td>
<td>3600309 PSY CONSERVATION</td>
<td>3(3-0-6)</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>2226001 INTRO VIET CULTURE</td>
<td>3(3-0-6)</td>
<td>3600208 TOB ALC HLTH</td>
<td>3(3-0-6)</td>
<td>3914101 REC QUAL LIFE DEV</td>
<td>3(3-0-6)</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>2231255 FR LIT WRKS</td>
<td>3(3-0-6)</td>
<td>3600209 EMER DISAS CARE</td>
<td>3(2-2-5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>2232241 GER CH JU LIT</td>
<td>3(3-0-6)</td>
<td>3640203 MTRNL CHILD HEALTH</td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>2232253 GER-SKP CNTR TODAY</td>
<td>3(3-0-6)</td>
<td>3700104 IN HC NEW GEN</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>2235320 CONTEMP PORT BRAZ</td>
<td>3(3-0-6)</td>
<td>3700105 FOOD SCI ART</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>2244482 INTRO ITAL CINEMA</td>
<td>3(3-0-6)</td>
<td>3700107 SEXUAL DEVELOPMENT</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>2236103 RUS LANG CULT</td>
<td>3(3-0-6)</td>
<td>3700108 HLTH PREV INFECT DIS</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>2236204 RUS LIT WORKS</td>
<td>3(3-0-6)</td>
<td>3700109 IMMUNITY OF LIFE</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>2244151 INTRO CAMBO CULT</td>
<td>3(3-0-6)</td>
<td>3700110 GOOD HLTH</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>2501191 HIST ART ARCH</td>
<td>3(3-0-6)</td>
<td>3700113 BLOOD ESS HLTH</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>2501292 INTRO HSE DSGN</td>
<td>3(3-0-6)</td>
<td>3700114 INTRO ENVI TOX</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>2501295 INTRO DESIGN</td>
<td>3(3-0-6)</td>
<td>3700115 BRIEF HLTH SCI</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>2501296 THAI ARCH HERITAGE</td>
<td>3(3-0-6)</td>
<td>3705103 PREP DIAG RAD PROC</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>2501297 ENJOY ARCH SKETCH</td>
<td>3(2-2-5)</td>
<td>3741101 COMP HLTH SCI</td>
<td>2(1-3-2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>2501298 UNDERST ARCH</td>
<td>3(2-3-4)</td>
<td>3741102 LIVE SMART HLTH</td>
<td>2(0-0-4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>2501299 BUDDHIST ART/ARCH</td>
<td>3(3-0-6)</td>
<td>3741207 MOD TECH</td>
<td>2(0-0-4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>2502291 DESIGN EVERYDAY</td>
<td>3(3-0-6)</td>
<td>3742100 PHY THR DAILY LIFE</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>2502292 CULINARY DESIGN</td>
<td>3(2-2-5)</td>
<td>3742102 EXERCISE THERAPY</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>2502330 DSGN TH CULT HER</td>
<td>3(3-0-6)</td>
<td>3742106 BLC BODY MIND QOL</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>2502378 JWL APPRECIAT</td>
<td>3(3-0-6)</td>
<td>3743422 WEIGHT CONTROL</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>2502379 APPRE CER</td>
<td>3(3-0-6)</td>
<td>3900200 EX/PS HLTH</td>
<td>3(2-2-5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>กลุ่มวิชาภาษาต่างประเทศ</td>
<td>กลุ่มวิชาภาษาศาสตร์และคณิตศาสตร์</td>
<td>กลุ่มวิชาศึกษาศาสตร์</td>
<td>กลุ่มวิชาสารศาสตร์</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85 2502393 CONT JP DSGN</td>
<td>4000205 ORG AGR</td>
<td>3(3-0-6)</td>
<td>4(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>86 2502430 DSGN ENTREPRN</td>
<td>4000210 QUAN ANAL AGRI BUS</td>
<td>3(3-0-6)</td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>87 2541151 SPARK CREAT (Inter)</td>
<td></td>
<td>3(1-4-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88 2541152 C/C PROB SOLV (Inter)</td>
<td></td>
<td>3(1-4-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89 2541154 COLOR AESTHETICS (Inter)</td>
<td></td>
<td>3(1-4-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 2541155 VIS CULT (Inter)</td>
<td></td>
<td>3(2-2-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>91 2541156 ARCH ENV FILM (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>92 2541157 PERSPEC EU ARCH (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>93 2541158 LAND/LANDSCAPE (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>94 2541159 UNDST/BSC IA DSGN (Inter)</td>
<td></td>
<td>3(2-2-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95 2541162 POSTMOD PHOTO (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96 2541163 FML ANAL/PRES ARCH (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>97 2541168 DSGN ASIAN PESSP (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98 2541169 HIST ANIMATION (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>99 2542001 ART DSGN FLD (Inter)</td>
<td></td>
<td>3(0-9-0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 2542002 COMM DSGN PROJ (Inter)</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101 2722272 DHAMMAVIDYA</td>
<td></td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102 2722288 DHAMMA SELF</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103 2736101 ART APPRECIATION</td>
<td></td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104 2737110 MUS APPRECIATION</td>
<td></td>
<td>2(2-0-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>105 3500111 INTRO FINE APP ART</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106 3501120 HIST WEST ART I</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107 3501214 THAI ARTS I</td>
<td></td>
<td>3(2-2-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>108 3501217 EAR MOD ART</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>109 3501222 HIST ORNTAL ART I</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110 3501224 HIST THAI ARTS</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111 3502222 HIST CREAT ART</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112 3502271 HIST FASHION</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>113 3502272 HIST GRAPH DSGN</td>
<td></td>
<td>3(3-0-6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

กลุ่มวิชาภาษาต่างประเทศ

1. 2232009 GER COMM 3(3-0-6)
2. 5500111 EXP ENG I 3(2-2-5)
3. 5500112 EXP ENG II 3(2-2-5)
4. 5500193 GRAMMAR & WRITING 3(2-2-5)
5. 5500194 LISTEN ENG 3(2-2-5)
6. 5500200 SPK COMM 2(1-2-3)
7. 5500295 ENG ARTS ENG 3(2-2-5)
8. 5500492 PROF ENG TRAV 2(1-2-3)
9. 5500495 ENG IN ACT 3(2-2-5)

ศูนย์การศึกษาทั่วไป ปรับปรุงล่าสุด สิงหาคม 2559 สำนักงานเลขานุการ www.gened.chula.ac.th
CEN 01 Jamjuree Building 1
CEN 03 Office of the President’s Canteen
CEN 04 CU Printing House
CEN 05 Jamjuree Building 7
CEN 06 CU Stadium
CEN 07 CU Indoor Stadium
CEN 08 Dhamma Center Building
CEN 09 Department of Botany Laboratory Building
CEN 10 Chulaniwat Residence Halls 1
CEN 12 - CEN 16 Chulaniwat Residence Halls
CEN 17 Witthayaphathana Building
CEN 21 CU Alumni Association Building Office
CEN 24 Student Dormitories’s Indoor Stadium
CEN 25 Student Dormitories 1
CEN 27 Student Dormitories 5
CEN 28 CU Main Auditorium
CEN 29 Chakrabongse Building
CEN 30 Swimming Pool
CEN 31 Sala Phra Kieo
CEN 32 Prempurachatra Building
CEN 34 Student Dormitories (Men)
CEN 38 Student Dormitories’s Canteen
CEN 41 Tennis Court
CEN 42 Wankeaw Building
CEN 45 Center of Arts and Culture Building 2
CEN 46 Center of Arts and Culture Building 3
CEN 47 Jamjuree Building 4
CEN 50 Witthayaniwat Residence Hall
CEN 51 Pinitprachananart Building
CEN 52 Wittayakitt Building
CEN 53 Borommaratchakumari Building
CEN 55 Student Dormitories (Men)
CEN 58 Jamjuree Building 2
CEN 59 Jamjuree Building 3
CEN 60 Chalachakrabongse Building
CEN 61 Chulanarumit Building
CEN 62 Jamjuree Building 5
CEN 66 Jamjuree Building 8

INS 01 Visid Prachuabmoh Building
INS 02 Institute Building 2
INS 04 Center of Academic Resources
INS 06 Graduate School Building
INS 07 Sasaniwes Building
INS 09 Prajadhipok - Rambaibami Building
INS 11 Petroleum and Petrochemical Collage Building
INS 12 Institute Building 3
EDU 01 - EDU 10 Faculty of Education
DEN 01 - DEN 16 Faculty of Dentistry
LAW 03 Faculty of Law
COM 01 - COM 03 Faculty of Communication Arts
ACC 01 - ACC 09 Faculty of Commerce and Accountancy
PHA 01 - PHA 07 Faculty of Pharmaceutical Science
POL 01 - POL 05 Faculty of Political Science
SCI 01 - SCI 26 Faculty of Science
ENG 01 - ENG 30 Faculty of Engineering
ECO 01 Faculty of Economics
FAA 01 - FAA 04 Faculty of Fine and Applied Arts
ARC 01 - ARC 05 Faculty of Architecture
VET 01 - VET 16 Faculty of Veterinary Science
ART 01 - ART 04 Faculty of Arts
**important**

<table>
<thead>
<tr>
<th>Website</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chulalongkorn University</td>
<td><a href="http://www.chula.ac.th">www.chula.ac.th</a></td>
</tr>
<tr>
<td>CU Office of the registrar</td>
<td><a href="http://www.reg.chula.ac.th">www.reg.chula.ac.th</a></td>
</tr>
<tr>
<td>CU graduate School</td>
<td><a href="http://www.grad.chula.ac.th">www.grad.chula.ac.th</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contact Office</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean Office</td>
<td>Tel. 02-218-6308-10 Fax. 02-253-6161</td>
</tr>
<tr>
<td>Registration and Evaluation</td>
<td>Tel. 02-218-6332 Fax. 02-218-6335</td>
</tr>
<tr>
<td>Division Academic Affairs</td>
<td></td>
</tr>
</tbody>
</table>

Prepared By: Curricular and Academic Development Section / 
Academic Affairs / Faculty of Engineering
Tel. 02-218-6334-5 Fax. 02-218-6333