



BACHELOR OF ENGINEERING PROGRAM
IN COMPUTER INNOVATION ENGINEERING
(INTERNATIONAL PROGRAM)
(UPDATED CURRICULUM 2017)

Faculty of Engineering
King Mongkut's Institute of Technology Ladkrabang

**BACHELOR OF ENGINEERING PROGRAM
IN COMPUTER INNOVATION ENGINEERING
(INTERNATIONAL PROGRAM)
(UPDATED CURRICULUM 2017)**

Name of Educational Institute: King Mongkut's Institute of Technology Ladkrabang

Faculty/Department: Faculty of Engineering, Department of Computer Engineering

PART 1: GENERAL INFORMATION

1. Name of the Program

Name of the program (Thai): หลักสูตรวิศวกรรมศาสตรบัณฑิต สาขาวิชาวิศวกรรมนวัตกรรมคอมพิวเตอร์ (หลักสูตรนานาชาติ)

Name of the program (English): Bachelor of Engineering in Computer Innovation Engineering (International Program)

2. Degree and Major

Full name (Thai): วิศวกรรมศาสตรบัณฑิต (วิศวกรรมนวัตกรรมคอมพิวเตอร์)

(English): Bachelor of Engineering (Computer Innovation Engineering)

Abbreviation (Thai): วศ.บ. (วิศวกรรมนวัตกรรมคอมพิวเตอร์)

(English): B.Eng. (Computer Innovation Engineering)

3. Major Field

None

4. Total Credits

At least 128 credits

5. Type of the Program

5.1 Level

4-Year Bachelor Degree Program

5.2 Medium of Instruction

English

5.3 Admission

Thai and/or Foreign students

5.4 Collaboration with Other Institutes

The program is in collaboration with many university according to the memorandum of understanding (MOU) such as College of Engineering, Carnegie Mellon University, the University of South Florida, Imperial College, Chubu University, Kumamoto University, BK Birla Institute of Engineering and Technology, National Formosa University and South Eastern Regional College, etc. as details in Appendix I.

5.5 Degree Given to the Graduates

Single Degree; Bachelor of Engineering degree from King Mongkut's Institute of Technology Ladkrabang

6. Status of the Program and Consideration for the Authorization/Agreement

Revised program.

Course begins on August 2017

The program has been endorsed by the Academic Committee of KMITL in its meeting on the 20th January 2017

The program has been approved by the KMITL Council at its meeting on the 26th July 2017 (7/2017)

7. Readiness for Publicization as Qualified and Standardized Program

The program is ready for publicization as a qualified and standardized program according to the qualification standard of higher education as well as the ABET Accreditation in 2019.

8. Possible Career Path after Graduation

- Innovation Engineer
- Startup Entrepreneur
- Software Engineer
- DevOps Engineer
- Data Engineer
- Cloud Engineer
- IoT Engineer
- Information Security Analyst
- Computer Systems Analyst
- Product Designer
- Software Architect

- Technology Manager
- Solution Engineer
- Solution Architect

9. Name, Surname, ID Number, Position, and Qualification of Instructors Responsible for the Program (Executive Program Committee)

Name-Surname (Academic Position) Id Number	Highest Qualification (Department), Year of Graduation	University
1. Assoc. Prof. Dr. Pitikhate Sooraksa (Electrical Engineering) ██████████	Ph.D. (Electrical Engineering), 1996 M.S. (Electrical Engineering), 1993 B.S. (Physics), 1991 B.Ed. (Physics) (Hons), 1988	University of Houston, USA George Washington University, USA Srinakharinwirot University, TH Srinakharinwirot University, TH
2. Asst. Prof. Dr. Chutimet Srinilta (Computer Engineering) ██████████	Ph.D., Computer Engineering, 1998 M.S. (Computer Engineering), 1996 B.Eng. (Electrical Engineering), 1990	Syracuse University, USA Syracuse University, USA Kasetsart University, TH
3. Asst. Prof. Dr. Panarat Cherntanomwong (Electrical and Communication Engineering) ██████████	D.Eng. (International Development Engineering), 2008 M.Eng. (Electrical Engineering), 2000 B.Eng. (Telecommunication Engineering), 1998	Tokyo Institute of Technology, JP King Mongkut's Institute Technology Ladkrabang, TH King Mongkut's Institute Technology Ladkrabang, TH
4. Asst. Prof. Dr. Sutheera Puntheeranurak (Electrical and Communication Engineering) ██████████	D.Eng. (Science and Technology), 2009 M.Eng. (Electrical Engineering), 1999 B.S. (Applied Mathematics) (Hons), 1991	Tokai University, JP King Mongkut's Institute Technology Ladkrabang, TH King Mongkut's Institute Technology Ladkrabang, TH

5. Asst. Prof. Apinetr Unakul (Computer Engineering) ██████████	M.S. (Software Engineering), 1995 B.S. (Electrical and Computer Engineering), 1991	Boston University, USA Carnegie Mellon University, USA
6. Dr. Akkarit Sangpetch ██████████	Ph.D. (Electrical and Computer Engineering), 2013 M.S. (Electrical and Computer Engineering), 2010 B.S. (Computer Science), 2005 B.S. (Electrical and Computer Engineering), 2005	Carnegie Mellon University, USA Carnegie Mellon University, USA Carnegie Mellon University, USA Carnegie Mellon University, USA
7. Dr. Orathai Sangpetch ██████████	Ph.D. (Electrical and Computer Engineering), 2013 M.S. (Electrical and Computer Engineering), 2010 B.S. (Electrical and Computer Engineering), 2005	Carnegie Mellon University, USA Carnegie Mellon University, USA Carnegie Mellon University, USA
8. Dr. Ratthachai Chawuthai ██████████	Ph.D. (Informatics), 2016 M.Eng. (Information Management), 2012 B.Eng. (Computer Engineering), 2006	SOKENDAI, JP Asian Institute of Technology, TH King Mongkut's Institute of Technology Ladkrabang, TH

10. Location of Study

King Mongkut's Institute of Technology Ladkrabang

11. External Situation or Development Needed to be Considered for the Planning of the Program

11.1 Economic Situation/Development

The planning of bachelor degree program in Computer Innovation Engineering has been operated according to National Economic and Social Development Plan (2017-2021) which

emphasizes on the development of science technology, research, and innovation in order to reinforce the sustainable growth of the industrial part. The program also serves Thailand 4.0 policy which emphasizes on integrating emerging technology with current economy to enhance Thailand development and digitally transform Thai economy, which will improve economic efficiency and generate new innovation. Therefore, it is necessary to increase the capacity of digitally-literate, innovative computer engineering workforce who understands the technological foundation as well as the surrounding economic ecosystem. Our new economy will require a highly-skilled engineer who can adapt and transform innovative engineering into a working solution that can be applied and enhance economic productivity in order to be competitive and keep our economy sustainable.

11.1 Social and Culture Situation/Development

At present, the social structure of Thailand has undergone a change toward the society of the elderly. Economic groups have been formed, and the development of Thai local wisdom has created products of more value in order to compete with other countries. Moreover, the opening of ASEAN's free trade area has influenced the migration of labor and entrepreneurs to countries that offer a better reward. This, consequently, facilitates the flow of tradition and culture. The production of scholars in computer innovation engineer is, therefore, to create a workforce with the academic knowledge and applicable innovation as well as good moral and ethics so that they are ready to face the challenge happening in both regional and national parts. By being able to analyze the social and cultural situation to create new innovation which improves the way of living of people in the society. This, in turn, causes the strategic drive for self-development of citizens as well as the Thai society toward the society of wisdom and life-long learning.

12. Effects from 11.1 and 11.2 on the Development of the Program and the Relation to the Mission of the Institute

12.1 Development of the Program

The effects of external factors on the development of the Computer Innovation Engineering program, Bachelor of Engineering, call for the revision of the program so that it can support the needs according to “enhancing and improving human capital” as well as “developing science, technology, research and innovation” strategy of the 12th national economic and social development plan (2017-2021) under the principles of “sustainable economy” in the aspect of developing human resource with quality, ethics and wisdom to

foster the economy of quality, sustainability, righteousness and diversity as well as create strong foundation for innovation.

12.2 Relation to the Mission of the Institute

The development of the Computer Innovation Engineering program is related to the strategic advancement of scholar production to create next-generation scholars with capabilities and flexibility to adapt to the change in the economy, society, and culture. It also directly reflects the mission of the Institute to be the “Master of Innovation,” in the aspects of education, research, academic service and preservation of art and culture. The program also serves the mission of Faculty of Engineering in producing scholars with academic excellence according to the needs of the country and society, developing research to build up the body of knowledge for the development of the country, developing national and international collaboration of academic network, building up scientific and technological body of knowledge and giving academic service to the society, supporting the preservation of art and culture, along with developing curricula according to the standard of the educational quality assurance of King Mongkut’s Institute of Technology Ladkrabang.

13. Relation (if any) with Other Programs Open in the Faculty/Other Departments of the Institute (i.e. Subjects Open for the Service of Other Faculties/Departments or to Be Studied with Other Faculties/Departments)

13.1 Subjects/Subject Groups in the Program Open by Other Faculties / Departments / Programs

- General Education subjects
- Free electives

13.2 Subjects/Subject Groups in the Program Open and Required to be Studied by Other Faculties / Departments / Programs

- Free electives

13.3 Management

The executive program committee is primarily responsible for the program are the representatives to coordinate with the faculty, institution, instructors and other programs in order to assign the teaching strategies and contents along with the assessment of the program according to the key performance indicator to achieve the objectives of the program and to successfully produce innovative graduates.

The program committee will consult with members of the program's industrial advisory board. The board will be able to provide general guidelines, industrial trends, and demands which will help to keep the content of the program relevant to the current state of the art in the industry.

All requirements for the master degree are in addition to the requirements for the bachelor degree. No requirements for the master degree can be used in any way toward the bachelor degree.

3. Curriculum and Instructors

The B.Eng. in Computer Innovation Engineering program is a four-year full-time undergraduate program. In order to graduate, the students must complete at least 128 credits and satisfy the graduation requirements given in the following section. The program is designed to drive innovations and entrepreneurship in computing and information technology-related areas. Each semester will include a project-based theme which helps students practice and design innovative solutions in the respective areas.

In the first year, the students study basic courses in mathematics and science and improve their communication skills. Students will also be introduced to fundamental programming concepts and the foundation of digital systems. The first-year projects will give students hands-on experience and basic development of computing technologies.

In the second year, the students will learn advanced computing concepts which serve as the foundation of computing technologies. The students also learn to apply design methods for solutions in technical areas such as cyber-physical systems and computing infrastructures.

Third-year students will learn about the latest technologies and innovations which happen in the area. In each semester, the students will study new concepts and apply creativity in completing projects in trending areas such as cloud-mobile application development and IoT. Students will also learn about innovation engineering, along with the process and tools to facilitate new innovations.

Fourth-year students undertake significant innovative engineering design projects. Students will apply their skills and knowledge to create sustainable innovations while being able to apply the required standards and realistic engineering constraints. Students may also further specialize in their areas of interest and prepare for the next step in their careers.

3.1 Curriculum

3.1.1 <u>Minimum</u> Credits Required for Graduation	<u>128</u>	credits
3.1.2 Curriculum Structure		
A. General Education	<u>30</u>	credits
- English Proficiency Requirement (ESL) *Audits*	8	credits

- Communication	4	credits
- CIE Seminar	1	credits
- Innovation Training	16	credits
- Humanity and Social Science	9	credits
B. Computer Innovation Engineering	92	credits
- Introductory Courses	12	credits
- Science and Mathematics for Engineering	26	credits
- Foundation Courses	20	credits
- Integrated Innovation Courses	20	credits
- CIE Elective	8	credits
- Alternative Study	6	credits
C. Free Electives	6	credits
D. Innovation Internship	0	credits

3.1.3 Subjects

One academic credit is given to a course offered in a single semester which

- Meets in class for lecture or discussion for 1 hour per week; or
- Contains at least 3 laboratory hours per week.

Most courses are given 4 credits. These courses usually contain 3 hours of lecture or discussion per week. The courses are also accompanied with 1 additional hour of recitation or 3 hours of laboratory work per week. Students enrolled in the courses are also expected to spend at least 8 hours outside the class/lab for studying and completing the coursework.

The instructor-led lecture could be delivered as a traditional lecture or include learning activities in which the students can actively participate. The recitation is a compliment to a lecture where students can discuss and ask the recitation leader questions to clarify concepts, facts, or problem sets from the lecture. The laboratory hours give students the opportunity to learn from hands-on experience using specialized equipment or software related to the course's contents.

A. GENERAL EDUCATION

CREDITS

(LECTURE-LAB-SELF STUDY)

A.1 ENGLISH PROFICIENCY REQUIREMENT (ESL) 8 CREDITS

01006500 ACADEMIC LISTENING AND SPEAKING **Audits**

4 (4-0-8)

01006501 ACADEMIC READING AND WRITING ****Audits**** 4 (4-0-8)

Students must achieve the required English proficiency level prior to the graduation. The requirement could be satisfied using the English proficiency test scores submitted during the application, or after admitting to the program.

Non-native English speakers who have not achieved the required English proficiency level during admission must complete two English-as-a-Second-Language (ESL) courses in their first year of study. However, the credits from ESL courses will not be used in GPA calculation and will not be counted toward the graduation requirement.

A.2 COMMUNICATION 4 CREDITS

01006513 INTERPRETATION AND ARGUMENTS 4 (4-0-8)

Students are required to complete at least 4 credits from the courses in Communication Requirement category.

A.3 CIE SEMINAR 1 CREDITS

01006518 EMERGING TRENDS IN ENGINEERING 1 (1-0-2)

Students must complete a 1-credit seminar course which introduces them to current trends and areas of specialization in CIE. The course will also help students decide their areas of interest.

A.4 INNOVATION TRAINING 16 CREDITS

01006514 INNOVATIVE COMMUNICATION 4 (4-0-8)

01006515 DESIGN METHODS FOR INNOVATIONS 4 (4-0-8)

01006516 INNOVATION MANAGEMENT 4 (4-0-8)

01006517 LEAN STARTUP AND AGILE BUSSINESS 4 (4-0-8)

Students must complete at least 16 credits from the courses in Innovation Training category.

A.5 HUMANITY AND SOCIAL SCIENCE 9 CREDITS

01006502 PROFESSIONAL ETHICS 3 (3-0-6)

01006503 INTRODUCTION TO PSYCHOLOGY 3 (3-0-6)

01006504 PHILOSOPHY OF SCIENCE 3 (3-0-6)

01006505 CREATIVE THINKING 3 (3-0-6)

01006506 CRITICAL THINKING 3 (3-0-6)

01006507 PERSONAL ECONOMICS 3 (3-0-6)

01006508 DIGITAL ECONOMY	3 (3-0-6)
01006509 ENGINEERING AND PUBLIC POLICY	3 (3-0-6)
01006510 INTRODUCTION TO ECONOMICS	3 (3-0-6)
01006511 THAI SOCIETY AND CULTURE	3 (3-0-6)
01006512 ASIAN STUDY	3 (3-0-6)
01006519 INTRODUCTION TO ENVIRONMENTAL PRINCIPLES	3 (3-0-6)
01006520 LEADERSHIP AND PERSONAL DEVELOPMENT	3 (3-0-6)
01006521 MEDITATION FOR LIFE DEVELOPMENT	3 (3-0-6)
01006522 ENGLISH FOR SCIENCE AND TECHNOLOGY	3 (3-0-6)

Students must complete at least 9 credits from the courses in Humanity and Social Science electives.

B. COMPUTER INNOVATION ENGINEERING

CREDITS

(LECTURE-LAB-SELF STUDY)

B.1 INTRODUCTORY COURSES 12 CREDITS

01266111 FUNDAMENTALS OF PROGRAMMING	4 (3-3-8)
01266112 INTELLIGENT DEVICES AND DIGITAL SYSTEMS	4 (3-3-8)
01006700 DISCRETE MATHEMATICS	4 (4-0-8)

Students must complete 12 credits from Introductory courses. Students must complete 4 credits from discrete mathematics required for CIE and 8 credits from other CIE introductory courses.

B.2 SCIENCE AND MATHEMATICS FOR ENGINEERING 26 CREDITS

01006701 MATHEMATICS OF DATA SCIENCE	4 (4-0-8)
01006702 PHYSICS I	4 (3-3-8)
01006703 PHYSICS II	4 (3-3-8)
01006704 LINEAR ALGEBRA	4 (4-0-8)
01006705 NUMERICAL METHODS	4 (4-0-8)
01006706 OPERATIONS RESEARCH	4 (4-0-8)
01006707 BIOLOGY	4 (3-3-8)
01006708 CHEMISTRY	4 (3-3-8)
01006709 PROBABILITY AND STATISTICS	4 (4-0-8)
01006710 INTRODUCTION TO CALCULUS	3 (3-0-6)
01006711 ADVANCED CALCULUS	3 (3-0-6)
01006712 DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA	3 (3-0-6)

01006713 MATHEMATICAL CRYPTOGRAPHY 4 (4-0-8)

01006714 MATHEMATICS FOR 3D GAME AND COMPUTER GRAPHICS 4 (4-0-8)

Students must complete 26 credits from courses in Science and Mathematics. Students must acquire 6 credits from Introduction to Calculus and Advanced Calculus; at least 8 credits in Basic Science (Physics, Chemistry, or Biology; one of which must include laboratory component) and 12 additional credits from courses in Science and Mathematics category. Note that placement credits submitted during the application can also be used to satisfy the requirements.

B.3 FOUNDATION COURSES 20 CREDITS

01266211 PRINCIPLES OF COMPUTATION AND APPLICATIONS 4(3-3-8)

01266212 CYBER-PHYSICAL SYSTEM DESIGN 4(3-3-8)

01266213 COMPUTER SYSTEMS 4(3-3-8)

01266214 INFORMATION NETWORK AND CYBER SECURITY 4(3-3-8)

01266215 DATABASE TECHNOLOGY 4(3-3-8)

Students must complete at least 20 credits from Foundation courses.

B.4 INTEGRATED INNOVATION COURSES 20 CREDITS

01266311 ELEMENTS OF SOFTWARE CONSTRUCTION 4(3-3-8)

01266312 CLOUD COMPUTING 4(3-3-8)

01266313 INTERNET OF THINGS AND SMART SYSTEMS 4(3-3-8)

01266314 DATA ANALYTICS 4(3-3-8)

01266512 COMPUTER INNOVATION ENGINEERING CAPSTONE DESIGN 4(3-3-8)

Students must complete at least 20 credits from Integrated Innovation courses. Integrated Innovation courses are courses which synergize with each other and help students generate innovations in the respective areas. One of the courses in this category must include a significant engineering design component where teams of students analyze and design complex systems to solve problems.

B.5 CIE ELECTIVE 8 CREDITS

01266401 STARTUP ENGINEERING 4 (3-3-8)

01266402 MOBILE APPLICATION DEVELOPMENT 4 (3-3-8)

01266403 USER EXPERIENCE AND USER INTERFACE DESIGN 4 (3-3-8)

01266404 HUMAN COMPUTER INTERACTION 4 (3-3-8)

01266405 PRODUCT DESIGN STUDIO 4 (3-3-8)

01266406 IOT DEVICE DESIGN	4 (3-3-8)
01266407 DATA VISUALIZATION	4 (3-3-8)
01266408 MULTIMEDIA DATABASES AND DATA MINING	4 (3-3-8)
01266409 SOCIAL NETWORK ANALYSIS	4 (3-3-8)
01266410 COGNITIVE COMPUTING APPLICATIONS	4 (3-3-8)
01266411 ENTERPRISE SYSTEM DESIGN AND IMPLEMENTATION	4 (3-3-8)
01266412 SOFTWARE-DEFINED DATA CENTER	4 (3-3-8)
01266413 SOFTWARE-DEFINED NETWORKING	4 (3-3-8)
01266414 WIRELESS SENSOR NETWORK	4 (3-3-8)
01266415 LOCATION-BASED TECHNOLOGY AND SERVICE	4 (3-3-8)
01266416 IT SYSTEM MANAGEMENT	4 (3-3-8)
01266417 IT PROJECT MANAGEMENT	4 (3-3-8)
01266418 INFORMATION SECURITY MANAGEMENT	4 (3-3-8)
01266419 ENTERPRISE NETWORK SECURITY	4 (3-3-8)
01266420 CYBER THREATS AND DIGITAL FORENSICS	4 (3-3-8)
01266424 BLOCKCHAIN TECHNOLOGIES	4 (3-3-8)
01266422 MICROCONTROLLER DESIGN AND SYSTEM ON CHIP	4 (3-3-8)
01266423 FUNDAMENTALS OF AR, VR AND MIXED REALITY	4 (3-3-8)

Students must complete additional 8 credits courses from any categories. Students can take CIE elective courses to further specialize in their area of interests, or explore other aspects of Computer Innovation Engineering.

B.6 ALTERNATIVE STUDY 6 CREDITS

01266511 CAPSTONE DESIGN PREPARATION	6 (3-6-12)
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Regular students must complete the capstone design preparation. Students will practice open-ended engineering design and/or research that incorporates fundamental and advanced concepts in Computer Innovation Engineering. Students will learn to build innovation, identify the opportunities, propose ideas, design and implement innovative solutions while being able to apply standards and realistic engineering constraints.

01006301 COOPERATIVE EDUCATION	6 (0-45-0)
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The Co-Op is a 16-week extended internship experience in which students may opt to participate in. Interested students should contact the department or

the program committee regarding the current policies and the requirements. While on the Co-Op assignment, the students are participating in a recognized educational program and retain their full-time student status.

01006302 STUDY ABROAD 6 (6-0-12)

CIE student may choose to study abroad while still earning the Computer Innovation Engineering degree. Students should contact the department or the program committee regarding the current exchange options and transferred credits eligibility. The students must be able to transfer at least 6 credits or equivalent from the exchange program of study.

C. FREE ELECTIVES 6 CREDITS

Students must complete at least 6 additional credits from any courses offered by the institution.

D. INNOVATION INTERNSHIP 0 CREDITS

01006805 INDUSTRIAL INTERNSHIP 0 (0-45-0)

Students may choose to join internship in the industries, research labs, or startups; including incubating their own businesses starting from the first year.

Meaning of the Subject Codes

Subject Codes are assigned with 8 digits as follows:

1 st , 2 nd digit:	01	means Faculty of Engineering
3 rd , 4 th digit	26	means Computer Innovation Engineering program
5 th digit	6	means Bachelor Degree
6 th , 7 th , 8 th digit		means Order of the subject

3.1.4 Study Plan

Credit Notation: (L - E - S)

L = Lecture / Learning hours, E = Laboratory hours, S = Self-study hours

1st YEAR 1st SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006700	DISCRETE MATHEMATICS	4 (4-0-8)
01266111	FUNDAMENTALS OF PROGRAMMING	4 (3-3-8)
01006710	INTRODUCTION TO CALCULUS	3 (3-0-6)
01006702	PHYSICS I	4 (3-3-8)
010065xx	(GENED ELECTIVE)	3 (3-0-6)
01006500	(ESL) ACADEMIC LISTENING AND SPEAKING **AUDITS**	4 (4-0-8)
TOTAL CREDITS		18

1st YEAR 2nd SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006513	(GENED) INTERPRETATION AND ARGUMENTS	4 (4-0-8)
01266112	INTELLIGENT DEVICES AND DIGITAL SYSTEMS	4 (3-3-8)
01006711	ADVANCED CALCULUS	3 (3-0-6)
01006703	PHYSICS II	4 (3-3-8)
01006501	(ESL) ACADEMIC READING AND WRITING **AUDITS**	4 (4-0-8)
TOTAL CREDITS		15

2nd YEAR 1st SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006518	EMERGING TRENDS IN ENGINEERING	1 (1-0-2)
010065xx	(GENED ELECTIVE)	3 (3-0-6)
01006514	(GENED) INNOVATIVE COMMUNICATION	4 (4-0-8)
01266211	PRINCIPLES OF COMPUTATION AND APPLICATIONS	4 (3-3-8)
01266212	CYBER-PHYSICAL SYSTEM DESIGN	4 (3-3-8)
TOTAL CREDITS		16

2nd YEAR 2nd SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006515	(GENED) DESIGN METHODS FOR INNOVATIONS	4 (4-0-8)
010065xx	(GENED ELECTIVE)	3 (3-0-6)
01006709	(SCIENCE&MATH) PROBABILITY AND STATISTICS	4 (4-0-8)
01266213	COMPUTER SYSTEMS	4 (3-3-8)
01266214	INFORMATION NETWORK AND CYBER SECURITY	4 (3-3-8)
TOTAL CREDITS		19

3rd YEAR 1st SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
010067xx	(SCIENCE & MATHEMATICS ELECTIVE)	4 (4-0-8)
01266215	DATABASE TECHNOLOGY	4 (3-3-8)
01266311	ELEMENTS OF SOFTWARE CONSTRUCTION	4 (3-3-8)
01266312	CLOUD COMPUTING	4 (3-3-8)
TOTAL CREDITS		16

FOR REGULAR STUDENTS3rd YEAR 2nd SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006517	(GENED) LEAN STARTUP AND AGILE BUSINESS	4 (4-0-8)
010067xx	(SCIENCE & MATHEMATICS ELECTIVE)	4 (4-0-8)
xxxxxxxx	(FREE ELECTIVE)	3 (x-x-x)
01266313	INTERNET OF THINGS AND SMART SYSTEMS	4 (3-3-8)
01266314	DATA ANALYTICS	4 (3-3-8)
TOTAL CREDITS		19

4th YEAR 1st SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
xxxxxxxx	(FREE ELECTIVE)	3 (x-x-x)
012664xx	(CIE ELECTIVE)	4 (3-3-8)
01266511	CAPSTONE DESIGN PREPARATION	6 (3-6-12)
TOTAL CREDITS		13

4th YEAR 2nd SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
012664xx	(CIE ELECTIVE)	4 (3-3-8)
01266512	COMPUTER INNOVATION ENGINEERING CAPSTONE DESIGN	4 (3-3-8)
01006516	(GENED) INNOVATION MANAGEMENT	4 (4-0-8)
TOTAL CREDITS		12

FOR CO-OP/STUDY ABROAD STUDENTS3rd YEAR 2nd SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006517	(GENED) LEAN STARTUP AND AGILE BUSINESS	4 (4-0-8)

010067xx	(SCIENCE & MATHEMATICS ELECTIVE)	4 (4-0-8)
01266313	INTERNET OF THINGS AND SMART SYSTEMS	4 (3-3-8)
01266314	DATA ANALYTICS	4 (3-3-8)
012664xx	(CIE ELECTIVE)	4 (3-3-8)
TOTAL CREDITS		20

4th YEAR 1st SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006301	COOPERATIVE EDUCATION	6 (0-45-0)
or		
01006302	STUDY ABROAD	6 (6-0-12)
TOTAL CREDITS		6

4th YEAR 2nd SEMESTER

CODE	SUBJECT	CREDITS (L-E-S)
01006516	(GENED) INNOVATION MANAGEMENT	4 (4-0-8)
xxxxxxxx	(FREE ELECTIVE)	3 (x-x-x)
xxxxxxxx	(FREE ELECTIVE)	3 (x-x-x)
012664xx	(CIE ELECTIVE)	4 (3-3-8)

01266512	COMPUTER INNOVATION ENGINEERING CAPSTONE DESIGN	4 (3-3-8)
TOTAL CREDITS		18

Total credits required for graduation 128 credits

3.1.5 Details of Each Subject

Course description ([Appendix D](#))

3.2 Name, Surname, ID Number, Position, and Qualification of Instructors

3.2.1 Executive Program Committees

Name-Surname (Academic Position) ID Number	Qualification (Department), University, Year of Graduation	Academic Achievements
1. Assoc. Prof. Dr. Pitikhate Sooraksa (Electrical Engineering) ██████████	Ph.D. (Electrical Engineering), University of Houston, USA, 1996 M.S. (Electrical Engineering), George Washington University, USA, 1993 B.S. (Physics), Srinakharinwirot University, 1991 B.Ed. (Physics) (Hons), Srinakharinwirot University, 1988	1. Research: (Appendix H) - IT-Automation - Industrial Informatics 2. Textbook - Matrix Analysis - Differential equation - Control System Engineering - Chaos Robotic 3. Teaching obligations 12 hours/weekly
2. Asst. Prof. Dr. Chutimet Srinilta (Computer Engineering) ██████████	Ph.D., Computer Engineering, Syracuse University, USA, 1998 M.S. (Computer Engineering), Syracuse University, USA, 1996 B.Eng. (Electrical Engineering), Kasetsart University, 1990	1. Research (Appendix H) - GIS - Data Mining - Multimedia Systems 2. Textbook - 3. Teaching obligations 15 hours/weekly

COURSE DESCRIPTION

1. GENERAL EDUCATION

1.1 ENGLISH PROFICIENCY REQUIREMENT (ESL)

01006500 ACADEMIC LISTENING AND SPEAKING ****Audits**** 4 (4-0-8)

PREREQUISITE: NONE

The course provides ESL students guidance and extensive practice in listening and speaking in academic and professional settings. Listening focuses on understanding spoken English in formats such as college lectures and news broadcasts. Note-taking tasks are also included to reinforce aural comprehension. Students learn to recognize organizational patterns. Students also practice outlining main ideas and supporting details through audiotaped, videotaped and live presentations. Speaking focuses on increased fluency and communicative strategies used by native speakers in academic and professional settings.

01006501 ACADEMIC READING AND WRITING ****Audits**** 4 (4-0-8)

PREREQUISITE: NONE

This course is designed to improve the reading and writing skills of ESL students. Students receive practice on reading and vocabulary development. Reading practice will emphasize paraphrasing, summarizing, and the simple analysis of texts to identify main ideas and distinguish fact from opinion. Writing practice includes writing of simple and compound sentences, using compound tenses and correct word forms, word order, spelling, and punctuation. Students will also develop the ability to write varied, complex sentences and effective paragraphs in standard written English.

1.2 COMMUNICATION

01006513 INTERPRETATION AND ARGUMENTS 4 (4-0-8)

PREREQUISITE: NONE

This course provides the study of interpreting and analyzing written and visual arguments. Students will learn to identify the underlying values, definitions, and assumptions in those arguments. The students also learn how to synthesize a multiplicity of competing perspectives, and to articulate fundamental disagreements between those perspectives. Ultimately, students will advance their contributions to discussions in engineering, business innovations, and technology studies.

A.3 CIE SEMINAR

01006518 EMERGING TRENDS IN ENGINEERING 1 (1-0-2)

PREREQUISITE: NONE

This course consists of a series of lectures given by different faculty members and distinguished speakers from the academic and industries. The lectures are designed to provide students a good understanding of each curriculum structure and the courses in each subject areas. Students will be introduced to emerging trends in Engineering and the relevance of our courses. New courses and research opportunities will be presented, including the faculty's research fields. The course also discusses basic learning and working ethics and prepares students career-making skills. Pass/Fail, required to graduate.

A.4 INNOVATION TRAINING

01006514 INNOVATIVE COMMUNICATION 4 (4-0-8)

PREREQUISITE: NONE

This course provides the study and practice of different communication skills including technical, professional and creative writing; infographics design; and delivering presentation. The students will study relevant techniques and learn to combine a range of skills in order to effectively communicating technical or specialized concepts. They will be able to explore and translate the benefit, the uniqueness, and the credibility of innovative ideas to a target audience.

01006515 DESIGN METHODS FOR INNOVATIONS 4 (4-0-8)

PREREQUISITE: NONE

This course consists of structural design process to create innovative products or services. The students will study the process to gather trends and information such as global direction, public opinions, technology, business, society and economic; learn how to extract context of interested area to find opportunities; study the processes used to gather behaviors, generate intense understanding about areas that lead to innovative concepts, produce innovative solutions and finally offering innovative products and services.

01006516 INNOVATION MANAGEMENT 4 (4-0-8)

PREREQUISITE: NONE

This course introduces students to the concepts of innovative thinking and innovation management practices. This course prepares students with the insights and instruction necessary to successfully lead worldwide enterprises or local ventures. Covered topics include organization, strategy planning, policy development, communities, research and development and product management. Students are exposed to issues that challenged real-world organizations. Students will learn best practices used by engineering leaders who successfully develop commercially viable products and services, create efficient operating processes, manage profitable organizations, and transform companies into industry leaders.

01006517 LEAN STARTUP AND AGILE BUSSINESS 4 (4-0-8)
 PREREQUISITE: NONE

This course covers the basic principles of lean startup and agile business practice. Students will learn how to create an innovation accounting system to build products that meets customer demands; find the easiest and fastest ways to build minimum viable products to reduce time-to-market; learn tactics for improvement and measure customers' needs such as experimenting landing pages, A/B tests, MVPs on real customers; study how to implement an agile culture in business environments and learn how to develop business structures in order to keep the business functioning on constantly-moving units.

A.5 HUMANITY AND SOCIAL SCIENCE ELECTIVES

01006502 PROFESSIONAL ETHICS 3 (3-0-6)
 PREREQUISITE: NONE

This course introduces the theory and the practice of professional and engineering ethics, including code of conducts and regulations in academic, professional and technical fields. Students also learn about different approaches to ethical problems and examine real-life case studies, drawn from a variety of professional contexts. This course helps students develop skills and knowledge to manage and engage with ethical issues in their working lives.

01006503 INTRODUCTION TO PSYCHOLOGY 3 (3-0-6)
 PREREQUISITE: NONE

This course introduces a broad survey of psychological science including: sensation and perception; learning, memory, intelligence, language, and cognition; emotions and motivation; development, personality, health and illness, and social behavior. Students will study and discuss relations between the brain, behavior, and experience as well as learning the process of discovering new ideas and empirical results in the field.

01006504 PHILOSOPHY OF SCIENCE 3 (3-0-6)
 PREREQUISITE: NONE

The course provides a study of the thing we call "science", together with its nature and methodology. The topics cover the meaning of science, reality, the nature of scientific observations, scientific theories and their discovery and formation, scientific explanations and predictions, the problem of induction, scientific rationality, the nature of scientific knowledge, concepts of truth, hypothesis testing, hypothesis confirmation, hypothesis falsification, logic of scientific method, and scientific progress.

01006505 CREATIVE THINKING 3 (3-0-6)

PREREQUISITE: NONE

This course explores approaches to "How might we proceed when confronted by problems, situations too ambiguous, complex, or messy or impossible to be addressed directly through logical strategies?" It seeks to increase the participants' understanding of creativity, to improve their creative problem-solving skills and to enhance their ability to promote these skills in others, in a variety of educational settings. Students participate in activities designed to help develop their own creativity, and discuss the creative process from various theoretical perspectives. Readings are on such topics as creative individuals, environments that tend to enhance creative functioning, and related educational issues. Discussions with artists, scientists and others particularly involved in the creative process focus on their techniques, and on ways in which creativity can be nurtured.

01006506 CRITICAL THINKING 3 (3-0-6)

PREREQUISITE: NONE

This course explores issues about the nature and techniques of critical thought, viewed as a way to establish a reliable basis for our claims, beliefs, and attitudes about the world. We explore multiple perspectives, placing established facts, theories, and practices in tension with alternatives to see how things could be otherwise. Views about observation and interpretation, reasoning and inference, valuing and judging, and the production of knowledge in its social context are considered. Special attention is given to translating what is learned into strategies, materials, and interventions for use in students' own educational and professional settings.

01006507 PERSONAL ECONOMICS 3 (3-0-6)

PREREQUISITE: NONE

This course introduces students to the concept of personal economics. Students will learn to apply the economic way of thinking to manage their scarce resources. Employs economic concepts to understand: financial planning and income management; saving and investing; stocks, bonds, and mutual funds; risk-return tradeoff and diversification; interest rates and credit.

01006508 DIGITAL ECONOMY 3 (3-0-6)

PREREQUISITE: NONE

This course will develop and utilize economic principles to better understand and explain the expansion and integration of information and communications technologies into the global economies. It will provide an introduction to concepts and theories useful in analyzing economic aspects of the digital and information technology revolutions.

01006509 ENGINEERING AND PUBLIC POLICY 3 (3-0-6)
 PREREQUISITE: NONE

This course examines the processes of public and private decision making which affects the evolution of a technology. While technology has an important role in shaping today's society, the social forces often plays a central role in the evolution of a technology. This course will study an engineering-related technology and its related policies. Students will discuss the technological and institutional issues, their interaction, the possible need for public policy and the factors that govern the policy.

01006510 INTRODUCTION ECONOMICS 3 (3-0-6)
 PREREQUISITE: NONE

This course gives an overview of economics, covering basic concepts and theories of microeconomics and macroeconomics. Topics in microeconomics studied include demand and supply, price elasticities, consumer behavior theory, production and cost theory, and perfect and imperfect competitions. Macroeconomics topics studied include aggregate demand and supply, macroeconomic data (e.g. gross domestic product, national income, etc.), management of economic growth, inflation problems, unemployment problems, money and banking systems, fiscal and monetary policy, taxation, international trades, and exchange rates.

01006511 THAI SOCIETY AND CULTURE 3 (3-0-6)
 PREREQUISITE: NONE

This course covers a study of Thai social identity and culture, development and inheritance of Thai culture, evolution of Thai society, as well as relation of Thai society and culture to societies and cultures of other countries.

01006512 ASIAN STUDY 3 (3-0-6)
 PREREQUISITE: NONE

This course covers a study of an Asian country's language, social identity and culture. The course will discuss development and evolution of an Asian country, their economic prospect, cultural settings, societies and relations to the society and cultures of other countries.

01006519 INTRODUCTION TO ENVIRONMENTAL PRINCIPLES 3 (3-0-6)
 PREREQUISITE: NONE

This course provides students general principles of environmental engineering and science. Basics of the physical processes involved in the interactions between water, soil, climate, and vegetation. Natural and human activity as it impacts the environment, weather and climate, pollution.

01006520 LEADERSHIP AND PERSONAL DEVELOPMENT 3 (3-0-6)

PREREQUISITE: NONE

This course provides students fundamental skills for success in careers and team environments. The course will cover topics such as goal setting, career Skills, leadership skills, teamwork, effective communication, and public speaking. Learning methods will consist of hands on activities and projects, group work, lecture, discussion, reading, writing, and presenting.

01006521 MEDITATION FOR LIFE DEVELOPMENT 3 (3-0-6)

PREREQUISITE: NONE

This course introduces theory and practice of meditation including : meaning of meditation, objectives, methods, the beginning, process characteristics of reciting and meditating, benefits of meditation, meditation resistances and applying meditation in daily life, meditation as related to education and working purposes, objectives, methods, characteristics of the states of absorption (jhana) and insight knowledge (Nana), fundamental knowledge about insight meditation (Vipassana), differences between foundation meditation (Summata) and insight meditation (Vipassana), layout of foundation meditation (Summata) and insight meditation (Vipassana), insight mediation as related to world population.

01006522 ENGLISH FOR SCIENCE AND TECHNOLOGY 3 (3-0-6)

PREREQUISITE: NONE

This course will help students improve their critical thinking/analytical skills through a combination of reading articles, listening to lectures, and watching audiovisual programs on current hot topics in science and technology. Students will have directed practice in various areas of pronunciation, such as stress, intonation, reductions (i.e. informal speech), linking, consonant and vowel production, rhythm, and pitch. This course will help participants improve their oral presentation skills through an intercultural scientific/technological research project. This course is designed to inspire students to realize the power of R & D (i.e., research and development) in science and technology through studying distinguished entrepreneurs.

B. COMPUTER INNOVATION ENGINEERING

B.1 INTRODUCTORY COURSES

01266111 FUNDAMENTALS OF PROGRAMMING 4(3-3-8)

PREREQUISITE: NONE

This course introduces basic concepts of computer programming such as elementary programming, data types, expressions, simple algorithms and problem solving

involving sequential statements, conditionals and iterations. Students learn routines or methods as fundamental concepts and practice using strings, arrays, lists, maps or dictionaries, pre-defined libraries and classes, abstraction mechanisms and basic object-oriented programming concepts. Students will practice related activities of software development life cycle such as system requirement analysis, debugging, testing and validation.

01266112 INTELLIGENT DEVICES AND DIGITAL SYSTEMS 4(3-3-8)
PREREQUISITE: NONE

This course focuses on the fundamentals of designing and building modern intelligent devices in an application-driven context. The course provides an introduction to core computer engineering topics including digital circuit, signal and system design. Student will learn logic processing, boolean algebra and related applications such as boolean equation, reduction technique, fuzzy logic, logic programming, and logic frameworks. Students will develop and analyze digital circuit design and systems using integrated circuits, microcontrollers and programmable logic devices. The course also includes a substantial group project.

01006700 DISCRETE MATHEMATICS 4 (4-0-8)
PREREQUISITE: NONE

This course covers elementary discrete mathematics for computer science and engineering. It emphasizes mathematical definitions and proofs as well as applicable methods. Topics include formal logic notation, proof methods; induction, well-ordering; sets, relations; elementary graph theory; integer congruence; asymptotic notation and growth of functions; permutations and combinations, counting principles; discrete probability. Further selected topics may also be covered, such as recursive definition and structural induction; state machines and invariants; recurrences; generating functions.

B.2 SCIENCE AND MATHEMATICS FOR ENGINEERING

01006701 MATHEMATICS OF DATA SCIENCE 4 (4-0-8)
PREREQUISITE: NONE

This is a mathematical course designed for students with an interest in pursuing theoretical aspects of algorithms that aim to extract information from data. Covered topics include: Principal Component Analysis (PCA); Manifold Learning and Diffusion Maps; Semi-supervised Learning; Spectral Clustering; Concentration of Measure and tail bounds in probability; Dimension reduction; Compressed Sensing / Sparse Recovery; Group Testing; Approximation algorithms; Clustering.

01006702 PHYSICS I 4 (3-3-8)

PREREQUISITE: NONE

This course covers basic physics and mechanics including a study of motion, space and time, kinematics, Newton's law of motion, forces, energy and momentum, work, power, conservation laws, systems of particles, linear momentum, circular motion, rotation, torques, harmonic oscillation and gravitation.

01006703 PHYSICS II 4 (3-3-8)

PREREQUISITE: 01006702 PHYSICS I

This course provides the physical science required to analyze electrical and electronic devices. Covered topics include electrostatics and electromagnetics, electric field and potential, conductors, insulators, capacitors, dielectrics, electric current, electric circuits, magnetic fields and electromagnetism.

01006704 LINEAR ALGEBRA 4 (4-0-8)

PREREQUISITE: NONE

Topics include matrices, determinants, vector spaces, eigenvalues and eigenvectors, orthogonality and inner product spaces; applications include brief introductions to difference equations, Markov chains, and systems of linear ordinary differential equations. It may include computer use in solving problems.

01006705 NUMERICAL METHODS 4 (4-0-8)

PREREQUISITE: NONE

The course covers root finding, solving systems of linear equations, interpolation, least squares, numerical integration and differentiation, and solving systems of differential equations. Students may have learned some techniques in calculus to approximate an area with a Riemann integral or to approximate a function with a Taylor Series.

01006706 OPERATIONS RESEARCH 4 (4-0-8)

PREREQUISITE: NONE

This course provides an introduction to operation research and their applications for decision making. The course will emphasize the applications rather than the details of methodology. Covered topics include decision analysis, fundamentals of discrete probability, continuous probability distributions and their applications, statistical sampling, simulation modeling, regression models, linear optimization, nonlinear optimization and discrete optimization. Students will be exposed to a variety of applications that can be addressed using Operation Research techniques.

01006707 BIOLOGY 4 (3-3-8)

PREREQUISITE: NONE

This course provides the basis for further studies in biochemistry, cell biology, genetics and molecular biology. Students will gain the knowledge of the chemical principles underlying biological processes and cell structures as well as the analysis of genetics and heredity from a molecular perspective. Subject matter includes evolution, cellular processes energy and communication, genetics, information transfer, ecology, and interactions.

01006708 CHEMISTRY 4 (3-3-8)

PREREQUISITE: NONE

This course provides a study of fundamental principles of chemistry and its applications. The subject matter includes principles of atomic structure, intermolecular forces and bonding, chemical reactions, kinetics, thermodynamics, and equilibrium. Relevant examples will be drawn from such areas as environmental, materials, and biological chemistry.

01006709 PROBABILITY AND STATISTICS 4 (4-0-8)

PREREQUISITE: NONE

This course provides an introduction to fundamental tools of stochastic analysis. Probability, conditional probability; Bayes Theorem; random variables and transforms; independence; Bernoulli trials. Statistics, inference from limited data; outcomes of repeated experiments; applications to design; assessment of relative frequency and probability; law of large numbers; precision of measurements. Elements of stochastic processes, Poisson processes; Markov chains.

01006710 INTRODUCTION TO CALCULUS 3 (3-0-6)

PREREQUISITE: NONE

Function, Limit, Continuity and their applications, Mathematical induction, Introduction to derivative, Differentiation, Applications of derivative, Definite integrals, Antiderivative integration, Application of definite integral, Indeterminate forms, Improper integrals, Numerical integration, Sequences and series of numbers, Taylor series expansions of elementary functions vector analysis.

01006711 ADVANCED CALCULUS 3 (3-0-6)

PREREQUISITE: 01006710 INTRODUCTION TO CALCULUS

Functions of several variables and their applications, Vector algebra in three dimensions, Polar coordinates, Calculus of real - valued functions of two variables, Differentiation and integration of real - valued and vector - valued functions of multiple real variables, Introduction to line integrals, Lines, planes and surfaces in three-dimensional space, Calculus of real - valued functions in three-dimensional space, Principal theory for

applications such as Green's theorem, divergence theorem, Gauss theorem, Stokes theorem, etc.

01006713 MATHEMATICAL CRYPTOGRAPHY 4 (4-0-8)
PREREQUISITE: NONE

This is an advanced undergraduate course that provides a self-contained introduction to modern cryptography, with an emphasis on the mathematics behind the theory of public key cryptosystems and digital signature schemes. The course will focus on developing the mathematical tools needed for the construction and security analysis of diverse cryptosystems. Key topics include: classical cryptographic constructions, such as Diffie-Hellmann key exchange, discrete logarithm-based cryptosystems, the RSA cryptosystem, and digital signatures; fundamental mathematical tools for cryptography, including primality testing, factorization algorithms, probability theory, information theory, and collision algorithms; an in-depth treatment of important recent cryptographic innovations, such as elliptic curves, elliptic curve and pairing-based cryptography, lattices, lattice-based cryptography, and the NTRU cryptosystem.

01006714 MATHEMATICS FOR 3D GAME AND COMPUTER GRAPHICS 4 (4-0-8)
PREREQUISITE: NONE

This course provides the mathematical concepts that a developer needs to develop 3D computer graphics and game engines. Key topics include vectors; matrices; transforms; 3D geometry; ray tracing; lighting and shading; illumination; polygonal techniques; visibility determination; curves and surfaces; fluid and cloth simulation.

B.3 FOUNDATION COURSES

01266211 PRINCIPLES OF COMPUTATION AND APPLICATIONS 4(3-3-8)
PREREQUISITE: NONE

This course introduces fundamental programming concepts and problem-solving techniques that promote computational thinking skills. Theoretical foundations and practical applications of classical and parallel data structures and algorithms are explored. Program performance characteristics and complexity analysis are also covered. Students will spend a considerable amount of time writing programs to implement the concepts covered in the course.

01266212 CYBER-PHYSICAL SYSTEM DESIGN 4(3-3-8)
PREREQUISITE: NONE

This course introduces students to the design and analysis of cyber-physical systems -- computational devices and systems that integrate with physical processes for applications such as medical devices, consumer electronics, automotive systems, critical infrastructure control and robotics control. Students will learn about fundamental

architecture of embedded systems. Basic topics include computer arithmetic, memory, system bus, I/O, microcontroller and microprocessor design. Students also study the interactions between computer systems and physical dynamics including interfacing with physical environments, distributed communications, real-time control, energy conservation, safety and reliability. The course also includes a substantial group project.

01266213 COMPUTER SYSTEMS 4(3-3-8)
PREREQUISITE: NONE

This course provides a programmer's and designer's view of computer systems. Students will study how computer systems execute programs, store information, and communicate. It enables students to become more effective in dealing with issues of performance, portability and robustness. The course helps students understand the foundations and key concepts of computer systems such as compilers, networks and operating systems. Topics covered include: machine-level code and its generation, performance evaluation and optimization, exceptions and processes, scheduling and context-switching, memory organization and management, network programming, and supporting concurrent computation. The course also includes a substantial group project.

01266214 INFORMATION NETWORK AND CYBER SECURITY 4(3-3-8)
PREREQUISITE: NONE

This course covers the topics of computer networking and cyber security. Students will learn about principle of computer networking such as OSI model, networking standards, protocols, network services, network devices, network design, cyber security concepts, network attack, cybercrime, network management procedure, network protection technique, laws, and security standard e.g. ISO/IEC 27000

01266215 DATABASE TECHNOLOGY 4(3-3-8)
PREREQUISITE: NONE

Databases underlie technology used by most software system or electronic device that maintains persistent information. This course will provide a study of database systems and the properties that make them exceptionally useful and convenient: reliability, efficiency, scalability, concurrency control, data abstractions, and high-level query languages. Students will learn about the principles of database systems as well as emerging approaches in database technology and persistence techniques; including relational and non-relational databases, in-memory and distributed database systems.

B.4 INTEGRATED INNOVATION COURSES

01266311 ELEMENTS OF SOFTWARE CONSTRUCTION 4(3-3-8)
PREREQUISITE: NONE

This course introduces fundamental principles and techniques used to construct modern production-grade software. Students learn how to implement software that is safe from bugs, easy to understand, and ready for change. Topics include agile software development process, problem analysis, UML, software architecture and design, continuous integration and delivery, dependency management, design patterns and persistence. The course also includes a substantial group design project.

01266312 CLOUD COMPUTING 4(3-3-8)
PREREQUISITE: NONE

This course gives students an overview of Cloud Computing, its enabling technologies and hands-on experience from public and private cloud infrastructure. The course covers the topics of data centers, virtualization, infrastructure, platform, and programming models. The course will discuss the motivating factors, benefits, challenges, and service models; including the concepts behind software-defined infrastructure design and management. Students will explore virtualization and resource isolation technique for offering software, computation, network and storage services. Students will also be introduced to existing cloud platform, programming models and patterns for cloud native applications.

01266313 INTERNET OF THINGS AND SMART SYSTEMS 4(3-3-8)
PREREQUISITE: NONE

This course covers the topics of smart things network and communication: architectures, services and protocols; privacy and security; enabling technologies of IoT; IoT and smart system applications: smart cities, smart energy, smart transportation and mobility, smart home and building, smart factory and manufacturing, smart health and up-to-date applications; smart things networks for data management; IoT related standardization. The course also includes a substantial group design project.

01266314 DATA ANALYTICS 4(3-3-8)
PREREQUISITE: NONE

This course is designed to provide students the basic techniques of data science, that included prominent algorithms used to mine data (e.g., clustering and association rule mining), and basic statistical modeling (e.g., linear and nonlinear regression). The course is targeted towards individuals who would like to know the practices used and the potential use of large scale data analytics.

01266512 COMPUTER INNOVATION ENGINEERING CAPSTONE DESIGN 4(3-3-8)
PREREQUISITE: 01266511 CAPSTONE DESIGN PREPARATION
OR 01006301 COOPERATIVE EDUCATION
OR 01006302 STUDY ABROAD

This course consists of open-ended design projects that incorporate fundamental and advanced concepts in Computer Innovation Engineering. Students will analyze, design and implement innovative prototypes which require application of standards and realistic engineering constraints. Students from alternative study programs can extend their work from the alternative study programs. Each team of 1 to 4 students must design and implement a prototype of the proposed innovation. Measurements, simulations, and/or characterization of the proposed solution is performed so as to demonstrate that the design objectives and specifications have been met. The final design reports must address issues, as appropriate, that are related to engineering economics, commercialization, manufacturability, environmental, social issues, ethics, and health and safety. Each team must prepare and deliver oral presentations and demonstrations of their design prototype.

B.5 CIE ELECTIVE

01266401 STARTUP ENGINEERING 4(3-3-8)
PREREQUISITE: NONE

This course bridges the gap between academic and production software engineering. The course provides fast-paced introduction to key tools and techniques used in successful startups and large-scale projects: command line, dotfiles, text editor, distributed version control, debugging, testing, documentation, reading code, deployments. Students will learn to build a command line application, expose it as a web service, and then link with other students' applications and services to build a HTML5 mobile/web application. General principles are illustrated through modern Javascript and the latest web technologies.

01266402 MOBILE APPLICATION DEVELOPMENT 4(3-3-8)
PREREQUISITE: NONE

This course provides a study of application development for mobile devices. The course will cover the tools and frameworks required to develop applications for current and emerging mobile computing devices. Students will learn about the various constraints facing mobile application designers, with respect to hardware and user expectation. Students will also learn how to address these constraints with techniques in implementation, software design, and user-interaction design. Additionally, students will also learn about core concepts of modern mobile computing, such as software distribution models and location awareness.

01266403 USER EXPERIENCE AND USER INTERFACE DESIGN 4(3-3-8)
PREREQUISITE: NONE

This course is designed to guide students through the elements of user experience and visual design principles. Students will study relationships between design

and user that must exist to create a valuable user experience. This course will help students build prototype for the user experience and test the design, while learning why designing for the user experience is critical. Students will understand the research process before starting a design, including identifying what the business goals are and what the users' needs are. Following the strategy process, students learn to create wireframes, prototype applications or website, test the design, and explore the surface as the user. Students will discover the elements of user experience; know how to develop content requirements; be able to create an effective, informative design; and know existing resources available to assist with the UX design process.

01266404 HUMAN COMPUTER INTERACTION 4(3-3-8)
 PREREQUISITE: NONE

The study of human-computer interaction enables system architects to design useful, efficient, and enjoyable computer interfaces. This course provides a study of the theory, design procedure, and programming practices behind effective human interaction with computers. Students will learn about interaction design, implementation, and evaluation. The design process requires a solid understanding of the theory behind successful human-computer interaction and the usability engineering process. The course will discuss specific interface success stories and spectacular failures to learn from past experiences. Students will apply their knowledge in a series of practical assignments and labs that highlight selected portions of the design cycle, as well as familiarize them with programming practices, tools and effective techniques to create successful user interfaces.

01266405 PRODUCT DESIGN STUDIO 4(3-3-8)
 PREREQUISITE: NONE

This course helps students understand how to design better products which make people lives and their interactions with products easier and more satisfying. Students will observe and analyze interactions to make them human-scale and relatable on an individual level. Techniques of user observation will be practiced and analyzed for efficacy in defining concrete, human-scale problems. Sketching, model making and prototyping with computer-aided design tools and technologies such as 3D-printing and modeling will be introduced and practiced to display and analyze possible effectiveness of the design solution.

01266406 IoT DEVICE DESIGN 4(3-3-8)
 PREREQUISITE: NONE

This course explores how physical devices in the real world communicate and transfer information to smart-device processors, such as smartphones and IoT gateway. Students will learn to interface common sensors and actuators on physical devices.

Students then develop methods to acquire and process sensory data in mobile-enabled devices. The data may come from actuators, such as stepper motors, and LEDs, with various rates, depending on types of sensors. Therefore, students also learn how to sample the information as well as apply both analog-to-digital and digital-to-analog conversion concepts.

01266407 DATA VISUALIZATION 4(3-3-8)
PREREQUISITE: NONE

This course will discuss techniques and algorithms for creating effective visualizations based on principles from graphic design, visual art, perceptual psychology, and cognitive science. The course discusses techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction. Students will gain exposure to a number of common data domains and corresponding analysis tasks, including multivariate data, networks, text and cartography. Students will learn to evaluate and use visualization in their own work as well as build better visualization tools and systems thru hands-on labs, programming and data analysis assignments.

01266408 MULTIMEDIA DATABASES AND DATA MINING 4(3-3-8)
PREREQUISITE: NONE

The course covers advanced algorithms for learning, analysis and data management of large multimedia datasets. Topics include indexing for text and media databases, searching multimedia databases by content, fundamental signal processing methods, compression, fractals in databases, data mining, privacy and security issues, rule discovery, graph and stream mining.

01266409 SOCIAL NETWORK ANALYSIS 4(3-3-8)
PREREQUISITE: NONE

This course will introduce students to social network analysis, both its theory and computational tools to comprehend the social and information networks that have been fueled and accessible by the internet. Topics include network graph, random network models, network centrality, network formation and search, contagion, opinion formation and coordination. Students will apply social network analysis to existing online social networks and discover new applications.

01266410 COGNITIVE COMPUTING APPLICATIONS 4(3-3-8)
PREREQUISITE: NONE

This course provides an introduction to computational modeling of cognition which combines artificial intelligence and machine learning in an approach to mimic the brain's behavior. The course covers pattern recognition, knowledge representations, revision,

concept learning, explanation-based learning. We will discuss common tasks such as classification, diagnosis and advanced topics such as analogical reasoning, visual reasoning and meta-reasoning. The course will focus on cognitive computing application in several key areas including visual perception and attention, object and face recognition, learning and memory as well as decision-making and reasoning. Students will learn to train and use existing cognitive computing platform in order to solve real world applications.

01266411 ENTERPRISE SYSTEM DESIGN AND IMPLEMENTATION 4(3-3-8)
PREREQUISITE: NONE

This course provides hands-on instruction and practice planning, designing and deploying a modern enterprise system and infrastructure. The course covers designing, planning, deploying, securing, monitoring, automating, and virtualizing enterprise systems. The course covers the knowledge and skills needed to provide an enterprise solution that supports automated deployment to physical and virtual environment, including the supporting file and storage services; networking solutions such as DHCP, DNS, VPN and domain infrastructure; design service integrations; continuous integration; scalability and security controls for distributed services.

01266412 SOFTWARE-DEFINED DATA CENTER 4(3-3-8)
PREREQUISITE: NONE

This course provides an introduction to the concepts and applications of software defined data center (SDDC). Students will explore the software-defined approach to manage data centers and workload deployment. The course will discuss the challenges and implementations of SDDC which combine compute, storage, network and related data center resources in order to create logical applications. Covered topics include data center abstractions, virtualization, software-defined storage and networking, orchestration, automated approach to workload deployment and policy management.

01266413 SOFTWARE-DEFINED NETWORKING 4(3-3-8)
PREREQUISITE: NONE

This course provides the study of software-defined networking (SDN) and how it is changing the way communications networks are managed, maintained and secured. By abstracts networking infrastructure away from the actual physical equipment, SDN allows administrators to maintain the networking environment across multiple vendors and hardware, operating systems and versions. Students will learn the concept of SDN; control and data plane separation; network function virtualization and related protocols. Students will gain understanding of how to incorporate SDN into network operations and gains exposure to the tools, methodologies, and processes that can be employed to applications running on SDN fabrics.

01266414 WIRELESS SENSOR NETWORK 4(3-3-8)
PREREQUISITE: NONE

This course covers fundamentals of wireless network technology and distributed sensor networks. Students will also study the design of low power sensors, which collect information and pass the information via wireless networks for monitoring and control applications. Students will learn about the applications in areas such as environmental monitoring, smart energy systems, field surveillance, home automation and medical monitoring.

01266415 LOCATION-BASED TECHNOLOGY AND SERVICE 4(3-3-8)
PREREQUISITE: NONE

This course covers the topics of introduction to location awareness and survey applications, positioning and tracking principles, geolocation infrastructure, location based services (LBS), navigation and tracking system and services, a selection of emerging application possible through LBIS and security and privacy in LBIS. The students are encouraged to initiate the project related in location based technology such as application and service development on mobile devices, implementation of localization systems, etc.

01266416 IT SYSTEM MANAGEMENT 4(3-3-8)
PREREQUISITE: NONE

This course provides a study of information technology system management. Topics include the organization of IT system, ethics, legislation, outsourcing, product acceptance, ITIL process, Availability, performance tuning, change management, problem management, storage management, network management, capacity planning, security and business continuity.

01266417 IT PROJECT MANAGEMENT 4(3-3-8)
PREREQUISITE: NONE

This course addresses the subject of IT Project Management. We will study the project management from the perspective of a manager. The course will introduce tools and templates available to a Project Manager and how these tools can be used to manage a project and give a view of the project or project portfolio to the senior management. We will discuss the demands made on the Project Manager. We also look at common challenges that managers would face, such as cost overruns or project takes longer time than expected. The in-class learning is supplemented with simulations exercises during the course. The course will also cover several case studies to study how to measure a project in the business sense and will touch on some the business tradeoffs that a project management team.

01266418 INFORMATION SECURITY MANAGEMENT 4(3-3-8)

PREREQUISITE: NONE

This course explores the latest techniques for securing information and its systems, from policies and procedures to technologies and audit. Students will learn about information security management system which preserves the confidentiality, integrity and availability of information. Students will apply a risk management process and study requirements for establishing, implementing, maintaining and continually improving information security management system. Topics include information security organization and policy, human resource security, asset management, access control, cryptography, physical and environmental security, operations security, communications security, system acquisition, development and maintenance, supplier relationships, incident management, business continuity, regulatory and compliance.

01266419 ENTERPRISE NETWORK SECURITY 4(3-3-8)

PREREQUISITE: NONE

This course provides the study of enterprise network security. Covered topics include general security concepts, cryptographic methods, common threats and vulnerabilities, secure network devices and infrastructures (e.g. firewall, UTM, IDS, IPS), secure network administration principles and design elements (e.g. segmentation, layered security), network security tools, identity management and federations, public key infrastructure and certificate management, web application security, related protocols and services, wireless network security, compliance and operational security standards, ethics and laws related to enterprise network security.

01266420 CYBER THREATS AND DIGITAL FORENSICS 4(3-3-8)

PREREQUISITE: NONE

This course will address methods to properly conduct a computer and/or network forensics investigation including digital evidence collection and evaluation and legal issues involved in network forensics. Technical issues in acquiring court-admissible chains of evidence using various forensic tools that reconstruct criminally liable actions at the physical and logical levels are also addressed. Technical topics covered include detailed analysis of hard disks, files systems (including FAT, NTFS and EXT), and removable storage media; mechanisms for hiding and detecting hidden information; and the hands-on use of powerful forensic analysis tools.

01266424 BLOCKCHAIN TECHNOLOGIES 4(3-3-8)

PREREQUISITE: NONE

This course discusses the underlying technology for blockchain such as Bitcoin, Ethereum and its applications. We will study how does blockchain, cryptocurrency,

and smart contract work and what makes it difference. Issues such as anonymities and securities will also be addressed. Student will learn the required concepts to engineer secure software that interacts with the blockchain network. Student will be able to integrate ideas from blockchain technology into their own projects.

01266422 MICROCONTROLLER DESIGN AND SYSTEM ON CHIP 4(3-3-8)

PREREQUISITE: NONE

This course explores the design of System on Chip applications. Students will study, design, debug, and construct several systems that illustrate the design of embedded processors with custom peripherals running a real-time operating system. Students will be introduced to examples, description of specific module design, instructions and the operations of the hardware, such as microcontroller and FPGA, and high-level design tools.

01266423 FUNDAMENTALS OF AR, VR AND MIXED REALITY 4(3-3-8)

PREREQUISITE: NONE

This course explores the emerging technologies that fuel the frontier of design, interaction and software development using augmented reality, virtual reality and mixed reality. Students will learn the fundamentals of design and experience in the context of virtual/augmented/mixed reality, storytelling and content creation. Students will work with standard virtual reality framework, learn about design and existing constraints, implement projects to create immersive environments for users and potential applications.

B.6 ALTERNATIVE STUDY PROGRAMS

01266511 CAPSTONE DESIGN PREPARATION 6(3-6-12)

PREREQUISITE: NONE

This course instructs and prepare students in aspects of effective technical oral presentations through exposure to different workplace communication skills. As preparation and research for the capstone design, students must develop topics, identify a supervisor, and prepare a proposal for an oral presentation. The design must incorporate fundamental and advanced concepts in Computer Innovation Engineering. Each team of 2 to 4 students will propose innovative design projects which require application of standards and realistic engineering constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. Each team must prepare and deliver oral presentations describing their analysis of the problems, the proposed innovation and the design process.

01006301 COOPERATIVE EDUCATION 6 (0-45-0)

PREREQUISITE: NONE

This course demands the student to work in an innovative company or a government/private organization, which is approved by the program committee for working on an innovative project for at least 16 weeks. The work of the student is under supervision of a faculty member, who is regarded as the student's supervisor. The student must report progress to the supervisor regularly. Upon completion, the student must prepare and deliver oral presentations describing the work from the program.

01006302 STUDY ABROAD 6 (6-0-12)
PREREQUISITE: NONE

This course is reserved for students who participate in the study abroad program. Upon the completion of the program, the students must prepare and deliver oral presentations describing their experience from the program.