FACULTY OF ENGINEERING

Faculty Language Requirement

A. Applicable to S7 entrants

1. English

All Engineering Major students are required to complete ELT1111 Technical Communications.

2. Chinese

Engineering Major students exempted from the Chinese language requirement for admission by the Senate are required to complete, as determined by the Major Department (by a small group convened by the Associate Pro-Vice-Chancellor and Registrar from 2006-07 onwards):

(i) 3 units of Chinese, OR
(ii) 3 or 6 units of Elementary Chinese, OR
(iii) 3 units of Chinese or Elementary Chinese and 3 units of Cantonese, OR
(iv) 3 units of Chinese or Elementary Chinese and 3 units of Putonghua.

The courses for selection are as follows:

Elementary Chinese	
CHI1210	University Elementary Chinese
CHI1530	Oral Communication Skills
Chinese	
CHI1510	Business Chinese
CHI1520	Chinese for Executives
CHI1586	Creative Writing in Chinese
Cantonese	
CAN2013	Cantonese
CAN3013	Intermediate Cantonese
Putonghua	
PTH1001	Putonghua I (1 unit)
PTH2001	Putonghua II (1 unit)
PTH2003	Elementary Putonghua
PTH3001	Putonghua III (1 unit)
PTH3031	Putonghua in Current Affairs (1 unit)

Note: The above courses are 3-unit courses, unless otherwise specified.

B. Applicable to S6 entrants

1. Expository Writing

All Engineering Major students are required to complete *ELT2452 Expository Writing or ELT2456 Expository Writing (ERG/MED/SCI).

2. English

All Engineering Major students are required to complete ELT1111 Technical Communications and another 3 or 4 units of English elective course(s) from the following list:

ELT1004	Virtual Overseas Summer Camp for Engineering Undergraduates (1 unit)
ELT2201	Listening and Response
ELT2392	Reading Short Stories
ELT2500	Improving Pronunciation
ELT2501	Effective Oral Communication I
ELT3103	English Through Current Affairs and Issues
ELT3112	Business Communication
ELT3402	Academic Writing II
ELT3501	Effective Oral Communication II

3. Chinese

(i) All Engineering Major students, including mainland students proficient in Cantonese but excluding those in (ii) and (iii) below, are required to complete one of the following courses:

CHI1510	Business Chinese
CHI1520	Chinese for Executives
CHI1586	Creative Writing in Chinese
CHI1814	Professional Chinese (ERG & SCI)

(ii) Mainland students not proficient in Cantonese are required to complete 3 units of Chinese and 3 units of Cantonese. The courses for selection are as follows:

Chinese

CHI1510	Business Chinese
CHI1520	Chinese for Executives
CHI1586	Creative Writing in Chinese
CHI1814	Professional Chinese (ERG & SCI)

Cantonese

CAN2013	Cantonese
CAN3013	Intermediate Cantonese

(iii) Engineering Major students exempted from the Chinese language requirement for admission by the Senate are required to complete, as determined by the Major Department (by a small group convened by the Associate Pro-Vice-Chancellor and Registrar from 2006-07 onwards), 6 to 12 units of Chinese, Elementary Chinese, Cantonese or Putonghua. The courses for selection are as follows:

Elementary Chinese

CHI1210	University Elementary Chinese
CHI1530	Oral Communication Skills

* *Course offered in 2006-07 and before.*

Chinese	
CHI1510	Business Chinese
CHI1520	Chinese for Executives
CHI1586	Creative Writing in Chinese
CHI1814	Professional Chinese (ERG & SCI)
Cantonese	
CAN2013	Cantonese
CAN3013	Intermediate Cantonese
Putonghua	
PTH1001	Putonghua I (1 unit)
PTH2001	Putonghua II (1 unit)
PTH2003	Elementary Putonghua
PTH3001	Putonghua III (1 unit)
PTH3031	Putonghua in Current Affairs (1 unit)

Note: The above courses are 3-unit courses, unless otherwise specified.

Major/Faculty Requirement for S6 Entrants

All Engineering Major students are required to complete 9 units of courses from the following list to fulfil the Major/Faculty requirement for S6 entrants:

A. Applicable to students admitted in 2005-06 and thereafter

(i) ERG1010 Engineering Electronics
(ii) MAT1110 University Mathematics for Engineering
(iii) PHY1001 General Physics I
(iv) 3 units of any Engineering Faculty course(s) subject to the approval of the Major Department/academic adviser.

B. Applicable to students admitted in 2004-05

(i) ERG1010 Engineering Electronics
(ii) MAT1110 University Mathematics for Engineering
(iii) PHY1001 General Physics I

Faculty Enrichment Scheme for Engineering Undergraduates

This Scheme is targeted at students in the Faculty of Engineering who are keen on doing research and who may be planning to pursue further study on a research-oriented programme upon graduation. The Scheme aims to enrich the curriculum with additional courses which will strengthen the students' research techniques.

Requirement for Entering this Scheme

Students with an overall cumulative GPA of at least 3.3, or with the permission of the Faculty, may apply to join the Enrichment Scheme after their second term of attendance.

Study Requirements

Besides fulfilling the programme requirements of their Majors, the students enrolling in this Scheme are also required to complete the following:

(1) Required Courses (Note 1):
ERG2900, 3910, 3920

(2) Other Requirements:
Students are also required to:
- (a) complete at least 6 units of the postgraduate courses at 5000 and above level in the Faculty of Engineering which are open to undergraduates (Note 2);
- (b) obtain Grade B or above in the final year project of their Major Programme (Note 3);
- (c) obtain Grade B+ or above in both ERG3910 and 3920; and
- (d) obtain a Major GPA of at least 3.3 on graduation.

Notes:
1. ERG3910 and 3920 must be completed before the commencement of ERG4910, ACE3910, CSC4010 and INE3910.
2. The postgraduate courses at 5000 and above level offered by the Faculty taken by the students in their Major programmes or as free electives can also be counted towards the fulfilment of the postgraduate course requirement of the Enrichment Programme.
3. Depending on the Major Programme of the students, final year projects refer to ERG4910/4920, ACE3910/3920, CSC4010/4020, and INE3910/3920. Students must obtain Grade B or above in both courses.

ERG Coded Courses

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

ERG1010
Engineering Electronics
This course introduces the basic foundations of electronics and is suitable for Secondary six entrants in engineering and science. Introduction: review historical developments in electronics, electric current and potential, Ohm's law, Kirchoff's circuit laws applied to resistor networks; Electrostatics: electric field, Coulomb's Law, capacitors, electrical reactance, examples of electrostatic devices and machines; Magnetism and magnetic force on moving charges: Ampere's Law, Biot-Savart Law, cyclotron, Hall effect; Electromagnetism: Faraday's law, inductance, transformers; resonant circuits; Examples of electromagnetic devices and machines: sensors and actuators, motors, power generators and three phase power transmission. Introduction to electronic instrumentation and measurement circuits.

ERG1800
Modern Information Technology
2 U; 2 Lect. 1 Tut.
This course introduces the latest information technology to students of all disciplines. The objective is to enable the students to comprehend the extensive and rapidly changing information technology knowledge at an executive level. Topics will include, but not limited to, microprocessors, software, computer graphics, multimedia, Internet, electronic commerce, electronic publishing, etc. (Not for Engineering Faculty students.)

ERG1810
Engineering Laboratory I
1 U; 4 Lab.

ERG2011
Advanced Engineering Mathematics (Syllabus A)
Vector calculus: vector space; grad, div and curl; curvilinear coordinates; line and surface integrals; Green's theorem, divergence theorem, and Stoke's theorem. First order differential equations: linear, separable, exact and homogeneous equations; existence and uniqueness of solutions. Second order differential equations: linear independence; reduction of order; homogeneous equations; nonhomogeneous problem; series solutions. Partial differential equations: wave equation. Properties of Laplace transform and convolution integral. Fourier series, even and odd functions, Fourier transform and its properties.

ERG2012
Advanced Engineering Mathematics (Syllabus B)
Complex variables: complex number, analytic functions, complex functions, power series and convergence tests. Linear algebra: matrices, systems of linear equations and solutions, determinants and rank, eigenvalues and eigenvectors. Numerical integration and differentiation, numerical methods in linear algebra. Basic concept in probability and statistics.

ERG2013
Advanced Engineering Mathematics (Syllabus C)
Vector calculus: grad, double integrals, Jacobian. First order differential equations: partial differentiation, separable, exact and linear equations, integrating factors, existence and uniqueness of solutions. Second order differential equations: homogeneous and nonhomogeneous linear equations with constant coefficients, solution by undetermined coefficients, modelling of mechanical and electrical systems. Series: power series, Taylor series, convergence tests. Linear algebra: linear system of equations, rank, Cramer's rule, eigenvalues, eigenvectors, orthogonal matrices, diagonalization, vector space, inner product space, linear transformation. Numerical examples. (For Information Engineering Majors only and not for students who have taken ERG2011 or 2012.)

ERG2014
Advanced Engineering Mathematics (Syllabus D)
Linear algebra: vector spaces and subspaces; linear transformations and their matrix representations; eigenvalues and eigenvectors; symmetric and orthogonal matrices; systems of linear equations and their solutions; least-square approximation and singular value decomposition. Multivariable calculus: partial derivatives; differential, Jacobian matrix; 3-D vector space and algebra, scalar and vector fields; path integrals, double integrals, triple and surface integrals; Grad, Div, Curl; Green's theorem, Gauss's theorem, Stoke's theorem. (For Mechanical and Automation Engineering Majors only.)

ERG2015
Advanced Engineering Mathematics (Syllabus E)
Complex analysis: complex functions; complex differentiation; complex integration. Ordinary differential equations: separable equations; linear first-order equations with constant coefficients; systems of linear differential equatioins; nonhomogeneous equations. Partial differential equations: Fourier series; one-dimensional wave and heat equations; Laplace's equation; Poisson's equation. (For Mechanical and Automation Engineering Majors only.)

ERG2018
Advanced Engineering Mathematics (Syllabus H)
Calculus of several variables: partial derivatives, Jacobian matrices, chain rule. Linear algebra: matrices, inverses, vector spaces, basis and dimension, linear independence. Linear transformations: projection, orthogonality, systems of linear equations, Gaussian elimination, LU decomposition, eigenvalues and eigenvectors.

ERG2020
Digital Logic and Systems
Digital concepts; number systems; operations and codes; logic gates; Boolean algebra and logic simplification; combinational logic; functions of combinational logic; flip-flops and related devices; counters; finite state machines; programmable logic devices - programming and sequential logic applications; memory and storage; integrated circuit technologies. (Not for students who have taken ELE2120.)

ERG2030
Signals and Systems
Classification of signals. Linear time-invariant systems. Convolution. Sampling. Fourier series, discrete Fourier series and DFT. Continuous-time and discrete-time Fourier transforms. Laplace transform and its applications. State space representation. Stability and linear feedback. Introduction to z-transform.

ERG2040
Probability Models and Applications
Fundamental probability concepts. Functions of random variables. Conditional probability. Bayes' Theorem. Characteristic functions. Limit theorems. Markov chain. Applications.

ERG2310
Principles of Communication Systems
Review of linear system theory and probability. Analog modulations. Sampling and quantization. Baseband modulations. Passband modulations. Multiplexing methods. Noise and performance analysis. Introduction to error control coding. Case studies of communication systems.

ERG2810
Engineering Laboratory II
1 U; 4 Lab.

ERG2900
Engineering Colloquium
1 U; 2 STOT
Small group discussions on selected topics in Engineering. (This course is offered to students of the Faculty Enrichment Scheme for Engineering Undergraduates only.)

ERG3810
Product Development Project
1 U; 4 Lab.

ERG3820
Software Engineering Practice
2 U; 2 Lect. 1 Lab.
Introduction to software engineering principle. Software lifecycles: system modelling; requirement analysis and specifications; preliminary and detailed designs; implementation and testing; operation and maintenance. Software and system interface: design criteria; system integration; verification and validation; reliability and performance. Software tools and practice: application of CASE tools; documentation; communication skills; software project management. Prerequisite: CSC1110 or 1111 or 1500 or ERG1210. (Not for Computer Science and Computer Engineering Majors and students who have taken CSC3100 or IEG3080.)

ERG3910
Research Methodology
1 U; 1 Lect.
This course introduces the concepts of scholarly research, research methodologies, as well as current research developments in various research disciplines. Topics to be covered include: the logic of scientific discovery; purpose, nature, and types of scholarly research; research ethics; dissemination of research results; resources and techniques for literature survey; selection of research problem; overview of analytical tools and techniques; authoring of academic research papers; academic presentation; and intellectual property rights and obligations. Students are required to conduct a literature survey on a chosen research topic. (This course is offered to students of the Faculty Enrichment Scheme for Engineering Undergraduates only.)

ERG3920
Undergraduate Research
2 U; 2 STOT
Students will conduct a research study under the supervision of the course instructors. (This course is offered to students of the Faculty Enrichment Scheme for Engineering Undergraduates only.)

ERG4910, 4920
Thesis I, II
4 U each
(Graduation Project as prescribed by ERG4920 will carry a separate weight of 6.79% in honours classification in Electronic Engineering and 10% in honours classification in Information Engineering.)

Computer Engineering

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

CEG2400
Microcomputer Systems
Microcomputer system organization: bus architecture, signals and timing, memory systems. Input/output interfacing methods: polling, interrupt, direct memory access. Assembly language programming: addressing modes, data manipulation and control flow instructions, programme linkage, parameter passing, macros. Peripheral device interfacing and device driver development. Prerequisite: ERG2020.

CEG3150
Principles of System Software
Virtual machines. System supports for programme execution: micro-kernels, interrupts and synchronizations, interprocess communications, memory management, protection, portability, fault tolerance techniques and device drivers. Multi-processor system support. Prerequisite: CSC2100 or 2520.

CEG3420
Computer Design
Design of modern computer systems: performance evaluation, instruction sets, design of arithmetic logic units, datapath and control, pipelining, memory hierarchy, interfacing processors and peripherals, parallel processors. Prerequisite: ERG2020. (Not for students who have taken CSC3420.)

CEG3430
Microprocessing Systems and Applications
3 U; 2 Lect. 1 Tut. 1 Lab.
Introduction to microprocessor system developing methods such as memory and input/ output interfacing techniques. Use of interrupts, timers and analogue to digital conversion methods for hardware system building will also be discussed. Introduction to logic system design methodologies including the use of programming logic devices and hardware description languages. Prerequisite: CEG2400.

CEG3470
Digital Circuits
This course examines the issues involved in designing and analysing digital circuits in CMOS technology. Topics include fabrication process, usage of SPICE, transfer characteristics, noise margin, loading effect, propagation delay, fanout analysis, transient current, power dissipation, bistable circuits and memories. A brief introduction to VLSI circuits is also included. Prerequisites: ERG2020 and ELE2110.

CEG3480
Digital Systems Design
3 U; 2 Lect. 1 Tut. 1 Lab.
Advanced interfacing techniques such as the use of sensors and actuators for signal analysis and control. High speed digital system design issues such as power consumption, signal delay, signal transmission and noise handling. Prerequisite: CEG2400.

CEG3490
VLSI Design
This course teaches techniques in designing and analysing VLSI circuits. Topics include design rules, layout fundamentals, switch-level simulation, charge sharing, static and dynamic logics, propagation-delay estimates, power considerations, data-path organization, clocking schemes, synchronizers, asynchronous circuits, pads, systolic computation, silicon compiler, high-level synthesis and hardware description languages. Students will design complete IC's using both simple hand-layout programmes and CAD tools. Prerequisite: CEG3470.

CEG4430
Distributed Systems and Networks
This course aims to present the fundamental concepts and techniques about the design and construction of distributed systems. Topics to be covered are: models of distributed systems, networking and internetworking, concurrency control and synchronization, distributed programming, distributed operating systems and case studies of networking software. Prerequisite: CSC1110 or 1111 or 1130.

CEG5010
Reconfigurable Computing
3 U; 3 Lect. 1 Tut. 2 Lab.
This course is concerned with the design of reconfigurable computing systems using hardware description languages. Topics covered include field programmable gate array architectures (FPGA), computer arithmetic, high-speed digital logic, interfacing and case studies. Emphasis will be on how to design high-performance digital systems at the algorithmic, system and logic level. Each student is required to implement and test a digital design of moderate complexity. Prerequisite: CEG3480.

CEG5120
Sequential Machines and Automata Theory
Structure of sequential machines, linear sequential machines, state machine testing, information losslessness of finite automata, state-identification and fault-detection experiments, finite-state recognizers, sequential circuit retiming technique, synthesis for combinational and sequential circuits. Prerequisite: ELE2120 or ERG2020 or its equivalent.

CEG5270
CAD for Physical Design of Digital Systems
This course aims to present the fundamental concepts and algorithms applied in design automation (CAD) of VLSI circuits. The scope will include various areas in physical design of digital systems, including circuit partitioning, FPGA technology mapping, floorplanning, placement, routing, compaction and interconnect optimization. Prerequisites: CSC2100 and ERG2020.

CEG5330
Logic Synthesis and Testing
This introductory course aims at building fundamental background and practical techniques for digital logic design automation and hardware testing conscious design issues. Some academic (Berkeley ESPRESSO/SIS) and industry tools will be introduced. The topics range from the classic to recent techniques on representation, manipulation and optimization of Boolean logic, minimization/manipulation of 2-level Sum-of-Product (SOP) form, large multi-level Boolean network synthesis, technology mapping, delay analysis, sequential logic synthesis, state minimization, retiming resynthesis, verification, advanced applications using Ordered Binary Decision Diagrams (OBDD's), hardware fault testing, and notions of design for testability. Prerequisities: CSC2100 and ERG2020.

Study Scheme

1. Major Programme

A. Applicable to students admitted in 2006-07 and thereafter

Students are required to complete a minimum of 78 units of Major courses as follows (Notes):

(i) Required Courses: 60 units
ERG1810, 2011, 2012, 2020, 2310, 2810, 4910#, 4920#, CEG2400, 3150, 3420, 3430, 3470, 4430, CSC1111, 2100, 3190, ELE1110, 2110, 2860, ELT1111

(ii) Elective Courses: 18 units
Select 6 units from the following courses:
CEG3490, 5010, CSC3120, 3640, ELE4410#, IEG4020#, 4160#, 4190#
And select at least 6 units from the following courses:
CSC2800, 3100, 3120, 3170, 3210, 3220, 3250, 3270, 3280, 3290, 4120, 4130, 5150, 5160, 5180, 5240, 5250, 5310, 5320, 5330, 5340, 5350, 5360, 5420, 5430, 5460, 5470, CEG3480, 5120, 5270, 5330; and
any one course from@ (DSE3020, 4070, 4150, 4210, 4250, MKT4080)
Remaining units from any courses offered by the Faculty of Engineering (Except ERG3910 and 3920)

Total: 78 units

Recommended course pattern

Term 1	**Units**	**Term 2**	**Units**	**Term 3**	**Units**
CSC1111	3	CEG2400	3	CEG3150	3
ELE1110	3	CSC2100	3	CEG3430	3
ERG1810	1	ELE2110	3	CEG3470	3
ERG2011	3	ERG2012	3	CSC3190	3
ERG2020	3	ERG2810	1	ELT1111	3
	13		13		15
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
CEG3420	3	ERG4910	4	ERG4920	4
CEG4430	3	Electives	9	Electives	9
ELE2860	2				
ERG2310	3				
	11		13		13

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

@ *Applicable to students admitted in 2007-08 and thereafater only.*

B. Applicable to students admitted in 2005-06

Students are required to complete a minimum of 79 units of Major courses as follows (Notes):

(i) Required Courses: 61 units
ERG1810, 2011, 2012, 2020, 2310, 2810, 4910#, 4920#, CEG2400, 3150, 3420, 3430, 3470, 4430, CSC1130, 1140, 2100, 3640, ELE1110, 2110, 2860, ELT1111

(ii) Elective Courses: 18 units
Select 6 units from the following courses:
CEG3490, 5010, ELE4410#, IEG4020#, 4160#, 4190#
And select at least 6 units from the following courses:
CSC2800, 3100, 3120, 3160, 3170, 3210, 3220, 3250, 3270, 3280, 3290, 4120, 4130, 5150, 5160, 5180, 5240, 5250, 5310, 5320, 5330, 5340, 5350, 5360, 5420, 5430, 5460, 5470, CEG3480, 5120, 5270, 5330
Remaining units from any courses offered by the Faculty of Engineering (Except ERG3910 and 3920)

Total: 79 units

Recommended course pattern

Term 1	**Units**	**Term 2**	**Units**	**Term 3**	**Units**
CSC1130	3	CEG2400	3	CEG3150	3
ELE1110	3	CSC1140	1	CEG3430	3
ERG1810	1	CSC2100	3	CEG3470	3
ERG2011	3	ELE2110	3	CSC3640	3
ERG2020	3	ERG2012	3	ELT1111	3
		ERG2810	1		
	13		14		15
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
CEG3420	3	ERG4910	4	ERG4920	4
CEG4430	3	Electives	9	Electives	9
ELE2860	2				
ERG2310	3				
	11		13		13

Notes: Applicable to all Major students

1. Major courses which are at 3000 and above level will be included in the calculation of the Major GPA for honours classification. Courses with " # " are to be included in the Major GPA as well.
2. Besides the Major courses mentioned in Note 1, the other ACE, CSC, ELE, ERG, IDE, IEG, INE, MAE and SEG courses at 3000 and above level taken by the students will also be included in the calculation of the Major GPA.

2. Faculty Language Requirement

3. Major/Faculty Requirement for S6 Entrants

Computer Science

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

CSC1110
Introduction to Computing Using C
Computer-oriented problem-solving methods and algorithm development; structured programming concepts; concepts of abstract data types; simple data structures such as array, pointers and linked lists; illustrative applications. The C programming language will be used. (Not for students who have taken CSC1111 or 1130 or 1500.)

CSC1111
Introduction to Computing Using C++
Computer-oriented problem-solving methods and algorithm development; object oriented programming concepts; concepts of abstract data types; simple data structures; illustrative applications. The C++ programming language will be used. (Not for students who have taken CSC1110 or 1130 or 1500.)

CSC1130
Introduction to Computer Programming
This course aims at providing students with the basic knowledge of computer programming. In particular, programming methodologies such as object-oriented programming and structured programming, and the use of abstract data types will be illustrated using high-level programming languages such as Java.

CSC1140
Programming Laboratory
1 U; 1 Lab.
To supplement CSC1130, a series of programming exercises to be carried out at the beginning of the semester. Students will practise the programming principles they learn using different high-level programming languages. Prerequisite: CSC1130 or with the consent of the instructor.

CSC1410
Digital Logic
Number representation. Boolean algebra and logic gates. Combinational circuit minimization. Sequential circuit analysis and synthesis, sequential circuit state minimization, hazards and races. Digital circuit technology: digital integrated circuits, PLA and ROM. (Not for students who have taken CSC2510.)

CSC1500
Computer Principles and Programming
3 U; 2 Lect. 1 Tut.
This course introduces computer programming in C. Students will learn the functional elements of a computer system, modern programming concepts, problem solving and creation of computer applications. Students will be able to apply these computing skills in various disciplines. This course also provides a foundation to further study in advanced computing topics. (Not for Majors of Computer Science and Computer Engineering, and students who have taken CSC1110 or 1111 or 1130.)

CSC1530
Computer Principles and Object-Oriented Programming
3 U; 2 Lect. 1 Tut.
This course introduces computer programming in Java. Students will learn the functional elements of a computer system, modern programming concepts, problem solving and creation of computer applications. Students will be able to apply these computing skills in various disciplines. This course also provides a foundation to further study in advanced computing topics. (Not for Majors of Computer Science and Computer Engineering, and students who have taken CSC1110 or 1111 or 1130.)

*CSC1720
Building Web Applications

CSC1740
Modern Computer Systems
The course aims to provide an overview of modern computer technologies. Computing systems concepts such as modern computer architecture and network. System security issues such as virus protection, Internet security using firewalls and data encryption are also introduced. (Not for S7 entrants of Engineering Majors.)

CSC2100
Data Structures
The concept of abstract data types and the advantages of data abstraction are introduced. Various commonly used abstract data types including vector, list, stack, queue, tree, and set and their implementations using different data structures (array, pointer based structures, linked list, 2-3 tree, B-tree, etc.) will be discussed. Sample applications such as searching, sorting, etc., will also be used to illustrate the use of data abstraction in computer programming. Analysis of the performance of searching and sorting algorithms. Application of data structure principles. Prerequisite: CSC1110 or 1111 or 1130 or its equivalent. (Not for students who have taken CSC2520.)

CSC2110
Discrete Mathematics
Set theory, functions, relations, combinatorics, graph theory, algebraic systems, propositional and predicate logic.

CSC2120
Introduction to Software Engineering
2 U; 2 Lect. 1 Lab.
This course aims to introduce students to software engineering concepts. Software life cycles and processes: requirements analysis and specifications; design techniques, functional design, object oriented design; implementation methodology, software testing and maintenance; application of CASE tools; documentation. Software Engineering laboratory: a series of exercises to practise the principles of software engineering. Prerequisite: CSC1110 or 1111 or 1500 or 1530. (Not for Majors of Computer Science and Computer Engineering.)

* *Course offered in 2005-06 and before.*

CSC2510
Computer Organization
This course is designed to provide the basic knowledge of computer organization and assembly language programming. Functions and structures of the basic building blocks: CPU, memory unit and input/output units will be introduced. Assembly language programming is used as a tool to study the internal coding of information, number representation, arithmetic operations and the flow of information within a microcomputer. Prerequisite: CSC1110 or 1111 or 1130 or 1500 or 1530. (Not for Majors of Computer Science and Computer Engineering, and students who have taken ELE3230.)

CSC2520
Data Structures and Applications
This course formally examines the relationship between abstract data types and data structures. The implementation of abstract data types using various data structures will be discussed. Abstract data types including list, stack, queue, symbol table, tree and graph will be introduced. Introductory complexity analysis and big-O notation will be illustrated with simple algorithms such as searching and sorting. Prerequisite: CSC1110 or 1111 or 1130 or 1500 or 1530. (Not for Majors of Computer Science, Computer Engineering and students who have taken CSC2100.)

CSC2720
Building Web Applications
The course is concerned with the development of web applications. The major topics include 1) Building blocks of web applications, 2) Client-side technologies, 3) Server-side technologies, and 4) Web application design and securities issues. Prerequisite: CSC1110 or 1111 or 1130 or 1500 or 1530 or its equivalent. (Not for Majors of Computer Science, Computer Engineering, Information Engineering, Internet Engineering, and students who have taken INE2720 or CSC1720.)

CSC2800
Numerical Computation
This course aims at introducing the computational techniques on numerical methods. Course contents include computational error analysis; algorithms for roots finding; solutions of linear and non-linear equations, and their sensitivity to computational errors; constrained and unconstrained optimization; curve fitting; applications examples. Prerequisite: CSC1110 or 1111 or 1130 or 1500 or 1530 or its equivalent.

CSC3100
Software Engineering
Software lifecycles: system modelling, requirements analysis and specifications, design techniques, implementation methodology, testings, maintenance and engineering laboratory. Analytical tools: software metrics, system performance measurement and evaluation. Management techniques: estimations, planning, project management, communication skills and documentations. Introductions to CASE tools and security. Prerequisite: CSC1110 or 1111 or 1130. (Not for students who have taken ERG3820 or IEG3080 .)

CSC3120
Compiler Construction
The course aims at teaching students about compiler development methodology and its associated technology to modern applications. The course contents included formal aspects, lexical analysis, syntax analysis, syntax-directed translation, run-time environments, intermediate code generation, code generation and code optimization. Prerequisite: CSC3130 or 3640.

CSC3130
Formal Languages and Automata Theory
Deterministic and nondeterminisitic finite automata, regular expressions, context-free grammars, pushdown automata, context-sensitive grammars, parsing of LR(O) and LR(K) languages, introduction to Turing machines and computability. Prerequisite: CSC2110.

CSC3150
Introduction to Operating Systems
Principles of operating systems: process management, memory management, file system, protection and security. Design and implementation methodology, performance evaluation. Case studies. Concurrent Programming. Prerequisite: CSC2100.

CSC3160
Design and Analysis of Algorithms
Basics of algorithm analysis: correctness and time complexity. Techniques for designing efficient algorithms: greedy method, divide and conquer, and dynamic programming. Fundamental graph algorithms: graph traversals, minimum spanning trees and shortest paths. Introduction to complexity theory: polynomial-time reductions and NP-completeness. Prerequisites: CSC2100 and 2110. (Not for students who have taken CSC3190.)

CSC3170
Introduction to Database Systems
Concepts and principles of database management systems. Subjects include: basic concepts, system structures, data models, database languages (SQL in particular), relational database normalization, file systems, indexing, query processing, concurrency control and recovery schemes. Prerequisites: CSC2100 or 2520. (Not for students who have taken ITM3010.)

CSC3180
Principles of Programming Languages
This course introduces, analyses and evaluates the important concepts found in current programming languages. The concepts are illustrated by contrasting their appearances in different languages. Major topics include: concepts, paradigms and implementation techniques. Prerequisites: CSC2100 or 2520.

CSC3190
Introduction to Discrete Mathematics and Algorithms
Introduction to logic, combinatorics, recurrence relations and graph theory. Design and analysis of algorithms: greedy method, divide and conquer, and dynamic programming. Fundamental algorithms including sorting, graph algorithms, number-theoretic algorithms and numerical algorithms. Introduction to NP-completeness. Prerequisite: CSC2100. (Not for students who have taken CSC3160.)

CSC3210
Principles of Multiagent Systems
This course discusses the principles of multiagent systems. Topics include interactions, coordination, organizations and communications in multiagent systems; agent actions and behaviours; artificial minds and task distribution. Prerequisite: CSC1110 or 1111 or 1130.

CSC3220
Algorithms for Bioinformatics
First, introducing basic knowledge of DNA, genes, genomes, proteins, RNA, replication, transcription and translation. Then, introducing basic algorithms, such as dynamic programming, tree/graph searching and matching, context free grammar, etc, and applications to bioinformatics for sequence comparison, alignment and motifs; gene recognition and microarray; phylogenetic trees, protein structure and motif recognition.

CSC3230
Fundamentals of Artificial Intelligence
Basic concepts and techniques of artificial intelligence. Knowledge representation: predicate logic and inference, semantic networks, scripts and frames, and object-oriented representation. Searching: such as A*, hill-climbing, minimax and alpha-beta pruning. Planning: the frame problem and the STRIPS formalism, representation schemes and planning strategies. Neural networks: learning algorithms, neural architecture and applications. Natural language processing. Knowledge acquisition and expert systems: properties, techniques and tools of expert systems. Prerequisite: CSC2100.

CSC3250
Computers and Society
2 U; 2 Lect. 1 Tut.
This course studies social, legal, ethical issues of information technology in society. Problems related to privacy, computer crimes, freedom of speech, intellectual property, professionalism, health, safety will be discussed. Local and global examples will be used to illustrate the issues.

CSC3260
Principles of Computer Graphics
Fundamental computer graphics techniques and algorithms will be introduced. Topics to be covered include: graphics hardware and interaction devices, transformation of coordination systems, scan conversion algorithms, hidden surface algorithms, illumination models and shading, rendering, texture mapping, computer animation and visualization. Prerequisite: CSC2100 or 2520.

CSC3270
Advanced Programming Laboratory
2 U; 1 Lect. 1 Lab.
The course will mainly focus on programming exercises for advanced data structures and algorithms. Topics include dynamic programming, computational geometry, number theory, simulation, combinatorial problems, optimization techniques, graph theory, etc. Prerequisite: CSC2100. Corequisite: CSC3160.

CSC3280
Introduction to Multimedia Systems
This course covers the design and implementation of modern multimedia systems. Topics include multimedia systems design, multimedia data representation, multimedia hardware and software, multimedia communication and networking, multimedia programming and multimedia information systems.

CSC3290
Computational Photography
Computational Photography is an emerging new field created by the convergence of computer graphics, computer vision and conventional photography. Its main purpose is to overcome the limitations of the traditional camera by using computational techniques to produce a richer, more vivid, perhaps more perceptually meaningful representation of our visual world. The content of this course is to study ways in which samples from the real world (images and video) can be used to generate compelling computer imagery. We will learn how to acquire, represent, and render scenes from digitized photographs. The following topics will be covered: cameras, image formation and models; image manipulation (warping, morphing, mosaicing, matting, compositing); data-driven synthesis; visual perception; high dynamic range imaging and tone mapping; image-based lighting; non-photorealistic rendering; and other applications in photography. Prerequisite: CSC2100.

CSC3420
Computer System Architectures
This course provides a foundation for understanding and evaluating the design principles incorporated in modern computer systems with particular emphasis on architectural features required to support high-level languages and system software: design methodology and descriptive tools; instruction set design; memory system design; control system design; input/output systems design; parallel processing concepts and future trends. Prerequisite: ERG2020. (Not for students who have taken CEG3420.)

CSC3510
Computer Game Software Development
3 U; 2 Lect. 1 Lab.
This course aims at providing an overview on the role of computer technologies in creating interactive computer games. Categorization of different game genres is first introduced, followed by examination of various stages throughout the development of computer games. The concept of a game engine and workflow in using game engines to develop computer games are studied. Online games with the emphasis on the network and user management issues are discussed. The students are expected to be able to develop their own computer games using a game engine after studying this course. Prerequisite: CSC1110 or 1111 or 1500 or 1530. (Not for Majors of Computer Science and Computer Engineering.)

CSC3530
Software Technology
This course introduces the main concepts of modern software technology with special emphasis on contemporary middleware, Web Services, platforms, and service-oriented architecture issues. The topics of this course continually evolve as new technologies and approaches emerge. The key middleware services and Web technologies such as XML and its variants are covered. Emerging application servers and approaches to build Web applications are examined to illustrate practical applications. Prerequisite: CSC2520. (Not for Majors of Computer Science, Computer Engineering, and students who have taken CSC3100 or IEG3080.)

CSC3550
Introduction to Computer Graphics
This course aims to provide students from all disciplines with an opportunity to learn about computer graphics. Topics of this course include basic geometry for computer graphics, transformation of coordinate systems, scan conversion, shading and illumination, user interactions and animation. Prerequisite: CSC1110 or 1111 or 1130 or 1500 or 1530 or its equivalent. (Not for Majors of Computer Science and Computer Engineering.)

CSC3640
Introduction to Theoretical Computer Science
Basic set theory, relation and function, countable and uncountable sets, finite automata and regular languages, pushdown automata and context-free languages, turing machines, computability theory, basics of complexity theory. Prerequisite: CSC2100 or 2520. (Not for Computer Science Majors.)

CSC4010, 4020
Final Project I, II
4 U each; 4 Lect. 1 Lab.
This course involves a significant project in any area of computer science. The project may be taken individually or in small group. A project report has to be written under the supervision of the teaching staff.

CSC4120
Principles of Computer Game Software
This course aims at establishing the principles, techniques and tools in the design and development of computer game software with focus on the real time performance consideration. Topics include: stages in computer game development, concept of game engine, rendering considerations, physics effects, artificial intelligence (AI), audio effects, scripting and environment for game project development. Prerequisite: CSC2100 or 2520. Prerequisite/ Corequisite: CSC3260 or 3550.

CSC4130
Introduction to System Administration Laboratory
1 U; 1 Tut. 3 Lab.
The purpose of this course is to introduce the basic knowledge of system administration. Sample laboratory work include system installation, system upgrade, resource configuration and security setup. Prerequisites: CSC3150 or CEG3150, and CSC4430 or CEG4430. (Not for Computer Science Minors.)

CSC4160
Distributed and Parallel Computing
This course introduces concepts, models and implementations related to distributed and parallel computing. Topics include parallel and distributed system architectures, concurrent languages, synchronization and concurrency control techniques, and applications in distributed databases.

CSC4260
Current Topics in Computing Techniques
This course aims at providing the students with the latest knowledge of advancements in pure or applied computer science. Topics covered in this course will vary from year to year, subject to the availability and speciality of the teachers.

CSC4430
Data Communication and Computer Networks
This course is designed to present a systematic approach to the study of data communication and computer networks. The ISO OSI seven layered protocols are accepted as the framework for the course. Physical layer includes digital data transmission, data encoding and data communication techniques. Medium access sublayer includes ALOHA control protocols, IEEE 802 local area network protocols and fiber optic network protocols. Data link layer design issues, error detection and correction, sliding window protocols, network layer design issues, routing algorithms and internetworking. Transport layer and session layer design issues and examples on application layer protocols.

CSC4510
Programming Languages and Compilers
A systematic study of computer languages, the interplay between their designs and implementations, and an introduction to compilation. Classifications of languages and comparison of paradigms. Data types and structures, control structures and data flow, and flexibility and efficiency considerations. An introduction to all phases of compilers, grammars, lexical analysers and parsers. Prerequisite: CSC3510. (Not for Majors of Computer Science and Computer Engineering.)

CSC4640
Computer Structures
This course aims at providing an understanding of the design of a typical computer system. An overview of earlier generations of computer systems will be followed by detailed discussions of the principles and designs of the von Neumann computer and its derivatives. Topics covered will include data representations, computer arithmetic and ALU, machine instruction formats, memory hierarchy concept and implementation, I/O management, control unit and overlapped execution. Comparisons of modern computer systems will also be presented. Prerequisite: CSC2510. (Not for Majors of Computer Science and Computer Engineering.)

CSC5110
Advanced Topics in Software Engineering
Formal and advanced quantitative approaches in software engineering. Formal specifications: algebraic and model-based specifications, reasoning and proving, formal refinements and transformations from specifications to programmes. Software security: encryption theory and systems, viruses and other software attacks, controls and protections. Software reliability: models, theory and applications.

CSC5120
Advanced Topics in Database Systems
This course will introduce to students advanced topics in database systems including advanced data structures, concurrency control, deadlock resolutions, recovery schemes, distributed database systems, multimedia database indexing techniques and data mining. Prerequisite: CSC3170. (Not for students who have taken SEG5010.)

CSC5150
Learning Theory and Computational Finance
This course aims to introduce the computational learning theory for applications to various areas of finance. This course consists of two parts. The first part gives an introduction of basic mathematical methods in finance. The second part deals with nonlinear computing models, Bayesian Ying-Yang unified learning theory, other computational learning techniques and their applications to FOREX or stock forecasting, portfolio optimization and programmed trading.

CSC5160
Topics in Algorithms
This course will introduce to students topics in algorithms. The detailed contents may be changed from year to year depending on the current development and teacher specialty.

CSC5170
Theory of Computation Complexity
Deterministic and non-deterministic Turing machine, Church's thesis, uncomputability and intractability, NP-completeness, polynomial time hierarchy, probabilistic computation, predicate calculus and incompleteness.

CSC5180
Techniques for Data Mining
Data mining provides useful tools for the analysis, understanding and extraction of useful information from huge databases. These techniques are used in business, finance, medicine and engineering. This course will introduce the techniques used in data mining. Topics will include clustering, classification, estimation, forecasting, statistical analysis and visualization tools.

CSC5210
Advanced Topics in Computer Graphics and Visualization
Provide in-depth treatment of the following advanced computer graphics and visualization topics: radiosity rendering and global illumination, procedure texturing and modelling, image-based rendering, stereo imaging, real-time volume graphics and interactive visualization. Prerequisite: CSC3260 or its equivalent.

CSC5240
Combinatorial Search and Optimization with Constraints
Students will be exposed to various constraint-based combinatorial search and optimization techniques that arise in artificial intelligence, operations research, etc. Topics include, but are not limited to, local propagation, consistency algorithms, Boolean constraint solving, numerical constraint solving, linear programming, search, and their applications.

CSC5250
Information Retrieval and Search Engines
This course surveys the current research in information retrieval for the Internet and related topics. This course will focus on the theoretical development of information retrieval systems for multimedia contents as well as practical design and implementation issues associated with Internet search engines. Topics include probabilistic retrieval, relevance feedback, indexing of multimedia data and applications in e-commerce.

CSC5280
Image Processing and Computer Vision
Image processing: enhancement technique, image compression, segmentation, morphology, color image processing and restoration. Computer vision: representation, decision models, structural methods and image understanding.

CSC5310
Topics in Biometrics
This course introduces the fundamentals of biometrics — the technology for secure identification and personal verification. The course is designed with a balance between the basic theoretical background and practical application. It examines pattern recognition, discriminant analysis, classification methods and other techniques used in designing and implementing biometric systems. In particular, the course investigates several key biometric features, e.g., face related processing, fingerprint analysis, handwriting verifications, speaker recognition, etc.

CSC5320
Topics in Graph Algorithms
A course on graph theory and graph algorithms with emphasis on the algorithmic aspects of graph theory. The course will cover classical topics such as search techniques, connectivity, colouring, matching and covering, network flows, planarity, traversability, perfect graphs and NP-completeness of graph problems. It will also cover recent advances in graph minors and fixed-parameter tractability of graph problems. Prerequisite: CSC3160 or its equivalent.

CSC5330
Advanced Algorithms for Bioinformatics
This course introduces the computational issues and algorithms in bioinformatics. Topics include algorithms for pairwise sequence comparison and alignment for DNA and protein sequences, multiple sequence alignment, analysis and prediction of protein secondary structure, etc. Techniques such as dynamic programming, Hidden Markov models, neural networks and their applications in bioinformatics will also be covered.

CSC5340
Advanced Topics in Distributed Software Systems
This course will provide knowledge of basic architectural features of distributed systems, including client-server systems, network systems, middleware systems and their main advantages, challenges, design issues and current solutions. Current object-oriented distributed system and software platforms (CORBA, DCOM, and Java/RMI) will be studied in detail. Topics include: distributed systems characteristics and design issues, distributed software engineering, communication and remote procedure calls, building distributed systems, generosity and interoperability, naming and trading services, concurrent processes and threads, transactions and distributed transactions, reliability and availability, and security problems and solutions. Laboratory of a series of distributed system projects will be assigned and conducted.

CSC5350
Game Theory in Computer Science
This course aims at introducing the theory and application of game theory in the context of Computer Science, in particular, decision making in multiagent systems. The course first focuses on rational behaviour of agents in strategic games and the existence of pure and mixed strategy Nash equilibrium. Then extensive games with and without perfect information, including bargaining games and repeated games will be introduced. The concepts of subgame perfect equilibrium and sequential equilibrium will be discussed. Finally, the course covers coalitional games and the concepts of cores and kernels.

CSC5360
Grid Computing
This course is designed to give a broad overview of the concepts, technologies and open research areas of Grid computing along with the state-of-the-art in Grid software. Topics include architecture, programming, resource management, information infrastructure, security, data management, Grid middleware and tools, Web services, Grid services, current applications and research.

CSC5420
Computer System Performance Evaluation
Computer system performance evaluation through analytical and simulation studies. Brief overview of queueing theory, computational algorithms, sequential and parallel simulation techniques. Performance evaluation in distributed resource allocation, computer interconnection architecture, multiprocessing and multithreads computation, parallel I/O architectures, distributed database concurrency control protocols, multiple access protocols in communication network, and parallel programming models, etc. Students are expected to have knowledge in probability, stochastic processes and computer architecture.

CSC5430
Autonomous Agents and Multiagent Systems
Characteristics of autonomous agents. Agent architectures: BELIEF-DESIRE-INTENTION architecture, purely reactive architectures and hybrid architecture. Multiagent systems: speech acts theory, agent communication and agent cooperation protocols. Agent-oriented programming. Distributed hierarchical planning. Distributed rational decision making: protocols and strategies, Nash equilibrium and Pareto optimality, auctions, voting, Clarke tax, OCSM-contracts. Argumentation and negotiation. Prerequisite: CSC2110.

CSC5460
Virtual and Augmented Reality
This course introduces the fundamental and advanced research topics in virtual and augmented reality (VR/AR), including VR/AR tools and metaphors, multi-sensory interactions, geometric and behavior modeling, touch-enabled interfaces, real-time immersive navigation, human factors in VR/AR, augmented reality systems, internet-based VR/AR applications. The web-based virtual reality interfaces plus other graphics engines build up the developing tools for testing the alternative ideas/solutions for the advanced VR/AR research and real-time applications. Prerequisite: CSC3260 or its equivalent.

CSC5470
Computer and Network Security
Issues of computer and network security. Security protocols. Firewalls. Computer viruses. Audit trails. System security threats. Applications of cryptography. Prerequisite: CSC4430 or CEG4430 or IEG3310 or its equivalent. (Not for students who have taken IEG5240.)

Study Scheme

1. Major Programme

A. Applicable to students admitted in 2006-07 and thereafter

Students are required to complete a minimum of 74 units of Major courses as follows (Note):

(i)	Required Courses: CSC1130, 1140, 2100, 2110, 2800, 3100, 3120, 3130, 3150, 3160, 3170, 3180, 3250, 3420, 4010, 4020, ELT1111, ERG2020, 2040, MAT2310	59 units
(ii)	Elective Courses: CSC3210, 3220, 3230, 3260, 3270, 3280, 3290, 4120, 4130, 4160, 4260, 4430, 5110, 5120, 5150, 5160, 5170, 5180, 5210, 5240, 5250, 5280, 5310, 5320, 5330, 5340, 5350, 5360, 5420, 5430, 5460, 5470, CEG3430, 3470, 3480, 3490, 5010, 5270, 5330, IEG3050#, 4180#, SEG3420#, 3430#, 3490#; and any one course from@ (DSE3020, 4070, 4150, 4210, 4250, MKT4080)	15 units
		Total: 74 units

@ *Applicable to students admitted in 2007-08 and thereafter only.*

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1130	3	CSC1140	1	CSC3130	3
CSC2110	3	CSC2100	3	CSC3150	3
ERG2020	3	CSC2800	3	CSC3160	3
MAT2310	3	ERG2040	3	CSC3180	3
		ELT1111	3	Elective	3
	12		13		15
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
CSC3100	3	CSC3250	2	CSC4020	4
CSC3120	3	CSC4010	4	Electives	3
CSC3170	3	Electives	6		
CSC3420	3				
Elective	3				
	15		12		7

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

B. Applicable to students admitted in 2005-06

Students are required to complete a minimum of 74 units of Major courses as follows (Note):

(i) Required Courses: 59 units
CSC1130, 1140, 2100, 2110, 2800, 3100, 3130, 3150, 3160, 3170, 3180, 3250, 3420, 4010, 4020, 4430, ELT1111, ERG2020, 2040, MAT2310

(ii) Elective Courses: 15 units
CSC3120, 3210, 3220, 3230, 3260, 3270, 3280, 3290, 4120, 4130, 4160, 4260, 5110, 5120, 5150, 5160, 5170, 5180, 5210, 5240, 5250, 5280, 5310, 5320, 5330, 5340, 5350, 5360, 5420, 5430, 5460, 5470, CEG3430, 3470, 3480, 3490, 5010, 5270, 5330, IEG3050#, 4180#, SEG3420#, 3430#, 3490#

Total: 74 units

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1130	3	CSC1140	1	CSC3130	3
CSC2110	3	CSC2100	3	CSC3150	3
ERG2020	3	CSC2800	3	CSC3160	3
MAT2310	3	ERG2040	3	CSC3170	3
		ELT1111	3	Elective	3
	12		13		15
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
CSC3100	3	CSC3250	2	CSC4020	4
CSC3180	3	CSC4010	4	Electives	3
CSC3420	3	Electives	6		
CSC4430	3				
Elective	3				
	15		12		7

Note: Applicable to all Major students

Major courses at 3000 and above level will be included in the calculation of the Major GPA for honours classification. Courses with "#" and ERG3910, 3920 are to be included in the Major GPA as well.

2. Minor Programme

Students are required to complete a minimum of 18 units as follows:

(i)	Required Courses: CSC1530, 2510, 2520 and 3530	12 units
(ii)	Elective Courses: ACE3090, CSC2120, 3170, 3180, 3210, 3220, 3250$^{\Delta}$, 3280, 3420, 3510, 3550, 3640, 4120, ERG3820, INE2720$^{\Delta}$	6 units
		Total: 18 units

$^{\Delta}$ *The units earned in CSC3250 which count towards the requirement of this Minor Programme in Computer Science shall not count towards the requirement of the Minor Programme in Information Technology and vice versa. Students are required to declare if CSC3250 will count towards the requirement of the Minor Programme in Computer Science at their final term of attendance.*

Notes: 1. Course and Unit Exemptions (for Minor students only):
Students are allowed to exempt from a maximum of 9 units of courses. Students who have taken course(s) in Column A will be exempted automatically from taking the corresponding equivalent course(s) in Column B due to similarities in the contents of some courses.

Column A	Column B
CSC1110	CSC1500
CSC1110/1111	CSC1530
ELE3230	CSC2510
CSC2100	CSC2520
CSC3100	CSC3530
IEG3080	

2. Other than the course and unit exemptions stated in Note 1 above, courses which Automation and Computer-Aided Engineering/Mechanical and Automation Engineering, Electronic Engineering, Information Engineering, Systems Engineering and Engineering Management Majors have taken to fulfil their Major requirement cannot be used to fulfil the Minor Programme requirement. Students are required to declare which course/s will count towards the requirement of Minor Programme at their final term of attendance.

3. **Applicable to Mathematics Majors**
Mathematics Majors who have taken MAT2071and 2072 will be exempted from CSC1530. They may also choose any one from MAT3230, 3240 and 3260 as Minor elective course.

4. **Applicable to Physics Majors**
Physics Majors who have taken PHY2351 will be exempted from CSC1530. They may also choose PHY3350 and any one from PHY4350, 4360 and 4370 as Minor elective course.

3. *Faculty Language Requirement*
4. *Major/Faculty Requirement for S6 Entrants*

Electronic Engineering

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

ELE1110
Basic Circuit Theory
Basic circuit theorems; mesh and nodal analysis; modified nodal analysis; State Equations. Topological formulation of circuit equations. Transient and steady-state analyses. AC circuits. Frequency responses. P-N junction diode; bipolar and unipolar transistors; diode and transistor models; large signal and small signal analyses; operation amplifiers.

ELE2110
Electronic Circuits
Bipolar and FET amplifiers. Differential amplifiers. Operational amplifiers and applications. Frequency response of amplifiers. Feedback principles. Oscillators, multivibrators and wave generators. Logic circuits: ECL and CMOS. Students are advised to take ELE1110 before taking this course.

ELE2120
Digital Circuits and Systems
Digital circuit technologies of logic families, circuit characteristics: noise immunity, loading effect, fan-in and fan-out, logic timing analysis. Analysis of TTL switching circuits. Combinational logic design techniques: Boolean algebra, K-map and Quine-McCluskey. Functional blocks of combinational logic. Sequential logic circuits. Synchronous and asynchronous sequential machine design procedures. Digital systems design. (Not for students who have taken ERG2020.)

ELE2240
Control and Electrical Technology
Linear approximation of engineering systems. Transfer function and block diagrams. Transient response and steady state errors. Characteristic equation. Stability analysis. Root locus. Controllers and compensators. Magnetic circuits and transformers. Three phase circuits and power systems. Alternators and induction motors. Direct current generators and motors. Feedback control systems with synchros and direct current motor actuators. Students are advised to take ERG2030 before taking this course. (Not for students who have taken ACE2030.)

ELE2510
Microelectronic Devices
Fundamentals: atoms, bonds, crystal structures, electrons in solids, band structure, effective mass and the Fermi Energy. Conduction in semiconductors: intrinsic, extrinsic, drift, mobility, diffusion, recombination, Hall effect. Junctions: metal/semiconductor, p/n, breakdown, MOS diode. Transistors: MOST, JFET, MESFET, BJT. I.C. fabrication: layout, lithography, layer formation.

ELE2860
Professional Engineering Practice
2 U; 2 Lect.; 1-2 Tut
Introduction to engineering: engineering practice; professional ethics; professional societies. Industrial environment: health and safety; the trend of global and local industries. Engineering management: project management; quality assurance; communication skills and personal developement.

ELE3010
Introduction to Lasers and Photonics
This course is intended for undergraduate engineering and science students. It covers the basic physics, engineering and system aspects of various lasers and a broad range of photonic technologies. This course then addresses their important roles in modern information systems. The course contents include the basic principles and the engineering applications of lasers and photonics, using real-life examples from a wide-range of photonics information systems including state-of-the-art optical display, optical storage, optical communications and optical sensors.

ELE3210
Analog Integrated Circuits
Ideal and non-ideal op-amp characteristics. SPICE models and simulations. Complete DC, small signal analysis of a 741 type op-amp including internal design. Noise consideration. Applications and design techniques: current and voltage sources, current to voltage and voltage to current converters, regulator, band-gap reference, switching regulator, active rectifier, logarithmic amplifiers, Gilbert multiplier, phase detector, active filters, digital to analog and analog to digital converters, temperature compensation. Basic phase lock loop theory and applications. Students are advised to take ELE2110 before taking this course.

ELE3230
Microprocessors and Computer Systems
CPU registers and control units, Addressing modes and instruction set. Bus and data path. Memory systems. Input/output techniques: programmed I/O, interrupt and DMA. Assembly language and programming techniques. Computer/microprocessor applications. Case study of a computer/microprocessor system. Students are advised to take ELE2120 or ERG2020 before taking this course.

ELE3240
Medical Instrumentation and Sensors
Foundamental concepts of the design of instrumentation and sensor. Electrode theory. Wireless electrodes. Transducers. Biosensors. Applications of microprocessor system for measurements. Micro-controllor based measurement systems. The origins and measurements of bioelectric, ultrasonic and bioaccoustic signals. Applications: electro-bioimpedance measurements, cochlear implant devices and transdermal drug delivery systems; and distributed random Functional Electric Stimulator. Electrical safety and hazard.

ELE3310
Basic Electromagnetic Theory
Review of vector analysis and differential equations. Stationary fields. Maxwell's equations and time-varying fields. Scalar and vector potential. Wave equations and solutions. Plane waves. Transmission lines and waveguides. Microstrip lines and passive circuits. Numerical methods in electromagnetics. Students are advised to take ERG2011 before taking this course.

ELE3320
Introduction to Optical Communications
Comparison between optical and non-optical (such as copper-based and microwave) communications. Theory of dielectric optical waveguides. Single-mode and multi-mode optical fibres. Propagation of optical waves in fibres. Fibre parameters and measurement techniques. Manufacturing and splicing of fibres. Fibre components for communication systems. LED and laser diode sources. Detection and amplification of optical signals. Techniques for optical signal enhancement. Multiplexing techniques. Analog and digital optical transmission systems. Students are advised to take ELE2510 and 3310 before taking this course.

ELE3330
Wireless Transmission Systems
Common wireless systems and international communication standards. Antenna fundamentals. Antenna arrays. Applications: mobile phone handset, basestation and trunk antennas. Antenna measurement techniques. Propagation basics. UHF and microwave line-of-sight links. Propagation over suburbs, urban areas, into and inside buildings. Multipath fading models. Wideband channel characterization. Propagation measurement techniques. Introduction to radar system and satellite communication system. Students are advised to take ELE3310 before taking this course.

ELE3340
Analog and Digital Communications
Orthogonality and signal representations. Design and analysis of amplitude, phase, and frequency modulation systems. Digital modulation systems, optimum binary receiver and the matched filter, coherent and non-coherent reception of ASK, FSK, PSK, DPSK, M-ary communications. Introduction to information and coding theory. Students are advised to take ELE3410 before taking this course.

ELE3410
Random Processes and Digital Signal Processing
Random variables and random processes. Gaussian processes. Correlation functions and power spectral density. DTFT and DFT. Z-transform and inverse Z-transform. Frequency response and stability of DT systems. Student are advised to take ERG2030 before taking this course.

ELE3510
Solid State Electronics
Introduction to quantum mechanics: particle-wave nature of electron, Schrodinger equations, electrons in 1-D potential well and potential barrier. Hydrogen atom and the periodic table. Properties of bonds. Concepts of band theory of solids. Free electron model of metals. Case studies of electronic properties of materials: e.g. semiconductors, dielectric and magnetic materials, superconductors, optoelectronic materials, and some other advanced applications. Students are advised to take ELE2510 before taking this course. (Not for students who have taken ELE4570.)

ELE3520
Computer-Aided Circuit Analysis and Hardware Description Languages
This course is characterized by its requirement on students to learn electronic design tools through practical exercises. Circuit Level - SPICE as a hardware language, circuit analysis using PSPICE, PSPICE analog behavioural models and model parameters. Logic Level - Electronic design domains, hardware description languages, AHPL, VHDL and Verilog. System Level - Introduction to SpecC. Engineering drawings, introduction to computer graphics. Students are advised to take ELE2110 and 2120 before taking this course. (Not for students who have taken ELE2230.)

ELE3820
Electronic Engineering Laboratory
1 U; 4 Lab.

ELE4110
Bioelectronics
Electrical safety and hazard. Interference and shielding. Nature, measurement and special considerations of bioelectrical signals in general. Generation, propagation and measurement of biopotentials: ECG, EEG, EMG, EGG, ERG, etc. Nature and application of bio-impedance. Bio-instrumentation techniques and special considerations. Topics in bio-electronics of recent interest.

ELE4120
Bioinformatics
Basic concepts of bioinformatics engineering; database basics, text, visual and multimedia data representation, acquisition and presentation; computational and statistical methods in biological systems; signal processing and knowledge engineering in DNA sequence analysis; introduction to genetic engineering.

ELE4190
Biomedical Modelling
Basic physiologic systems: neuromuscular system, auditory system, pulmonary-cardiovascular system etc. Renewal process. Bioelectric phenomena: action potentials, cellular membrane models, volume conductor models, ECG, EMG, EEG, etc. Biomedical modelling: lumped element model, bioimpedance, medical ultrasound, dispersion effects, and otoacoustic emissions. Topics in biomodelling of recent interest.

ELE4310
Modern Communication Systems
Communication fundamentals: signals, coding and error control, antennas and propagation, communication networks and TCP/IP protocols.Wireless Systems: spread spectrum systems, satellite communications, cellular networks, wireless LAN, Bluetooth. Broadband communications: optical fiber systems, cable modem and ADSL access.(Include one communication system simulation project). (Not for students who have taken IEG4100.)

ELE4320
Microwave Electronics
Revision of transmission line theory, Smith chart and principles of impedance matching. Microstrip lines. S-parameters. Microwave network analysis. High frequency electrical characteristics of microwave components. Noise analysis. Microwave circuit design principles, CAD tools and fabrication. Microwave measurement techniques.

ELE4410
Advanced Digital Signal Processing and Applications
Design and realization of digital filters. Optimal statistical filtering. Discrete cosine transform, fast fourier transform and time-frequency analysis. Spectral estimation. DSP for multimedia applications. (Students are advised to take ELE3410 before taking this course.)

ELE4430
Digital Image Processing
Representation: 2D and 3D imaging, visual perception, imaging geometry and geometric correction. Processing: enhancement, restoration and coding. Analysis: segmentation, description and recognition. Applications: Real-time image processing, biometric and biomedical image processing. (Not for students who have taken IEG4160.)

ELE4510
Physics and Technology of Semiconductor Devices
Review of semiconductor physics. Advanced MOS devices and technologies. Special microwave devices: tunnel devices, transfer electron devices, etc. Photonic devices: LED, semiconductor lasers, photodetectors, and solar cells. Semiconductor sensors and transducers. Introduction to materials and technology for advanced semiconductor devices. Heterojunction concepts and devices: HEMT, HBT, and quantum-well devices. Introduction to organic light emitting diodes.

ELE4520
Integrated Optics
An introduction to integrated optics and its applications in communications systems. Optical waveguide modes and parameters. Waveguide fabrication techniques. Coupling techniques and losses in optical waveguides. Waveguide couplers, modulators and switches. Electro-optic, magneto-optic and acousto-optic effects. Characteristics and modulation of semiconductor lasers. Distributed feedback and distributed Bragg reflector lasers. Integrated optical detectors. Current trends and fundamental limits of integrated optics. Students are advised to take ELE3320 before taking this course.

ELE4530
Integrated Circuits Fabrication Technology
Modem IC fabrication of CMOS and bipolar transistors. Simple geometric layout of integrated circuits. Process engineering for VLSI fabrication: photolithography, plasma etching, ion implantation, chemical vapour deposition, epitaxy, oxidation, diffusion and metallization. Process simulations. Reliability, yield and packaging of IC's.

ELE4550
Application Specific IC Technologies
Circuit Techniques: Bipolar and CMOS logic gates. ASIC design styles: PLD, gate array, standard cell, silicon compiler, selection criteria. ASIC design automation: VHDL, EDIF, synthesis, schematic capture, simulation, placement, routing. Testability considerations: testability evaluation, test vector generation, fault simulation, structured design for testability, ATE. Design practice: complex system design (e.g. Multimedia processing systems.)

ELE4560
Electronic Thin Film Science
Thin film deposition and layered structures. Surface energies. Diffusion in solids. Stress in thin films. Surface kinetic processes. Homoepitaxy: Si and GaAs. Heteroepitaxy and superlattices. Electrical and optical properties of heterostructures, quantum wells, and superlattices. Schottky barriers and interface potentials. Solid phase amorphization, crystallization and epitaxy. Interdiffusion. Thin film reactions. Grain boundary diffusion. Electromigration in metals.

ELE4580
Microoptics
Fundamentals of microoptics: Fraunhofer and Fresnel diffraction, spatial and temporal coherence, polarization, interferometers and thin film filters; microlens performance: diffraction limit and aberrations, scaling from macro to micro components; refractive microoptics: GRIN optics, microprisms and micromirrors; diffractive microoptics: fabrication techniques, examples of diffractive optical elements, modelling of diffractive optics; Waveguides; Case studies of microoptics applications such as beam shaping, optical interconnects and optical data storage.

ELE5110
Advanced Medical Instrumentation and Biosensors
Review on physiological measurements and medical devices; electrodes and transducers for biomedical measurements; physiological monitoring and therapeutic devices; drug delivery systems; body sensor networks (BSN) and body area networks (BAN); wearable sensors and systems; E-textile devices. Medical imaging modalities; MRI, CT, PET, SPECT, ultrasound, etc.; bio-imaging: molecular imaging, cell imaging, etc. Selected topics of current interests in biomedical sensors.

ELE5140
Biomedical Information Engineering
Neuro-informatics: neural communication, neuro-myoelectrical channel, random point process, biomodulation, cable analogy, biotissue and dispersion filtering, biodemodulation. Medical information technology: HIS, virtual hospital, wireless physiologic sensing, medical data compression and telemedicine techniques. Selected topics of recent interest.

ELE5210
CMOS Analog Integrated Circuits
Review MOS device properties and electrical models. Basic analog circuit building blocks including simple and cascode current sources, active loads, common source and common drain amplifiers, DC biasing networks, and differential amplifiers. Analog sub-systems building blocks including CMOS OTA op-amp, OCA, comparators, A/D, D/A, and switching capacitor circuits. Selected topics in CMOS RF circuits.

ELE5260
CMOS Integrated Circuits
Modern circuit design techniques used in current CMOS integrated circuits. CMOS digital and analog integrated circuits: static and dynamic logic, transmission gate intensive logic, switching characteristic of static logic, I/O buffer, CMOS, SRAM and operational amplifier.

ELE5280
Analog-Digital ASIC Design
Analog-digital ASIC design: technology trends, integration requirements, design skills and methodologies; characteristics of modern IC technologies; layout and matching; noise in electronic circuits; coupling and isolation; synthesis of basic cells: operational transconductance amplifiers, comparators, voltage and current references; design of analog-digital integrated circuits at the building block and system level: continuous-time and sampled-data filters, Nyquist-rate A/D and D/A converters, oversampled A/D converters.

ELE5310
Advanced Microwave Engineering
Topics will be selected from the following areas : RFIC/MMIC design, linearization techniques for RF power transmitters, high frequency circuit packaging, microwave filter design, LTCC/ MCM technology, computer-aided design of microwave circuits, electromagnetic simulation.

ELE5350
Advanced Electromagnetism
Review of electromagnetics fundamentals. Green's Function: scalar, vector and dyadic forms. Electromagnetic sources: point source, line source, sheet source and ring source. Plane wave, cylindrical wave and spherical wave. Electromagnetic theorems and principles: duality, uniqueness, reciprocity, surface and volume equivalence, etc. Transmission in waveguide and layered material. Scattering from canonical structures. Analytical and numerical solutions of Maxwell's Equation: asymptotic method, finite element method, etc.

ELE5380
RF Integrated Circuits and Systems
Introduction to radio communication systems; wireless standards; transceiver architectures; characteristics of passive IC components; review of semiconductor devices: bipolar, CMOS, MESFET; design examples: LNA, mixer, RF power amplifier, phase-locked loop, oscillator and synthesizer; applications: GSM and DECT system. Prerequisite: ELE4320.

ELE5420
Digital Coding of Speech Signals
Transmission bit rates in speech coding; waveform coding techniques: PCM, DPCM, ADPCM, DM, ADM; analysis-synthesis coding techniques: speech production mechanism, short-time spectral analysis, channel vocoder, format vocoder, LPC vocoder; other coding techniques: voice-excited vocoder, sub-band coding, adaptive transform coding, adaptive predictive coding, time-encoded speech.

ELE5431
Advanced Techniques for Video Coding
Introduction: television standards, digital image representation, statistical models, basic lossless and lossy coding techniques; advanced coding techniques: wavelet coding, synthetic-natural hybrid coding, postprocessing techniques; image coding standards: JPEG, JPEG2000; video coding standards: H.261, H.263, MPEG1, MPEG2, MPEG4; HDTV standard.

Study Scheme

1. Major Programme

A. Applicable to students admitted in 2007-08 and thereafter

Students are required to complete a minimum of 76 units of Major courses as follows:

(i)	Required Courses: ERG1810, 2011, 2012, 2030, 2310, 2810, 3810#, 4910#, 4920#, ELE1110, 2110, 2120, 2510, 2860, 3210, 3230, 3310, 3820, CSC1111, 2120, ELT1111 Graduation Project as prescribed by ERG4920 will carry a separate weight of 6.79% in honours classification.	55 units
(ii)	Elective Courses: Group A: select any three of the following courses with at least two courses at 3000 and above level: ELE2230, 2240, 3010, 3240, 3320, 3330, 3340, 3410, 3510, 3520, CSC2100, IEG3310#, SEG2440/DSE1030+ Group B: select any four of the following courses: ELE4110, 4120, 4190, 4310, 4320, 4410, 4430, 4510, 4520, 4530, 4550, 4560, 4570, 4580, 5110, 5140, 5210, 5260, 5280, 5310, 5350, 5380, 5420, 5431, IEG4100#, MSE4210#	21 units
		Total: 76 units

In addition, students are required to take four weeks of industrial training in the summer after their first year of attendance.

\+ *Student can take either SEG2440 or DSE1030 but not both.*

Streams of Specialization (Notes 3 and 4)
There are five optional streams of specialization: Biomedical Engineering, DSP and Multimedia Technology, Integrated Circuit Technology, Microelectronics and Photonics, and Microwave and Wireless Engineering. Students may choose to specialize in one of the five streams and select the courses as prescribed. A student may choose not to specialize in any of the five streams and simply follow the study scheme for S7 entrants, S6 entrants or Sub-Degree entrants as appropriate.

To qualify for a stream of specialization, students are required to complete the following requirements:

a. at least 12 units including two compulsory and two elective courses under the stream with Grade B- or above; and

b. ERG4910 and 4920 in an approved topic that is relevant to the stream with Grade B or above.

Biomedical Engineering Stream

(i) Compulsory Courses:
ELE3240 and 4190

(ii) Elective Courses: (select any two of the following)
ELE4110, 4120, 4430, 5110 or 5140

DSP and Multimedia Technology Stream

(i) Compulsory Courses:
ELE3410 and 4410

(ii) Elective Courses: (select any two of the following)
ELE4310/4550*, 4430, 5420 or 5431

Integrated Circuit Technology Stream

(i) Compulsory Courses:
ELE3520 and 4550

(ii) Elective Courses: (select any two of the following)
ELE4530, 5210, 5260, 5280 or 5380

Microelectronics and Photonics Stream

(i) Compulsory Courses:
ELE3320 and 4510

(ii) Elective Courses: (select any two of the following)
ELE3510, 4520, 4530, 4560, 4580 or 5260

Microwave and Wireless Engineering Stream

(i) Compulsory Courses:
ELE3330 and 4320

(ii) Elective Courses: (select any two of the following)
IEG4100/ELE4310*, ELE4410, 5310 or 5380

* *only one of these two courses will be counted towards the unit requirement for elective courses.*

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1111	3	ELE2110	3	ELE2510	3
ELE1110	3	ELE2120	3	ELE3230	3
ELT1111	3	ERG2012	3	ELE3310	3
ERG1810	1	ERG2030	3	ERG2310	3
ERG2011	3	ERG2810	1	ERG3810	1
General Education/ Free Elective[1]	3			General Education/ Free Elective[1]	3
	16		13		16

Term 4	Units	Term 5	Units	Term 6	Units
CSC2120	2	ERG4910	4	ERG4920	4
ELE2860	2	Group A Elective	3	Group B Electives	6
ELE3210	3	Group B Electives	6	General Education/	6
ELE3820	1	General Education/	3	Free Elective[1]	
Group A Electives	6	Free Elective[1]			
General Education/	3				
Free Elective[1]					
	—		—		—
	17		16		16

Note: [1] 12 units of them must be General Education courses, the rest are free electives. Students are recommended to take some management and/or business administration courses to satisfy the professional requirements.

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

B. Applicable to students admitted in 2005-06 and 2006-07

Students are required to complete a minimum of 79 units of Major courses as follows:

(i) Required Courses: 55 units
ERG1810, 2011, 2012, 2030, 2310, 2810, 3810#, 4910#, 4920#, ELE1110, 2110, 2120, 2510, 2860, 3210, 3230, 3310, 3820, CSC1111, 2120, ELT1111
Graduation Project as prescribed by ERG4920 will carry a separate weight of 6.79% in honours classification.

(ii) Elective Courses: 24 units
Group A: select any three of the following courses with at least two courses at 3000 and above level: ELE2230, 2240, 3010, 3240, 3320, 3330, 3340, 3410, 3510, 3520, CSC2100, IEG3310#, SEG2440
Group B: select any five of the following courses: ELE4110, 4120, 4190, 4310, 4320, 4410, 4430, 4510, 4520, 4530, 4550, 4560, 4570, 4580, 5110, 5140, 5210, 5260, 5280, 5310, 5350, 5380, 5420, 5431, IEG4100#, MSE4210#

Total: 79 units

In addition, students are required to take four weeks of industrial training in the summer after their first year of attendance.

Streams of Specialization (Notes 3 and 4)

There are four optional streams of specialization: Biomedical Engineering, DSP and Multimedia Technology, Integrated Circuit Technology and Microwave and Wireless Engineering. Students may choose to specialize in one of the four streams and select the courses as prescribed. A student may choose not to specialize in any of the four streams and simply follow the study scheme for S7 entrants, S6 entrants or Sub-Degree entrants as appropriate.

To qualify for a stream of specialization, students are required to complete the following requirements:

a. at least 12 units including two compulsory and two elective courses under the stream with Grade B- or above; and
b. ERG4910 and 4920 in an approved topic that is relevant to the stream with Grade B or above.

Biomedical Engineering Stream

(i) Compulsory Courses:
ELE3240 and 4190
(ii) Elective Courses: (select any two of the following)
ELE4110, 4120, 4430, 5110 or 5140

DSP and Multimedia Technology Stream

(i) Compulsory Courses:
ELE3410 and 4410
(ii) Elective Courses: (select any two of the following)
ELE4310/4550*, 4430, 5420 or 5431

Integrated Circuit Technology Stream

(i) Compulsory Courses:
ELE3520 and 4550
(ii) Elective Courses: (select any two of the following)
ELE4530, 5210, 5260, 5280 or 5380

Microwave and Wireless Engineering Stream

(i) Compulsory Courses:
ELE3330 and 4320
(ii) Elective Courses: (select any two of the following)
IEG4100/ELE4310*, ELE4410, 5310 or 5380

* *only one of these two courses will be counted towards the unit requirement for elective courses.*

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1111	3	ELE2110	3	ELE2510	3
ELE1110	3	ELE2120	3	ELE3310	3
ELT1111	3	ERG2012	3	ERG2310	3
ERG1810	1	ERG2030	3	ERG3810	1
ERG2011	3	ERG2810	1	Group A Elective	3
General Education/ Free Elective[1]	3			General Education/ Free Elective[1]	3
	16		13		16
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
CSC2120	2	ERG4910	4	ERG4920	4
ELE2860	2	Group B Electives	9	Group A Elective	3
ELE3210	3	General Education/ Free Elective[1]	3	Group B Electives	6
ELE3230	3			General Education/ Free Elective[1]	3
ELE3820	1				
Group A Elective	3				
General Education/ Free Elective[1]	3				
	17		16		16

Note: [1] 12 units of them must be General Education courses, the rest are free electives. Students are recommended to take some management and/or business administration courses to satisfy the professional requirements.

Notes: Applicable to all Major students

1. Major courses at 3000 and above level will be included in the calculation of the Major GPA for honours classification. Courses with " # " are to be included in the Major GPA as well.
2. Besides the Major courses mentioned in Note 1, the other ELE courses at 3000 and above level taken by the students will also be included in the calculation of Major GPA.
3. A student who satisfies all the requirements of a stream of specialization may obtain a certifying letter from the department.
4. Students can also apply for the certifying letter if they satisfy all the requirements of a stream of specialization.

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

2. Minor Programme

Students are required to complete a minimum of 18 units of Major courses as follows:

(i)	Required Courses: ELE1110, ELE2120 (or ERG2020$^{\Delta}$)	6 units
(ii)	Elective Courses (at least 6 units at 3000 level or above): ERG2030, 2310, ELE2110, 2230, 2510, 3010, 3210, 3230, 3240, 3310, 3320, 3330, 3340, 3410, 3510, 3520, 4110, 4120, 4190, 4310, 4320, 4410, 4430, 4510, 4520, 4530, 4550, 4560, 4570, 4580, 5110, 5140, 5260, 5380	12 units
		Total: 18 units

$^{\Delta}$ *Applicable to students who passed this course in 2005-06.*

Option for Biomedical Engineering Stream (Notes 5 to 7)

Students may qualify for the Biomedical Engineering Stream in Minor Programme in Electronic Engineering, by completing at least 12 units from the core electives under the stream.

Biomedical Engineering

ELE3240, 4110, 4120, 4190, 4430, 5110 or 5140

Notes: 1. A maximum of 6 units course exemption will be considered.
2. A maximum of 6 units can be used to fulfil both the Major and Minor Programme requirements.
3. In any case, the total number of units exempted and used to fulfil both the Major and Minor Programme requirements cannot exceed 6 units.
4. Major students minoring in Electronic Engineering are required to declare which ELE coded courses will be counted towards the fulfilment of the requirements of the Minor Programme in Electronic Engineering at their final term of attendance.
5. To qualify for a stream certification, students must complete the core elective courses with Grade B- or above.
6. A student who satisfies all the requirements of a stream of specialization may obtain a certifying letter from the department.
7. Students can also apply for the certifying letter if they satisfy all the requirements of a stream of specialization.

3. *Faculty Language Requirement*
4. *Major/Faculty Requirement for S6 Entrants*

Information Engineering

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

IEG1001
Information Engineering in Society
2 U; 2 Lect. 1 Tut.
This course puts the study of information engineering in societal perspective, helping students appreciate the significance, value, practices and contributions of an information engineer to society. The lectures will introduce the major topics of information engineering (e.g., information theory, transmission and networking) and discuss how they are related within the discipline. This course prepares students with the necessary information, communication, learning and creating skills for study and future career. It requires students to read articles on information technologies and applications, and do case studies on how technologies can benefit a particular sector of the society.

IEG1810
Electronic Circuit Design Laboratory
1 U; 3 Lab.
Transistor and RC circuit, amplifier, oscillator, active filter, design project. Corequisite: ELE1110.

IEG2051
Signals and Systems
Linear time-invariant systems. Fourier analysis of continuous-time and discrete-time signal and systems. Laplace transform. z-transform. Feedback systems. Applications such as processing of communication signals and images, control of disk drive systems, and analysis of the stock market.

IEG2810
Digital Systems Design Laboratory
1 U; 3 Lab.
Combinational logic, sequential logic, finite state machine, PLAs, design project. Corequisite: ERG2020.

IEG3010
Digital Communications
Source and channel models. Modulation and detection. Intersymbol interference and equalization coding, multipath fading, spread spectrum and synchronization. Prerequisite: ERG2310.

IEG3050
Simulation and Statistical Analysis
System simulation, data analysis, statistical inference, regression, correlation and variance analysis, sensitivity analysis, variation reduction and importance sampling techniques for rare events. Workload representation and traffic generation. Experimental design. Basic queueing theory (Little's Law, M/M/1 and variations). Operational laws. Case studies on client-server systems.

IEG3080
Information and Software Engineering Practice
Software Engineering practice such as requirement analysis and specifications, system design and integration, object-oriented designs and development, software testing and maintenance, software quality and performance metrics, documentation, CASE tools, project planning and management. Information engineering practice concerning software intellectual property rights, privacy, Internet commerce, entrepreneurship and public policies. (Not for students who have taken CSC3100 or ERG3820.)

IEG3090
Advanced Internet Protocols and Systems
High speed networks. Quality of service (QoS) guarantees. Network control such as admission, congestion and flow control. Routing and resource reservation protocols. Real-time and streaming protocols. Advanced networking programming. Studies of next generation Internet and applications. Prerequisites: IEG3310. (Not for students who have taken INE3010.)

IEG3310
Computer Networks
OSI reference model. Overview of TCP/IP. Local area networks and wide area networks. Network layer and protocols. Transport layer and protocols. Examples of application layer protocols such as HTTP. Network security: firewall, SSL, and private and public keys encryption systems. One term project on client-server programming to create a web server and proxy.

IEG3810
Microprocessor System Design Laboratory
1 U; 3 Lab.
Address decoder, CPU bus demultiplexing, memory subsystem, I/O subsystem, interrupt handling, design project. Corequisite: ELE3230.

IEG3821
Information Engineering Laboratory
2 U; 4 Lab.
This course consists of experiments on both communication technologies and networking technologies. Communication technologies include: analog and digital communication techniques; optical and mobile communication systems, and switching system principles. Networking technologies include: configuration and management of network switches and routers, network routing protocol analysis, and local-area-network (LAN) switching techniques.

IEG3830
Product Design Project
The objective of this course is for students to gain hands-on experience in designing viable hardware/software products that make use of new technologies. Students work in teams of two to three persons, and each team is required to propose, specify, prototype and document a product design. Each team will be guided by a supervisor throughout the project and prototyping support will be provided by relevant laboratories in the Department.

IEG3831
Networking Laboratory I
1 U; 3 Lab.
Switch and router configuration and management. Network traffic measurement and monitoring. Protocol monitoring and packet analysis. Data logging. Pre/Corequisite: IEG3310. (Not for students who have taken INE2810.)

IEG3841
Networking Laboratory II
2 U; 4 Lab.
Design and configuration of enterprise, ISP and backbone networks and Internet exchange. Configuration of Internet routing protocols such as OSPF and BGP for Internet peering and traffic engineering. Prerequisite: IEG3831. Pre/Corequisite: IEG3090.

IEG4020
Telecommunication Switching and Network Systems
Basic telephony; concepts of switching, transmission, multiplexing and concentration; circuit switching, time-space-time switching; virtual-circuit/label switching; crossbar/bus/shared-memory switches; Ethernet switches at edge and metro; switching characteristics of interconnection networks; parallel switching control in sorting, concentration, multicasting and distribution.

IEG4030
Optical Communications
Fibre, transmission modes, dispersion, light sources and transmitters, photodiodes and receivers, optical system components, optical amplifiers, photonic switching, modulation and sensitivity, multiplexing schemes, optical links, lightwave network (e.g., FDDI and SONET), video distribution, fiber-in-the-loop. Prerequisite: ERG2310 or with the approval of the course instructor.

IEG4060
Decision Making Methodology
The nature of decision-making. Decision theory: value theory, utility theory, human judgement and inference, value of information, Bayesian decision analysis. Introduction to group decision making: Arrow's Theorem, collective choice, cooperative and non-cooperative models. Decision algorithms and pattern recognition: statistical decision procedures, feature extraction, linear and quadratic classifiers, context-dependent methods, applications in image analysis and machine vision.

IEG4100
Wireless Communication Systems
Introduction to digital cellular systems; physical characteristics of radio channels, fading channel, advanced digital modulation, spread spectrum technology, diversity techniques, multiple access schemes, mobile network control and management, 2G and 3G standards. Prerequisite: IEG3010 or with the approval of the course instructor.

IEG4130
Information and Network Security
This course covers the basics of cryptography, network security, and computer security. Topics include cryptography, PKI, authentication, access control, policy and audit, security assurance, web and network threats, standards, wireless and mobile security. (Not for students who have taken MAT4260.)

IEG4140
Teletraffic Engineering
Introduction to performance concepts in teletraffic systems. Performance evaluation methodologies. Mathematics models: Markov chains, elementary queuing theory and queuing networks. Applications to cellular networks, Internet, circuit-switched, packet-switched and ATM networks.

IEG4160
Image and Video Processing
Two-dimensional signal processing, image enhancement, image restoration, image and video coding. Image and video content recognition and analysis, with introduction to texture image analysis, general two-dimensional shape recognition, Chinese character recognition, and human face recognition. (Not for students who have taken ELE4430.)

IEG4180
Network Software Design and Programming
This is a project-oriented course that teaches the development of network applications. Subject areas include object-oriented programming (C++ and Java); message-driven programming (windows); client-server systems design; interprocess communication; sockets: blocking and nonblocking I/O; multithreaded process; iterative and concurrent server designs; system-throughput bottlenecks; multimedia over network. Case studies: FTP, RPC, Web.

IEG4190
Multimedia Coding and Processing
Theory of data compression. Lossless coding including Huffman code. Speech coding. Audio coding including MP3 and AC3. Image compression including JPEG. Video compression, including H.26X and MPEG. Multimedia applications. Introduction to topics in audio and image processing.

IEG4200
Channel Coding and Modulation
This course covers classic and new channel coding, and related modulation schemes. Topics include Reed-Solomon code, convolutional code, concatenation, low-density parity-check (LDPC) code, and optionally, OFDM, MIMO, and network coding. (Not for students who have taken MAT4260.)

IEG5124
Signal Analysis and Application
Principles of signal analysis: representation, decomposition and transformation. Fundamentals of digital filtering. Orthogonal transforms: DFT and FFT; KLT and DCT; rectangular transforms; lapped orthogonal transforms. Subband decomposition: band-pass signals; two-channel filter banks. Introduction to multi-resolution analysis. Audio and visual signals: source models; introduction to human perception and information processing.

IEG5154
Information Theory
Introduction. Shannon's information measures. Entropy rate of a stationary process. The source coding theorem. Kraft inequality. Huffman code. Redundancy of a prefix code. The channel coding theorem. Rate-distortion theory. Universal data compression. Students taking this course are expected to have taken ERG2040.

IEG5240
Applied Cryptography
Symmetric cryptography. Asymmetric cryptography including integer factorization, discrete logarithm and elliptic curve. Digital signature, one-way hashing, zero-knowledge proof, certificate and certificate authority. Secure information infrastructure, virtual private network (VPN), online shopping and payment systems, e-cash. Economic impact. Cryptography and international politics. Smart card, steganography, time stamping. Cryptanalysis technology. Pseudo-random number generator. (Not for students who have taken CSC5470.)

IEG5270
Advanced Topics in P2P Networks and Systems
This course covers the principles, architectures, and applications of peer-to-peer networks and systems. Topics include protocols, network architectures, data distribution policies, directory service and query processing, quality-of-service, reliability, fairness, incentive mechanism, security, privacy, and intellectual property issues. Practical P2P systems such as file-sharing, overlay networks, and application layer multicast will be surveyed as case studies.

IEG5280
Mobile Networking
This course introduces the principles of networking protocol design under the mobile/wireless environment. Mobile networking protocol design for the MAC, network, transport, session and application layers will be covered. The course will follow a "problem-and-solution" approach in which key generic problems created by the mobile/wireless environment on each protocol layer are first introduced. Alternative solutions as well as their associated trade-offs, are then illustrated via real-world examples. Specific problems and their practical solutions to be studied include: multi access control in a wireless environment, mobility management for infrastructure-oriented wireless networks (e.g., location tracking and handover), routing in mobile ad hoc networks, wireless transport protocol design, session and service control for multimedia wireless networks, content adaptation and location awareness support for mobile applications and services. Emerging mobile networking technologies and future directions will also be discussed. Prerequisite: IEG3010 and 3310 or their equivalents.

IEG5290
Network Coding Theory
Examples of network coding. Acyclic networks: linear network codes and desirable properties, existence and construction, static network codes. Cyclic networks: convolutional network codes. Relations between network coding and classical algebraic coding theory.

IEG7011
Information Engineering and Technology Management
Human aspects: planning, staffing, organizing, motivating, leading and control. Technical aspects: planning, strategic and operational considerations, technology lifecycle and decision making. Management of research, engineering design, production functions, marketing and service support. Project screening and selection. Project structuring, scheduling and budgeting. Project control. Management of outsourcing and multi-team projects. Management styles. Career management. (Not for students who have taken SEG7430 or 7490.)

IEG7012
Innovation and Entrepreneurship
Entrepreneur characteristics; product innovation: factors driving innovation, creation and evaluation of new product ideas, risk assessment of commercialization, critical factors for success; business planning: market assessment and strategy, business model, product planning, financial planning, cash flow; financing options, negotiation and deals; formation of a new venture: team, company and product building; execution and dealing with reality; exit strategies; case studies related to innovation and entrepreneurship in information engineering. (Not for students who have taken SEG3450.)

IEG7013
Cases in IE Project Planning I
This course offers students practical knowledge and insights in Information Engineering project planning through case studies of selected large scale IE infrastructural projects. Examples include financial institutions such as banks and stock exchange; corporate information/enterprise systems and networks. Guest speakers will be invited to share their knowledge and experiences. Students shall participate in hypothetical case planning of selected IE infrastructural projects.

IEG7014
Cases in IE Project Planning II
This course offers students practical knowledge and insights in Information Engineering project planning through case studies of selected large scale IE infrastructural projects. Examples include communication infrastructures for transportation and logistic systems, government and public information networks, ISP and telco networks, etc. Guest speakers will be invited to share their knowledge and experiences. Students shall participate in hypothetical case planning of selected IE infrastructural projects.

Study Scheme

1. Major Programme

A. Applicable to students admitted in 2006-07 and thereafter

Students are required to complete a minimum of 72 units of Major courses as follows:

(i) Required Courses: 51 units
ERG2013, 2020, 2040, 2310, 4910#, 4920#, IEG1001, 1810, 2051, 2810, 3080, 3310, 3810, 3821, CSC1110, 2100, ELE1110, 3230#, ELT1111
Graduation Project as prescribed by ERG4910/4920 will carry a separate weight of 10% in honours classification.

(ii) Elective Courses: 21 units
Select a total of 21 units from Core Electives and Non-core Electives, in which at least 15 units should be from Core Electives:
(a) Core Electives: CSC3150#, IEG3010, 3050, 3090, 3830, 3831, 3841, 4020, 4030, 4060, 4100, 4130, 4140, 4160, 4180, 4190, 4200, 5124, 5154, 5240, 5270, 5280, 5290

Option for Streams of Specialization (Notes 1 and 2)

To qualify for a stream of specialization, the student must complete at least 12 units from the core electives list under the streams.

Telecommunications
IEG4020, 4030, 4100, 4130, 4140, 4200, 5280
Internet Engineering
CSC3150# (required), IEG3090, 3831, 3841, 4130, 4180, 5240, 5270

Information Processing
IEG4160, 4190, 5124, 5154, 5240, 5290

(b) Non-core Electives: ACE2050, ACY1111, CSC2110, 3130#, 3160#, 3170#, 3230#, 3260#, 5280#, 5470#, ECO1010, ELE3310#, 3330#, 4320#, 4550#, IEG7011#, 7012#, 7013#, 7014#, MAT3080#, 3260#, 3310#, MGT1020, MKT2010, SEG2420, 2440, 3430#, 3490#, 3500#, 3560#, 4410#

Total: 72 units

Plus workshops, training sessions and industrial visits.

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1110	3	CSC2100	3	ELE3230	3
ELE1110	3	ERG2020	3	ERG2310	3
ERG2013	3	ERG2040	3	IEG3310	3
IEG1001	2	IEG2051	3	IEG3810	1
IEG1810	1	IEG2810	1	Elective*	3
	12		13		13
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
ELT1111	3	ERG4910	4	ERG4920	4
IEG3080	3	Electives*	12	Electives*	12
IEG3821	2				
Electives*	7				
	15		16		16

* *Out of 21 Elective Course units, at least 15 units should be from Core Elective. 13 units of free electives are required.*

Notes: 1. A student who satisfies all the requirements of a stream of specialization may obtain a certifying letter from the department.

2. Students can choose not to have any specification. A student may graduate with no stream of specialization as long as they satisfy the Major graduate requirements list above.

3. Major courses at 3000 and above level will be included in the calculation of the Major GPA for honours classification. Courses with "#" are to be included in the Major GPA as well.

4. Besides the Major courses mentioned in Note 3, all other ACE, CEG, CSC, ELE, ERG, MAE and SEG courses at 3000 and above level taken by the students will also be included in the calculation of the Major GPA.

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

B. Applicable to students admitted in 2005-06

Students are required to complete a minimum of 78 units of Major courses as follows:

(i) Required Courses: 51 units
ERG2013, 2020, 2040, 2310, 4910#, 4920#, IEG1001, 1810, 2051, 2810, 3080, 3310, 3810, 3821, CSC1110, 2100, ELE1110, 3230#, ELT1111
Graduation Project as prescribed by ERG4910/4920 will carry a separate weight of 10% in honours classification.

(ii) Elective Courses: 27 units
Select a total of 27 units from Core Electives and Non-core Electives, in which at least 15 units should be from Core Electives:

(a) Core Electives: CSC3150#, IEG3010, 3050, 3090, 3830, 3831, 3841, 4020, 4030, 4060, 4100, 4130, 4140, 4160, 4180, 4190, 4200, 5124, 5154, 5240, 5270, 5280, 5290

Option for Streams of Specialization (Notes 1 and 2)

To qualify for a stream of specialization, the student must complete at least 12 units from the core electives list under the streams.

Telecommunications
IEG4020, 4030, 4100, 4130, 4140, 4200, 5280
Internet Engineering
CSC3150# (required), IEG3090, 3831, 3841, 4130, 4180, 5240, 5270
Information Processing
IEG4160, 4190, 5124, 5154, 5240, 5290

(b) Non-core Electives: ACE2050, ACY1111, CSC2110, 3130#, 3160#, 3170#, 3230#, 3260#, 5280#, 5470#, ECO1010, ELE3310#, 3330#, 4320#, 4550#, IEG7011#, 7012#, 7013#, 7014#, MAT3080#, 3260#, 3310#, MGT1020, MKT2010, SEG2420, 2440, 3430#, 3490#, 3500#, 3560#, 4410#

Total: 78 units

Plus workshops, training sessions and industrial visits.

(iii) One Student; One Minor
Students who have declared a Minor Programme can use a maximum of 6 Minor course units (out of 12 non-cores elective units) to fulfil the requirement of the Non-core Electives, whereas;

(a) the requirement for Core Electives remains the same;
(b) the exemption is still allowed if the student is not able to graduate with his/her declared Minor;

(c) no exemption will be granted if the student subsequently dropped the Minor;
(d) the 6 units can come from courses in any of the Minor(s) regardless of how many Minors student declared;
(e) except for case in (d), a course to satisfy the Minor Programme's requirement cannot be used simultaneously to satisfy the non-core electives requirement.

Recommended course pattern

Term 1	**Units**	**Term 2**	**Units**	**Term 3**	**Units**
CSC1110	3	CSC2100	3	ELE3230	3
ELE1110	3	ERG2020	3	ERG2310	3
ERG2013	3	ERG2040	3	IEG3310	3
IEG1001	2	IEG2051	3	IEG3810	1
IEG1810	1	IEG2810	1	Elective*	3
	12		13		13
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
ELT1111	3	ERG4910	4	ERG4920	4
IEG3080	3	Electives*	12	Electives*	12
IEG3821	2				
Electives*	7				
	15		16		16

* *Out of 27 Elective Course units, at least 15 units should be from Core Elective. 7 units of free electives are required.*

Notes: 1. A student who satisfies all the requirements of a stream of specialization may obtain a certifying letter from the department.
2. Students can choose not to have any specialization. A student may graduate with no stream of specialization as long as they satisfy the Major graduate requirements list above.
3. Major courses at 3000 and above level will be included in the calculation of the Major GPA for honours classification. Courses with "#" are to be included in the Major GPA as well.
4. Besides the Major courses mentioned in Note 3, all other ACE, CEG, CSC, ELE, ERG, MAE and SEG courses at 3000 and above level taken by the students will also be included in the calculation of the Major GPA.

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

2. Double Degree Programme in Mathematics and Information Engineering

This Double Degree Programme is jointly offered by Department of Mathematics and Department of Information Engineering. Please refer to Double Degree Programme in Mathematics and Information Engineering for details about this programme.

The Second Degree awarded by the Double Degree Programme is Bachelor of Engineering in Information Engineering. The four required courses for this degree include ELE1110, ERG2013, IEG1001 and 1810, which together account for 9 units. Students in the Double Degree Programme are granted the exemption of substituting these 9 units, as a whole, with a pass in each of MAT2010, 2020 and 2030 in fulfilling the requirements for Bachelor of

Engineering in Information Engineering. The exemption remains granted in case that a student is transferred from the Double Degree Programme to the Programme of Information Engineering.

3. Minor Programme

Two streams of study are available:

I. **Telecommunications**

The stream focuses on the fundamental principles, architectures, design, analysis, and practices of telecommunications and networking system. This stream is suitable for students with interests in the theory of and applications of mathematics to the study of telecommunications systems.

(i)	Required Courses: ERG2040, 2310, IEG1001, 2051	11 units
(ii)	Electives Courses: IEG3010, 3080, 3090, 3310, 4020, 4030, 4100, 4130, 4140, 4160, 4180, 4190	6 units
		Total: 17 units

II. **Computer Networking**

The stream focuses on the principles, architectures, design, and development of systems for computer networks in general and the Internet in particular. This stream is suitable for students with interests in computer networks, Internet software development and systems design.

(i)	Required Courses: CSC1110, 2100, IEG1001, 3310	11 units
(ii)	Elective Courses: IEG3010, 3080, 3090, 4020, 4030, 4100, 4130, 4140, 4160, 4180, 4190	6 units
		Total: 17 units

Notes: 1. Recommended elective courses for the stream are underlined.

2. Students may seek exemptions for up to 9 units. The following courses are exempted automatically:

CSC1110	equivalent:	CSC1130 or 1500 or MAT2071 and 2072 or PHY2351
CSC2100	equivalent:	CSC2520
ERG2040	equivalent:	MAT3280
IEG3310	equivalent:	CSC4430
IEG2051	equivalent:	ERG2030

Other course exemption are possible and will be considered on a case-by-case basis.

3. A maximum of 9 units course exemption will be considered.
4. A maximum of 9 units can be used to fulfil both the Major and Minor Programme requirements.
5. In any case, the total number of units exempted and used to fulfil both the Major and Minor Programme requirements cannot exceed 9 units.
6. Major students minoring in Information Engineering are required to declare which courses will be counted towards the fulfilment of the requirements of the Minor Programme in Information Engineering at their final term of attendance.

4. *Faculty Language Requirement*
5. *Major/Faculty Requirement for S6 Entrants*

Mechanical and Automation Engineering

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

MAE2010
Computer-Aided Drafting
2 U; 1 Lect. 3 Tut. 1st term
Introduction to concepts and skills needed to sketch and create 2D drawings and 3-D models. Introduction to CAD systems. A series of projects for students to learn and practice using various CAD packages for modelling, engineering drawing, animation and analysis. (Not for students who have taken ACE1060.)

MAE2020
Engineering Mechanics
1st term
Force and moment vectors. Free-body diagrams. Equations of equilibrium. Friction. Moments of inertia. Kinematics of particles. Newton's second law. Energy and momentum methods of particles. Kinematics of rigid bodies. Dynamics of rigid bodies. Energy and momentum methods for rigid bodies. Equivalent to ACE1100.

MAE2030
Thermodynamics
2nd term
Fundamental concepts. Pure substance. Work and heat. First and second laws of thermodynamics. Entropy. Elementary power and refrigeration cycles. Applications to air conditioning and internal combustion engines.

MAE2040
Basic Electronics
2nd term
Linear circuit theory. DC and AC analysis. Op-Amps. RLC circuits. Phasor representation and frequency analysis. Introduction to semiconductor devices. Diodes and BJT transistors circuit models. Introduction to digital circuits. Equivalent to ACE1030.

MAE3010
Mechanics of Materials
1st term
Linear elasticity. Stress and strain. Stress-strain relations. Loading and deformation. Statically indeterminate problems. Torsion. Shear forces and bending moments. Stresses in beams. Deflections of beams. Equivalent to ACE2080.

MAE3020
Manufacturing Technology
2nd term
Overview of manufacturing engineering, engineering materials, metal forming processes, machining processes, plastic injection molding processes, and assembly. Hands-on experiments/projects. Equivalent to ACE2060.

MAE3030
Fluid Mechanics
2nd term
Nature of fluids. Fluid statics. Integral and differential equations of fluid flows. Conservation of mass, momentum and energy. Dimensional analysis. Internal flow. External flow. Applications of fluid mechanics in engineering systems.

MAE3040
Mechanical Design
2nd term
Engineering design process. Machine design methodology. Kinematics analysis. Load analysis. Materials and manufacture. Component design. Design synthesis and optimization. Design for reliability. Human factors in design. Equivalent to ACE2020.

MAE3050
Introduction to Control Systems
1st term
Mathematical modelling and linear approximation of engineering systems. Laplace transform. Transfer function and block diagram representation. Characteristics of feedback systems. Performance specifications. Routh-Hurwitz stability criterion. Root locus design. Frequency response design. Nyquist criterion. Utilization of computer-aided analysis and design software. Equivalent to ACE2030.

MAE3060
Introduction to Robotics
1st term
Robot classification and specification. Coordinate frames and homogeneous transformations. Denavit-Hartenberg notation. Forward and inverse kinematics. Differential motion. Jacobians and statics. Singularity. Actuators, sensors, and end-effectors. Trajectory generation. Introduction to robot motion planning. Equivalent to ACE2140.

MAE3070
Engineering Computer Graphics
1st or 2nd term
Elements of interactive computer graphics. Mathematical bases and manipulation of curves and surfaces. Introduction to geometric and solid modelling. Visualization techniques. Applications in industries. Equivalent to ACE2050.

MAE3080
Fundamentals of Machine Intelligence
1st or 2nd term
Data structures, sorting, and searching. Knowledge representation: state space; logical statements; rules; connectionism. Discrete problem solving by state space search. Deduction by resolution in predicate logic. Inference by ruled-based systems. Mappings by networks. Principles of learning. Application examples. Equivalent to ACE2070.

MAE3910
Engineering Profession
2 U; 2 Lect. 1 Tut.; 1st term
Introduction of engineering as a profession (different engineering fields, social responsibility, and career advancement); engineering ethics (law in Hong Kong, mainland China, UK, and US, intellectual property, company and employee relationship); professional engineering registration; engineering project management: market research and response, project scheduling (Gantt chart, PERT/CPM); company visits. Equivalent to ACE2150.

MAE3920
Engineering Design and Applications
2nd term
The course includes a project for students to practice the following topics: engineering design process, innovation and design basics, CAD and CAE tools and applications, prototyping (mechanical workshop), prototyping (electronics workshop), quality and inspection. Equivalent to ACE2160.

MAE4010
Computer-Integrated Manufacturing
1st or 2nd term
Concurrent engineering. Computer-integrated manufacturing models and concepts. Rapid prototyping. Computer-aided manufacturing. Control of manufacturing systems: numerical control and computer numerical control; programmable logic controller; computer aided process planning and manufacturing scheduling; quality assurance. Hands-on experiments/projects. Equivalent to ACE3040.

MAE4020
Finite Element Modelling and Analysis
1st or 2nd term
Finite element method. Computational procedures. Basic elements. Shape functions. Formulation techniques. Boundary conditions. Modelling considerations. Implementation of finite elements. Software use. Engineering applications. Equivalent to ACE3070.

MAE4030
Heat Transfer
1st or 2nd term
Basic concepts. Steady and transient heat conduction. Natural and forced convection. Radiation. Numerical methods.

MAE4040
Mechatronic Systems
1st or 2nd term
Physical system modelling and analysis. Measurement and manipulation principles. Sensors. Actuators. Signal conditioning. Data acquisition and conversion. Microcontrollers and interface. Control system design and tuning. Case studies in system integration. Equivalent to ACE2130.

MAE4050
Modern Control Systems Analysis and Design
1st or 2nd term
Continuous and discrete domain state space representations: transition matrix; stability; controllability and observability; pole placement control; state estimator. Emulation designs. Discrete design. Case studies. Equivalent to ACE3010.

MAE4060
Virtual Reality Systems and Applications
1st or 2nd term
Introduction of virtual reality in engineering applications. Sensors and actuators. Principle and mechanism of VR equipments. Model representation in VR. Computational physics in virtual reality. Real-time rendering. Virtual prototyping. Applications in engineering analysis and simulation. (Not for Majors of Computer Science and Computer Engineering.)

MAE4070
Engineering Optimization
1st or 2nd term
Basic concepts of engineering optimization. Formulation of engineering problems as optimization problems. Method of Lagrange multipliers. Optimality conditions. Unconstrained and constrained optimization. Dynamic programming.

MAE4910
Final Year Project I
3 U; 1st term
This course involves a project in any area of mechanical and automation engineering. Equivalent to ACE3930. (For Mechanical and Automation Engineering Majors only.)

MAE4920
Final Year Project II
5 U; 2nd term
This course involves a project in any area of mechanical and automation engineering. Equivalent to ACE3940. Prerequisite: MAE4910.

(Graduation Project as prescribed by MAE4910/4920 will carry a separate weight of 10% in the assessment for degree classification in Mechanical and Automation Engineering.)

MAE5010
Advanced Robotics
1st or 2nd term
Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control, visual servoing, grasping analysis, object manipulation; sensors and sensor networks, advanced topics in recent development of robotic theory and applications. Equivalent to ACE5030.

MAE5020
Topics in Linear Control Systems
1st or 2nd term
Advanced topics in recent development of linear control theory and its applications. The detailed course contents may be changed from year to year depending on the current development. Equivalent to ACE5050.

MAE5030
Topics in Computer-Aided Geometric Design
1st or 2nd term
Advanced topics in recent development of computer-aided geometric design. The detailed course contents may be changed from year to year depending on the current development. Equivalent to ACE5010.

MAE5040
Computer Vision
1st or 2nd term
Camera models. Stereo vision, camera calibration and stereo calibration. Shape from motion, camera motion estimation and motion tracking. Shape from boundary. Active range sensing. Early vision. Multimedia applications like image transfer and image mosaic construction. Industrial applications. Equivalent to ACE5020.

MAE5050
MEMS and Nano-Robotics
1st or 2nd term
Introduction to MEMS/NEMS devices. Micro/Nano fabrication techniques. MEMS/NEMS design methodology. Experimental methods for Micro/Nano devices. Applications for MEMS/NEMS. Dominant physical phenomena in the Micro/Nano worlds. Micro and Nano scale robotics and assembly. Equivalent to ACE5090.

MAE5060
Computational Intelligence
1st or 2nd term
Concepts, models, methods, and applications of computational intelligence. Topics include neural networks, support vector machines, fuzzy systems, simulated annealing, genetic algorithms, and their applications to control, robotics, automation, manufacturing, and transportation. Equivalent to ACE5070.

MAE5070
Nonlinear Control Systems
1st or 2nd term
Ordinary differential equation description of nonlinear state space systems. Phase plane analysis. Linearization. Concepts of stability. Lyapunov theory. LaSalle theory. Limit cycles. Feedback linearization. Sliding mode control. Backstepping. (Equivalent to ACE5100.)

MAE5080
Smart Materials and Structures
1st or 2nd term
Overview of smart materials technology. Characteristics of smart materials such as piezoelectric materials, magnetorheological fluids, and shape memory alloys. Smart actuators and sensors. Structural modelling and design. Dynamics and control for smart structures. Integrated system analysis. Applications in biomedical devices, precision machinery, transportation, and buildings. Equivalent to ACE5120.

MAE5090
Topics in Robotics
1st or 2nd term
One or more of the following topics will be discussed in the class. Advanced robot control: adaptive control; cooperative robot control; underactuated robot control; multi-finger hand control. Mobile robot: obstacle avoidance; learning; control; and mobile manipulators. Space robotics: dynamics; control; telescience. Human and robot interaction: interface; learning skills. Biorobotics: robots and intelligent systems for medical, healthcare, and laboratory automation and clinic surgery. Robot motion planning: configuration space; search algorithm; potential field, and sensor-based motion planning. Equivalent to ACE5110.

MAE5100
Advanced Engineering Design and Optimization
1st or 2nd term
To provide in-depth understanding of the principles and tools of engineering system design, statistical optimization methods, Design for Six Sigma (DFSS), TRIX, and complex system design.

*ACE1030
Basic Electronics

*ACE1040
Design Principles and Practice

*ACE1050
Design Computing

*ACE1060
Computer-Aided Design and Practice

*ACE1100
Engineering Mechanics

ACE2020
Engineering Product Design
1st term
Engineering design process. Machine design methodology. Kinematics analysis. Load analysis. Materials and Manufacture. Component Design. Design synthesis and optimization. Design for reliability. Human factors in design.

ACE2030
Introduction to Control Systems
1st term
Linear approximation of engineering systems. Laplace transform. Transfer function and block diagram representation. Characteristics of feedback systems. Performance specifications. Routh-Hurwitz stability criterion. Root locus design. Frequency response design. Nyquist criterion. Introduction to state space models. Utilization of computer-aided analysis and design software. (Not for students who have taken ELE2240.)

ACE2040
Multimedia Technology for Design
2nd term
Multimedia Communication. Multimedia information. Systems and standards. Multimedia networks and services. Graphics, video, sound and audio data. Tools for sound generation and processing. Tools for manipulating video and graphics data. Applications of multimedia in design. Prerequisite: ACE2050 or its equivalent.

ACE2050
Engineering Computer Graphics
1st term
Elements of interactive computer graphics. Mathematical bases and manipulation of curves and surfaces. Introduction to geometric and solid modelling. Display techniques. Applications in industries.

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* *Courses offered in 2006-07 and before.*

ACE2060
Manufacturing Technology
2nd term
Overview of manufacturing engineering. Engineering materials. Metal forming processes. Machining processes. Plastic injection molding processes. Assembly. Hands-on experiments/projects.

ACE2070
Fundamentals of Machine Intelligence
2nd term
Data structures, sorting and searching. Knowledge representation: state space; logical statements; rules; connectionism. Discrete problem solving by state space search. Deduction by resolution in predicate logic. Inference by ruled-based systems. Mappings by networks. Principles of learning. Application examples.

ACE2080
Engineering Materials
1st term
Basic engineering materials. Engineering properties of materials. Linear elasticity. Stress and strain. Stress-strain relations. Loading and deformation. Torsion. Shears, moments, and deflections in beams. Fracture. Fatigue. Stress concentration. Safety factor. Material selection for design. Fundamentals of material processing. (Not for students who have taken ACE2120.)

ACE2090
Engineering Practice
1st term
Introduction to engineering profession. Engineering ethics. Environment protection. Industrial health and safety. Introduction to engineering economics. Management tasks. Industrial and engineering organizations. Strategic management and decision making. Basic marketing concepts. (Not for students who have taken ELE2860, 2880 or SEG2470.)

ACE2110
Signal Processing
1st term
Overview of signals and systems. Fourier transform. Sampling theorem. The z-transform. Discrete Fourier transform. Introduction to analysis and design of filters.

ACE2130
Mechatronics Systems
2nd term
Physical system modelling and analysis. Measurement and manipulation principles. Sensors. Actuators. Signal conditioning. Data acquisition and conversion. Microcontrollers and interface. Control system design and tuning. Case studies in system integration.

*ACE2140
Introduction to Robotics

* *Course offered in 2006-07 and before.*

ACE2150
Engineering Profession
2 U; 2 Lect. 1 Tut.; 1st term
Introduction of engineering as a profession (different engineering fields, social responsibility, and career advancement); engineering ethics (law in Hong Kong, mainland China, UK, and US, intellectual property, company and employee relationship); professional engineering registration; engineering project management: market research and response, investment calculation, project scheduling (Gnatt chart, PERT/CPM), risk management, quality control, customer relationship; company visits.

ACE2160
Engineering Design and Applications
2nd term
The course includes a significant project for students to practice the following topics: engineering design process, innovation and design, CAD and CAE tools and applications, prototyping (mechanical workshop), prototyping (electronics workshop), quality and inspection.

ACE2910
Product Design Practice
1st term
Principles and methods of product development. Elements of design cycle: identifying customer needs by practicing quality functional deployment, concept generation by exploring variety of creative thinking and innovation techniques, product architecture using modelling tools, aesthetic and ergonomics consideration, design-for-manufacturing and design for environment.

ACE3010
Modern Control Systems Analysis and Design
1st term
Continuous and discrete domain state space representations: transition matrix; stability; controllability and observability; pole placement controller; state estimator. Emulation designs. Discrete design. Case studies.

ACE3040
Computer-Integrated Manufacturing
1st or 2nd term
Concurrent engineering. Computer-integrated-manufacturing models and concepts. Rapid prototyping. Computer-aided-manufacturing. Control of manufacturing systems: numerical control and computer numerical control; programmable logic controller; computer-aided process planning and manufacturing scheduling; quality assurance. Hands-on experiments/ projects.

ACE3050
Computational and Optimization Methods
1st or 2nd term
Numerical solutions to linear and nonlinear equations. Computational linear algebra. Numerical differentiation and integration. Numerical methods for differential equations. Linear and nonlinear programming. Dynamic programming. Prerequisite: ERG2014 and 2015.

ACE3070
Finite Element Modelling and Analysis
1st or 2nd term
Finite element modelling. Computational procedures. Basic elements. Shape functions. Formulation techniques. Boundary conditions. Modelling considerations. Implementation of finite elements. Software use. Engineering applications.

ACE3080
Multimedia Data Modelling and Analysis
1st or 2nd term
Introduction to various advanced techniques for the modelling and processing of graphics, video, and audio information. Example topics include wavelet analysis and synthesis, radiosity and global illumination, watermarking, and perceptual codings.

ACE3090
Computer Game Design and Development
1st or 2nd term
Character design. Story boarding. Puzzle and mission design. Animation techniques including physical modelling, inverse kinematics, soft object modelling, procedural modelling, and motion capture techniques. Collision detection. Behaviour modelling. Scene management. Use of music and audio effects in games. The use and the interface of different peripherals. Tools for game development. Design of games on the internet.

*ACE3100
Machine Vision and Image Processing

*ACE3120
Geometric Modelling and Processing

*ACE3130
Robot Dynamics and Control

*ACE3140
Optimal and Robust Control

*ACE3180
Methods and Applications of Computational Intelligence

*ACE3200
MEMS and Nano Robotics

*ACE3210
Nonlinear Systems and Control

*ACE3220
Smart Materials and Structures

ACE3930
Final Year Project I
3 U; 1st term
This course involves a significant project in any area of automation and computer-aided engineering. (For Automation and Computer-Aided Engineering Majors admitted in 2006-07 and before.)

ACE3940
Final Year Project II
5 U; 2nd term
This course involves a significant project in any area of automation and computer-aided engineering. Prerequisite: ACE3930. (For Automation and Computer-Aided Engineering Majors admitted in 2006-07 and before.)

(Graduation Project as prescribed by ACE3930/3940 will carry a separate weight of 10% in the assessment for degree classification in Automation and Computer-Aided Engineering .)

* *Courses offered in 2006-07 and before.*

Study Scheme

1. Major Programme

Mechanical and Automation Engineering

Applicable to students admitted in 2007-08 and thereafter

Students are required to complete a minimum of 72 units of Major courses as follows:

(i)	Required Courses: CSC1111, ELT1111, ERG2014, 2015, MAE2010, 2020, 2030, 2040, 3010, 3020, 3030, 3040, 3050, 3060, 3910, 3920, 4910, 4920, MGT1010 Graduation Project as prescribed by MAE4910/4920 will carry a separate weight of 10% in the assessment for degree classification.	57 units
(ii)	Elective Courses (at least 9 units of courses at MAE4000 level and above): CSC2800, 3170#, DSE2050, ELE3230#, 3240#, ERG2020, 3820#, MAE3070, 3080, 4010, 4020, 4030, 4040, 4050, 4060, 4070, 5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, MGT4090#, SEG2440# (or DSE1030+), SEG3500#, 3600#, 3810#	15 units
		Total: 72 units

Plus three weeks of industrial training in the summer after their first year of attendance.

+ Students can take either SEG2440# or DSE1030 but not both.

Recommended Course Pattern

Term 1	**Units**	**Term 2**	**Units**	**Term 3**	**Units**
CSC1111	3	ERG2015	3	MAE3010	3
ELT1111	3	MAE2030	3	MAE3050	3
ERG2014	3	MAE2040	3	MAE3060	3
MAE2010	2	MGT1010	3	MAE3910	2
MAE2020	3			Major Elective	3
	14		12		14
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
MAE3020	3	MAE4910	3	MAE4920	5
MAE3030	3	Major Electives	6	Major Elective	3
MAE3040	3				
MAE3920	3				
Major Elective	3				
	15		9		8

Notes: 1. Major courses at MAE3000 level and above will be included in the calculation of the Major GPA for honours classification. Courses with "#" are to be included in the Major GPA as well.

2. Students are strongly advised to consult with the academic adviser in choosing Major elective courses.

3. Students are required to take Professional Engineering Training Module which consists of ELT1111, MGT1010, MAE3910, 3920, 4910, 4920 and three weeks of industrial training.

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

Automation and Computer-Aided Engineering

A. Applicable to students admitted in 2006-07

There are two streams of specialization: Automation and Design. Students may choose to specialize in one of the two streams and select certain courses as prescribed. A student who does not wish to specialize in any of the two streams should follow a study scheme devised with the advice of the Academic Adviser of the Department.

Students are required to complete a minimum of 81 units of Major courses as follows:

(i)	Required Courses: ACE1030, 1060, 1100, 2060, 2070, 2080, 2150, 2160, 3930, 3940, CSC1111, ELT1111, ERG2014, 2015, 3820#, MGT1010 Graduation Project as prescribed by ACE3930/3940 will carry a separate weight of 10% in the assessment for degree classification.	48 units
(ii)	Elective Courses (at least 9 units of courses at ACE3000 (or MAE4000) level and above): *Core Electives* ACE1040, 1050, 2020, 2030, 2040, 2050, 2110, 2130, 2140, 2910, 3010 *Non-core Electives* ACE3040, 3050, 3070, 3080, 3090, 3100, 3120, 3130, 3140, 3180, 3200, 3210, 3220, CSC3170#, ELE3230#, 4230#, ERG2020, IEG3310#, MAE5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, SEG2440#, 3450#, 3490#, 3500#	33 units
		Total: 81 units

Plus three weeks of industrial training in the summer after their first year of attendance.

Streams of Specialization

To qualify for a stream of specialization, students must complete the core electives under the stream.

(1) **Automation Stream**
ACE2030, 2110, 2130, 2140, 3010

(2) **Design Stream**
ACE1040, 1050, 2020, 2040, 2050, 2910

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

B. Applicable to students admitted in 2005-06

There are two streams of specialization: Automation and Design. Students may choose to specialize in one of the two streams and select certain courses as prescribed. A student who does not wish to specialize in any of the two streams should follow a study scheme devised with the advice of the Academic Adviser of the Department.

Students are required to complete a minimum of 79 units of Major courses as follows:

(i)	Required Courses: ACE1030, 1060, 1100, 2060, 2070, 2080, 2090, 3930, 3940, CSC1110, ELT1111, ERG2014, 2015, 3820[#] Graduation Project as prescribed by ACE3930/3940 will carry a separate weight of 10% in the assessment for degree classification.	43 units
(ii)	Elective Courses (at least 9 units of courses at ACE3000 (or MAE4000) level and above): *Core Electives* ACE1040, 1050, 2020, 2030, 2040, 2050, 2110, 2130, 2140, 2910, 3010 *Non-core Electives* ACE3040, 3050, 3070, 3080, 3090, 3100, 3120, 3130, 3140, 3180, 3200, 3210, 3220, CSC3170[#], ELE3230[#], 4230[#], ERG2020, IEG3310[#], MAE5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, SEG2440[#], 3450[#], 3490[#], 3500[#]	36 units
		Total: 79 units

Plus three weeks of industrial training in the summer after their first year of attendance.

Streams of Specialization

To qualify for a stream of specialization, students must complete the core electives under the stream.

(1) **Automation Stream**
ACE2030, 2110, 2130, 2140, 3010

(2) **Design Stream**
ACE1040, 1050, 2020, 2040, 2050, 2910

Recommended Course Pattern (Automation Stream)

I. Applicable to students admitted in 2006-07

Term 1	Units	Term 2	Units	Term 3	Units
ACE1030	3	ACE1100	3	ACE2080	3
ACE1060	3	ERG2015	3	ACE2150	2
CSC1111	3	MGT1010	3	Core Electives:	
ELT1111	3	Core Elective:		ACE2030	3
ERG2014	3	ACE2140	3	ACE2110	3
				Major Elective	3
	—		—		—
	15		12		14

Term 4	Units	Term 5	Units	Term 6	Units
ACE2060	3	ACE3930	3	ACE3940	5
ACE2070	3	Core Elective:		Major Electives	6
ACE2160	3	ACE3010	3		
ERG3820	2	Major Electives	9		
Core Elective:					
ACE2130	3				
	14		15		11

II. Applicable to students admitted in 2005-06

Term 1	Units	Term 2	Units	Term 3	Units
ACE1030	3	ACE1100	3	ACE2080	3
ACE1060	3	ELT1111	3	Core Electives:	
CSC1110	3	ERG2015	3	ACE2030	3
ERG2014	3	Core Elective:		ACE2110	3
		ACE2140	3	Major Electives	6
		Major Elective	3		
	12		15		15
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
ACE2060	3	ACE2090	3	ACE3940	5
ACE2070	3	ACE3930	3	Major Elective	3
ERG3820	2	Core Elective:			
Core Elective:		ACE3010	3		
ACE2130	3	Major Electives	6		
Major Elective	3				
	14		15		8

Recommended course pattern (Design Stream)

I. Applicable to students admitted in 2006-07

Term 1	Units	Term 2	Units	Term 3	Units
ACE1030	3	ACE1100	3	ACE2080	3
ACE1060	3	ERG2015	3	ACE2150	2
CSC1111	3	MGT1010	3	Core Electives:	
ELT1111	3	Core Electives:		ACE2020	3
ERG2014	3	ACE1040	3	ACE2050	3
		ACE1050	3	ACE2910	3
	15		15		14
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
ACE2060	3	ACE3930	3	ACE3940	5
ACE2070	3	Major Electives	9	Major Electives	6
ACE2160	3				
ERG3820	2				
Core Elective:					
ACE2040	3				
	14		12		11

II. Applicable to students admitted in 2005-06

Term 1	Units	Term 2	Units	Term 3	Units
ACE1030	3	ACE1100	3	ACE2080	3
ACE1060	3	ELT1111	3	Core Electives:	
CSC1110	3	ERG2015	3	ACE2020	3
ERG2014	3	Core Electives:		ACE2050	3
		ACE1040	3	ACE2910	3
		ACE1050	3	Major Elective	3
	—		—		—
	12		15		15
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
ACE2060	3	ACE2090	3	ACE3940	5
ACE2070	3	ACE3930	3	Major Elective	3
ERG3820	2	Major Electives	9		
Core Elective:					
ACE2040	3				
Major Elective	3				
	—		—		—
	14		15		8

Notes: 1. Major courses at ACE2000 or MAE3000 level and above will be included in the calculation of the Major GPA for honours classification. Courses with "#" are to be included in the Major GPA as well.

2. Students are strongly advised to consult with Academic Adviser in choosing Major elective courses.

2. Minor Programme

Students are required to complete a minimum of 18 units as follows:

(i) Required Courses: 6 units
MAE2020, 3060

(ii) Elective Courses: 12 units
MAE2030, 3010, 3020, 3030, 3040, 3050, 3070, 3080, 4010, 4020, 4030, 4040, 4050, 4060, 4070

Total: 18 units

Notes: 1. Elective courses are subject to availability.

2. Students are required to take one of the following mathematics courses as prerequisite: ERG2011, 2012, 2013, 2014, 2015, 2018, MAT1020, 2010.

3. Students who have not obtained the HKALE grade E or above in (a) one A-Level subject on Physics or Engineering Science, or (b) two AS Science subjects with one of which being Physics, are required to take PHY1001 before taking MAE courses.

3. Faculty Language Requirement

4. Major/Faculty Requirement for S6 Entrants

Systems Engineering and Engineering Management

Course Description

(Unless otherwise specified, all are 3-unit term courses of three hours of lecture and one hour of tutorial per week.)

SEG2420
Operations Research I
Review of linear algebra. Linear programming: simplex methods, duality and sensitivity analysis. Network flows: transportation and assignment problems, shortest paths, minimum spanning trees, network simplex method and multicommodity flows. Modelling issues in linear programming and network flows applications.

SEG2430
Applied Probability and Statistics
Sample space. Random variable. Probability and conditional probability. Distribution. Expectation and variance. Characteristic function. Law of large numbers and central limit theorem. Markov chain. Poisson process. Estimation: errors, sample size, maximum likelihood estimation and consistency. Regression. Time series.

SEG2440
Engineering Economics
Principles of engineering economy. Value and cost; cash flows. Economic analysis of alternatives, technological, social and human factors. Models involving allocation and scheduling of resources. Analytical techniques for evaluating industrial projects. Relationship between economics of technical choice and industrial productivity. Basic financial accounting concepts; accounting cycle; financial statements.

SEG2450
Production Planning and Control
Overview of engineering economy. Introduction to industrial organizations and functions of management. Principles of production planning and control. Inventory management. Materials requirements planning. Stochastic modelling of manufacturing systems. Manufacturing resources planning. Capacity planning and scheduling. Productivity measurement and analysis. Just-in-time approach. Quality management; introduction to ISO 9000. (Not for Systems Engineering and Engineering Management Majors.)

SEG2470
Fundamentals in Engineering Management
This course is aimed at introducing students to the basics of engineering management. The major topics include: management tasks, industrial and engineering organizations, strategic management and decision making, financial management and basic marketing concepts. The use of mathematical models and computer-aided decision support is emphasized.

SEG2500
Management Principles for Engineering Managers (I)
Introduction to Management functions including planning, organizing, influencing, and controlling; project management; team building; corporate knowledge management, strengths and weaknesses of engineers as managers; global issues, and engineering management challenges. Introduction to marketing management including market segmentation, product positioning, pricing strategy, promotion, channels, marketing survey, customer relationship management, and the use of customer relationship management systems. (Not for Systems Engineering and Engineering Management Majors.)

SEG2510
Management Principles for Engineering Managers (II)
Introduction to financial and cost analysis: valuation of assets, liabilities, shareholder's equity; determination of revenues and expenses; cost analysis; allocation of indirect cost; budgeting and performance; use of financial and cost data for planning and control. Introduction to macroeconomics including national income accounting, aggregate demand and supply models, demand and supply of money, fiscal and monetary policies, balance of payment, exchange rate systems, and business cycle theory. (Not for Systems Engineering and Engineering Management Majors.)

SEG2520
Fundamentals in Financial Engineering
Overview of financial markets for securities, foreign exchange, options and futures; special emphasis on understanding of the market characteristics; interpretation of financial statements of an organization in terms of liquidity, solvency, profitability, efficiency and growth.

SEG2530
Systems Engineering and Society
2 U; 2 Lect. 1 Tut.
Introduction to Systems Engineering, design and innovation in engineering. Intellectual property rights and other legal issues related to engineering, information technologies and E-commerce. Professional liabilities, engineering ethics and societal impact. Health considerations, safety concerns and environmental impact.

SEG3410
System Simulation
System concept and mathematical models. Model building: parameter estimation and data analysis. Elementary queuing theory and applications: M/M/S models. Introduction to simulation and simulation language. Principles of discrete event simulation. Random number generators and output analysis. Optimization via simulation. Applications to production and manufacturing systems. Prerequisites: CSC1110 and SEG2430 or with the approval of the course instructor.

SEG3420
File Structures and Processing
Role of files in data processing. Data organization on secondary storage. Choice of storage media. Blocking and buffering. Design of file parameters and performance computation of file processing. Record clustering and record partitioning. File organizations and access methods for sequential, indexed and direct file organizations. VSAM files. Static and dynamic hashed files. Hybrid files. Prerequisite: SEG3460 or with the approval of the course instructor.

SEG3430
Information Systems Analysis and Design
Information system development life cycle; user requirement analysis; feasibility study; cost/benefit analysis; systems analysis tools such as data flow diagrams and process specification tools. Real time systems analysis. Transformation from analysis to design. Structured chart. System design quality heuristics such as coupling and cohesion. System design packaging and design optimization: CASE (Computer-Aided Software Engineering) Tools. Prerequisite: SEG3460 or with the approval of the course instructor.

SEG3440
Operations Research II
Non-linear programming: convex sets and functions; local and global optima; Lagrange multipliers; optimality conditions for unconstrained problems; descent methods; constrained optimization; Karush-Kuhn-Tucker conditions; solution methods. Non-differentiable optimization: integer programming models; formulations; cutting-plane methods; branch-and-bound. Dynamic programming: models and formulation; Bellman's equations; solution methods.

SEG3450
Engineering Innovation and Entrepreneurship
Factors that drive continuous creative product innovation. Study of processes of creating, assessing and pursuing product opportunities. Evaluation of new product ideas and risk assessment of commercialization. Product development strategies in industrial marketing. Understanding the behaviour of buyer. Formulation and implementation of innovative marketing strategy and business plan. Prerequisite: SEG2440 or 2450 or with the approval of the course instructor.

SEG3460
Computer Processing Systems Concepts
Principles of operating system functions. Introduction to assemblers, linkers, loaders and libraries. Performance analysis of scheduling algorithm. Applications based on systems such as DOS, UNIX and MVS/ESA. Job control language, procedures, parameter passing and utilities. Comparison of programming languages of different levels and their evaluation and selection based on application needs. Prerequisite: CSC1110 or with the approval of the course instructor.

SEG3470
Dynamic Optimization and Applications
Dynamic programming for sequential decision making under uncertainty, optimal control and combinatorial optimization. Applications to network problems (shortest paths, Viterbi algorithm, the travelling salesman problem) and discrete time dynamic optimization problems of finite and infinite horizon (linear-quadratic optimal control, inventory control, portfolio analysis). Numerical solution methods for infinite-time dynamic programming: value iteration, policy iteration and linear programming. Introductory continuous-time optimal control: calculus of variations, Pontryagin principle and the Hamilton-Jacobi-Bellman equation. Prerequisites: SEG2430 and 3440 or with the approval of the course instructor.

SEG3490
Information Systems Management
In-depth discussion of the challenges, techniques and technologies associated with the management of IT in a competitive environment. The linkage of IT to business strategy and business process re-engineering. Type of information systems: MIS, DSS, TPS. Development process. Information system planning. Systems project management and control. IT acquisition, budgeting and deployment. Performance evaluation and auditing. Operations management. Privacy and security. Prerequisite: SEG3430 or with the approval of the course instructor.

SEG3500
Quality Control and Management
Quality planning, control and improvement. Sampling theory. Statistical quality control theory applied to production operations. Specification and control charts for monitoring production systems. Quality engineering - the Taguchi Method. Quality control issues of manufacturing and service industry. Case studies of quality control problems in industry. Use of computer aids. Introduction to ISO 9000. Prerequisite: SEG2430 or with the approval of the course instructor.

SEG3510
Human-Computer Interaction
This course provides an introduction to the fast evolving field of human computer interaction (HCI). HCI is a multidisciplinary subject concerning the design, implemen-tation and evaluation of interactive computing systems for human use, and the study of major phenomena surrounding them. We will provide a broad overview of the field, including the theory and principles underlying good designs, with an emphasis on the interface design process, development and evaluation. We will also sample some state-of-the-art technologies in HCI, such as speech recognition, haptics, virtual reality, software agents and computer supported cooperative work.

SEG3520
Managing Information Technology
Types of information systems: MIS, DSS, TPS. Subsystems. Development process. Information system planning. Establishing standards and procedures. Systems project management and control. Acquisition of resources. Budgeting for computer systems. Performance evaluation. Information system quality. Information technology concepts: networking, database, batch processing and distributed processing. Software quality assurance. Privacy and security. Auditing computer systems. Managing distributed and end-user information systems. Software cost estimation. (Not for students of Engineering Faculty.)

SEG3530
Engineering and Technology Management
Managerial functions: planning, organizing, influencing and control. Strategic formulation and decision making. Strategic and operational considerations of technology. Management of research, engineering design and production functions. Project screening and selection. Project structuring, scheduling and budgeting. Project control.

SEG3540
Concepts of Information Systems
The roles of information systems in business application. Concepts of IS technology: databases, information retrieval, intelligent systems, transaction processing. Integration of different IS technologies. Concepts of telecommunication, Internet and Intranet. (Not for students of Engineering Faculty.)

SEG3550
Fundamentals in Information Systems
Basic elements of information systems, their concepts and interrelations. Database systems: database models, relational database, database application programming. Information retrieval: models, indexing, performance evaluation. Expert systems: knowledge and data engineering, expert system shell, application studies.

SEG3560
Introduction to E-Commerce
The course provides an overview of the technologies that support the development of E-Commerce applications, business models and strategies for E-Commerce, electronic payments and security, as well as legal issues related to E-Commerce such as intellectual property rights.

SEG3570
Stochastic Models
Review of basic probability. Probabilistic dynamic programming. Stochastic processes and Markov chains. Birth-and-death processes and queuing models. Stochastic inventory models: single and multiple periods. Forecasting and time series. Markov decision processes. Prerequisite: SEG2430 or with the approval of the course instructor.

SEG3580
Risk Analysis for Financial Engineering
Analysis and modelling of market, credit, and operational risks in Financial Engineering. Fundamental financial instruments and derivatives: forward, futures, options, and swaps. Sources and models of market risks: interest rate, foreign exchange rate, equity prices, and commodity prices. Major credit scoring and rating models: Z-score, Logit, and Merton. Major commercial applications and systems, KMV and CreditMetrics. Different approaches to measure Value at Risk (VaR): historical, parametric, and Monte Carlo.

SEG3590
Investment Science
Basic theory of interests, fixed income securities, the term structure of interest rates, valuation of a firm, decision making under uncertainty, mean-variance portfolio theory, capital asset pricing model, models and data, basics of forward and futures contracts, basic options theory.

SEG3600
Engineering Entrepreneurship
2 U; 2 Lect. 1 Tut.
Evaluation of new product ideas and risk assessment of commercialization. Study of processes of creating, assessing and pursuing product opportunities. Venture launch and growth. Formulation and implementation of innovative marketing strategy and business plan. (This course must be taken concurrently with SEG3810 and is not for students who have taken SEG3450.)

SEG3610
Fundamentals in E-Commerce
2 U; 2 Lect. 1 Tut.
This course provides an overview of the technologies that support the development of E-Commerce applications, business models and strategies for E-Commerce, electronic payment and security. (Not for students who have taken SEG3560.)

SEG3630
Service Management
Overview of the operations functions of service organizations. Examination of methods for designing and operating service delivery systems in the health care, financial, hospitality, telecommunication, and logistics industry. Discussion on service strategy, services for individual and corporate customers, service technologies, process and facility design, management of waiting lines, demand forecasting, demand and supply management, service quality, staffing and scheduling.

SEG3810
Product Development Project
1 U

SEG4410
Real-Time Computer Systems
Introduction to real-time data processing systems and their design and analysis. Reliability and fault tolerance. Exception and exception handling. Concurrent programming. Shared-memory-based synchronization and communication. Message-passing-based synchronization and communication. Atomic actions and error recovery in concurrent processes environment. Resource control. Real-time facilities of real-time languages. Implementation efficiency. Case studies. Prerequisite: SEG3460 or with the approval of the course instructor.

SEG4420
Combinatorial Optimization
Overview of combinatorial optimization. Optimization on networks: maximum-cardinality matching, maximum-weight matching, travelling salesman problem, vehicle routing problem. Packing: formulations, solutions and analysis of capital budgeting problems. Covering: formulations, solutions algorithms and applications to airline crew scheduling and facility locating. Graph coloring: definitions, basic properties and solutions. Introduction to NP-hardness. Prerequisite: SEG3440 or with the approval of the course instructor.

SEG4430
Stochastic Models in Decision Making
Elementary factors in stochastic models. Stochastic dynamic programming. Advanced topics in queuing system: queuing models involving nonexponential distributions, queuing networks, Monte Carlo analysis and decision models. Stochastic inventory models: single and multiple period models with and without set-up costs. Forecasting techniques: constant level models and linear trend models. Prerequisites: SEG2430 and 3440 or with the approval of the course instructor.

SEG4480
Decision Methodology and Applications
Review of basic decision analysis concepts and methodologies. Single- and multiattribute utility theory under both certainty and uncertainty. Assessment methodologies; strength of preference; risk attitude; trade-off judgements. Prior information; subjective probability; Bayesian analysis; sequential analysis. Multiobjective optimization; methods for generating Pareto optimum solutions; methods with prior assessment of preferences; method with progressive assessment of preferences. Risk sharing and group decisions. Cooperative and non-cooperative game methods. Applications to risk analysis and management. Prerequisites: SEG2430 and 3440 or with the approval of the course instructor.

SEG4500
Facility Management
Construction and renovation. Maintenance and operation. Real estate consideration and planning. Space planning layout. Facility financial forecasting and management. General administrative services. Successful facility management. Industrial applications. Prerequisite: SEG2420 or with the approval of the course instructor.

SEG4510
Case Studies in Decision Making
Review of quantitative decision-making methods. Examination of problems arising from practical business planning and operations, and applications of quantitative methods, including mathematical tools and operations research techniques, to solve problems. Emphasis will be placed on studies of cases of successful real-world applications and project work. Prerequisites: SEG3410 and 3440 or with the approval of the course instructor.

SEG4520
Intelligent Management Support Systems
Decision modelling and support. Overview of management support systems. Data and model management in decision support systems. Group decision process. Group decision support systems and distributed group decision support systems. Executive information and support systems. Applications of artificial intelligence methodologies in decision support of accounting, investment and marketing systems. Integration of decision support technologies. Design and development of management support systems. Organizational and societal impacts. Prerequisite: CSC3230 or with the approval of the course instructor.

SEG4530
Introduction to Client/Server Systems
Client/server theory and practice. Management aspects: vision, priority and transition strategies, operational challenges. Overview of major protocols and distributed system concepts. Prerequisite: SEG3460 or with the approval of the course instructor.

SEG4540
Open Systems for E-Commerce
Overview the technologies and mechanisms of open systems. Advanced Internet applications including electronic commerce using open system and Web technologies. Multimedia applications over open systems. Applications on wireless and mobile network. Prerequisite: SEG3460 or with the approval of the course instructor.

SEG4550
Production Systems Planning and Management
Systems analysis and business process re-engineering. Performance variability and measures. Push and pull production systems. Operations planning. Production scheduling. Aggregate and workforce planning. Capacity planning and management. Enterprise resource planning systems.

SEG4560
Computational Intelligence for Decision Making
Introduction to knowledge-based system, neural computing, genetic algorithm and fuzzy logic. Inference methods and uncertainty management in design and implementation of expert systems. Application of computational intelligence techniques to management decision systems in specific business areas. Prerequisite: CSC2100 or with the approval of the course instructor.

SEG4570
System Design and Implementation
System implementation methodology construction, testing and maintenance. Software re-engineering and reverse engineering; software reliability and programme quality assurance; software reusability Software metrics. Performance engineering. Configuration management. Object-oriented system design. Use of computer-aided tools. Prerequisite: SEG3430 or with the approval of the course instructor.

SEG4580
Special Topics in SE&EM I
This course is designed to investigate and discuss selected topics of current interest in Systems Engineering and Engineering Management.

SEG4581
Special Topics in SE&EM II
This course is designed to investigate and discuss selected topics of curent interest in Systems Engineering and Engineering Management.

SEG4590
Special Topics in SE&EM III
This course is designed to investigate and discuss selected topics of current interest in Systems Engineering and Engineering Management.

SEG4591
Special Topics in SE&EM IV
This course is designed to investigate and discuss selected topics of current interest in Systems Engineering and Engineering Management.

SEG4600
Logistics Management
The integrated logistics management concept. Customer service. Channels of distribution. Transportation; vehicle routing and scheduling; freight consolidation. Facility location and network planning. Storage and material handling systems. Information systems for order processing and inventory tracking. Purchasing and supply scheduling. Business process re-engineering. Third-party logistics. Global logistics.

SEG4610
Supply Chain Management
Management of moving raw materials, in-process inventory and finished-goods; transferring information and payment. Topics include: distribution; inventory management; purchasing and supplier management; the value of information and information technology; supply chain integration and strategic partnering; product design for supply chain management.

SEG4620
Electronic Payments Systems
This course covers various methods of transferring payments over the Internet and compares their functionality. Topics include electronic cash, electronic checks, electronic credit cards, micro-payments, certification of authority, the encryption and digital signature techniques needed to support electronic cash, and the technologies available to support secure transactions on the Internet. Implementations of various payment systems are examined.

SEG4630
E-Commerce Data Mining
This course introduces data mining techniques suitable for E-Commerce applications. It covers the following topics: prediction, association rule mining, rule induction, trend and deviation analysis, pattern visualization and data mining packages. Emphasis will be placed on employing these techniques to marketing, risk management, business negotiation and commercial applications.

SEG4640
Financial Decision and Pricing Models
Review of important concepts in financial decision theory such as utility theory, arbitrage, market efficiency hypothesis, mean-variance analysis, capital asset pricing models, separation theorems and arbitrage pricing theory and option pricing. Computational techniques such as stochastic programming, binomial trees and the finite difference method. Prerequisites: SEG2440 or FIN2010 and SEG2420 or with the approval of the course instructor.

SEG4650
Procurement Management
Overview of purchasing, quality specification and inspection, materials planning and control, price determination and negotiation, contract management, vendor management, international issues, and acquisition of fixed assets and services.

SEG4660
Pricing and Revenue Management
Basics of revenue management: dynamic pricing strategies and product availability decisions, customer segmentation, demand estimation and forecasting, channel management, revenue-based inventory control. Application of optimization tools. Case studies in industries such as airline, hospitality, rental services, and events/ entertainment, with focus on multi-pricing across products, markets, channels and time. Prerequisite: SEG2420 or with the approval of the course instructor.

SEG5410
Optimal Control
3 U; 3 Lect.
Dynamic continuous-time systems. Examples, modelling and classification of optimal control problems. Pontryagin's maximum principle: adjoint equation, Hamiltonian system and sufficient condition of optimality. Bellman's dynamic programming: principle of optimality, Hamilton-Jacobi-Bellman equation and verification theorem. Linear quadratic control: Riccati equation and linear matrix inequality. Introduction to numerical methods of solving optimal control problems.

SEG5420
Scheduling and Sequencing
3 U; 3 Lect.
Classification of scheduling and sequencing problems. Sequencing involving capacity expansion. Single machine scheduling involving due dates: problem formulation and applications, complexity, exact solutions and approximate solutions. Parallel machine scheduling. Flowshop scheduling. Jobshop scheduling. Batch scheduling with set-up times between batches. Prerequisite: SEG3440 or with the approval of the course instructor.

SEG5430
Optimal Production Planning
3 U; 3 Lect.
Overview of manufacturing systems: resources, constraints, cost, planning horizon and objective of production planning. Deterministic production planning: parallel machine systems, flowshops and jobshops. Dynamic programming equations. Zero-inventory policy. Capacity expansion and HMMS model. Stochastic production planning: unreliable machines, Markov Chains, Akella-Kumar theorem and threshold-type policy. Hierarchical production planning. Prerequisites: SEG2430 and 3440 or with the approval of the course instructor.

SEG5440
Selected Topics in Discrete Optimization
3 U; 3 Lect.
Review of classical optimization. NP-hardness and using NP-hardness to analyse discrete optimization problems. Design and analysis of algorithms for easy and hard problems, including dynamic programming with pseudo-polynomial complexity, simulated annealing, fully polynomial approximation schemes, genetic algorithms and heuristics. Prerequisite: SEG3440 or with the approval of the course instructor.

SEG5450
Discrete Event Systems
3 U; 3 Lect.
Discrete event systems (DESs) modelling, manufacturing systems, computer networks and air-traffic control systems. Methodologies and techniques in analysing, controlling and managing of DESs: discrete event simulation, perturbation analysis, supervisory control and automata, Petri net, max algebra, etc. Prerequisite: SEG3410 or with the approval of the course instructor.

SEG5460
Information Systems Engineering
3 U; 3 Lect.
Review of information systems development, systems project planning and control, and other related managerial issues; information systems engineering economics; quantitative analysis of systems development; systems cost and effectiveness analysis; design principles and methodology for management information systems, decision support systems, real-time systems and unsurveyable systems. Prerequisite: SEG3430 or with the approval of the course instructor.

SEG5470
Knowledge Systems
3 U; 3 Lect.
The roles of knowledge systems in problem solving. Automation of commonsense reasoning. Nonmonotonic and plausible reasoning. Representation and reasoning about quantities, measurements, time, space and physics. Knowledge systems to represent mind, plans and goal.

SEG5480
Engineering Management Strategy
3 U; 3 Lect.
The course introduces students to the basics of strategic management. All aspects of strategic planning tools and techniques, strategy formulation and decision making, and implementation and control are covered. Topics include SWOT analysis, forecasting models, decision methodology, project planning, implementation and evaluation, team building and communication. Integration of business functions such as finance, human resources, marketing, and production and operations is emphasized.

SEG5490
Advanced Engineering Economics
3 U; 3 Lect.
Accounting income. Cash flow modelling. Depreciation and taxation. Overview of utility theory. Analysis of economic risk. Risk simulation. Decision tree analysis. Procedures for replacement analysis. Activity-based costing. Analytical hierarchy process. Economic optimization under constraints. Strategic investment analysis. Prerequisite: SEG2440 or with the approval of the course instructor.

SEG5520
Optimization I
3 U; 3 Lect.
The course covers the underlying theory and fundamental solution methodologies of mathematical programming: linear programming and unconstrained and constrained non-linear optimization. Topics include optimality conditions, search methods, descent methods, Lagrange multipliers and penalty functions. Developments of duality theory are presented. Concepts and issues in global optimization and multi-objective optimization are introduced. Applications are drawn from engineering and financial optimization.

SEG5530
Client/Server Systems Engineering
3 U; 3 Lect.
Issues in building client/server information systems. Concept, implementation and management aspects in the development cycle of client/server systems. Advanced technology such as distributed objects, CORBA and COM+, component technology and client/server system management.

SEG5540
Optimization II
3 U; 3 Lect.
The first part of this course covers underlying theory and fundamental solution methodologies of integer programming: optimality, relaxation and bounds, complexity and problem reductions, branch and bound, cutting plane algorithms, strong valid inequalities and duality theory. The second part of this course covers some of the recent developments in mathematical programming: interior point methodology, conic optimization and semidefinite programming. Various applications in engineering, management, and financial economics are discussed.

SEG5570
Numerical Methods in Finance
3 U; 3 Lect.
This course emphasizes the use of numerical methods for solving financial problems. The numerical methods include: binomial trees, Monte Carlo simulation, stochastic programming, linear/quadratic control models and semidefinite programming techniques. Those techniques will be applied, among other things, to: option pricing, index tracking, portfolio optimization, interest rate models and asset/liability management.

SEG5580
Advanced Stochastic Models
3 U; 3 Lect.
Poisson process. Birth-and-death process. Markov chain. Martingale. Brownian motion. Renewal and stationary processes. Stochastic integration and Ito's formula. Applications to queueing models, inventory models and financial investment/hedging models.

SEG5590
Financial Decision Models
3 U; 3 Lect.
Utility theory. Mean-variance model. Capital asset pricing. Asset dynamics and Ito processes. Option pricing and Black-Scholes formula. Term structure and interest-rate derivatives. Introduction to stochastic optimal control model and Hamilton-Jacobi-Bellman equation.

SEG5600
Logistics and Transportation Planning
3 U; 3 Lect.
Global logistics management. Facility location models. Network design. Transportation planning: mode selection, routing and scheduling. Transportation and transshipment problems. Vehicle routing models. Fleet management. Less-than-truckload deliveries. Warehouse layout and management. The lotsize/inventory/transportation tradeoff. Enabling technologies for logistics management.

SEG5610
Inventory and Supply Chain Management
3 U; 3 Lect.
Strategic importance of inventory management. Deterministic and Stochastic inventory models. Co-ordinated replenishment for multiple items. Enterprise resources planning. Multi-echelon inventory management: constant and time-varying demand models. Push and pull systems. Coordination and incentive issues in a supply chain. The value of information. Strategic partnering and product design for supply chain management.

SEG5620
Data Warehousing for Financial Engineering
3 U; 3 Lect.
This course addresses the data and decision aspects of financial information systems. The data aspect includes collection, cleansing, storage and retrieval of quantitative and qualitative financial data. The decision aspect include on-line analytical processing on financial data and data mining for nontrivial data pattern and knowledge.

SEG5640
Human-Computer Spoken Language Systems
3 U; 3 Lect.
Principles and theories underlying the design and implementation of human-computer spoken language systems. Component technologies including multilingual speech recognition, natural language understanding, dialog modelling and speech synthesis. Related topics including acoustic-phonetics in conversational speech, linguistic features of spoken launguage, digital signal processing, pattern recognition, machine learning, statistical modelling and artificial intelligence. Software architectures that integrate the various component technologies. Examples of real applications. Students are advised to take ELE3410 before taking this course. Prerequisite: SEG2430 or with the approval of the course instructor.

Study Scheme

1. Major Programme

A. Applicable to students admitted in 2007-08 and thereafter

There are three streams of specialization: Business Information Systems, Financial Engineering, and Logistics and Supply Chain Management. Students may choose to specialize in one of the three streams and select certain courses as prescribed. A student who does not wish to specialize in any of the three streams should follow a study scheme devised with the advice of the academic advisers of the Department.

Students are required to complete a minimum of 81 units of Major courses as follows:

(i)	Required Courses: ERG2018, 2020, 4910#, 4920#, SEG2420, 2430, 2440, 2530, 3410, 3430, 3440, 3460, 3530, 3550, 3570, 3600, 3610, 3810, 4570, ELT1111, CSC1110, 2100	63 units
(ii)	Six Elective Courses from: SEG2520, 3420, 3470, 3490, 3500, 3510, 3580, 3590, 3630, 4410, 4480, 4530, 4540, 4550, 4560, 4580, 4581, 4590, 4591, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 5410, 5420, 5430, 5470, 5480, 5490, 5520, 5530, 5540, 5570, 5580, 5590, 5600, 5610, 5620, 5640, CSC3230#, 3420#, FIN3010#, 3080#, 4110#, MAT4210#, 4250#, MKT2010	18 units
		Total: 81 units

Streams of Specialization

Students choosing a stream of specialization should take, among the six elective courses, at least five courses from the corresponding list for their stream of specialization.

Business Information Systems Stream
SEG3420, 3490, 3510, 3630, 4410, 4530, 4540, 4560, 4620, 4630, CSC3230#, 3420#
Financial Engineering Stream
SEG2520, 3490, 3580, 3590, 4480, 4560, 4630, 4640, FIN3010#, 3080#, 4110#, MAT4210#
Logistics and Supply Chain Management Stream
SEG3470, 3490, 3500, 3630, 4480, 4540, 4550, 4600, 4610, 4650, 4660, MKT2010

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1110	3	CSC2100	3	SEG2530	2
ELT1111	3	SEG2420	3	SEG3430	3
ERG2018	3	SEG2430	3	SEG3440	3
ERG2020	3	SEG3460	3	SEG3530	3
SEG2440	3			SEG3550	3
				SEG3610	2
	—		—		—
	15		12		16
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
SEG3410	3	ERG4910	4	ERG4920	4
SEG3570	3	Major Electives for respective stream	9	Major Electives for respective stream	9
SEG3600	2				
SEG3810	1				
SEG4570	3				
	—		—		—
	12		13		13

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

B. Applicable to students admitted in 2006-07

There are four streams of specialization: E-Commerce Systems, Financial Engineering, Information Systems, and Logistics and Supply Chain Management. Students may choose to specialize in one of the four streams and select certain courses as prescribed. A student who does not wish to specialize in any of the four streams should follow a study scheme devised with the advice of the academic advisers of the Department.

Students are required to complete a minimum of 81 units of Major courses as follows:

(i)	Required Courses: ERG2018, 2020, 4910#, 4920#, SEG2420, 2430, 2440, 2530, 3410, 3430, 3440, 3460, 3530, 3550, 3570, 3600, 3610, 3810, ELT1111, CSC1110, 2100	60 units
(ii)	Seven Elective Courses from: SEG2520, 3420, 3470, 3490, 3500, 3510, 3580, 3590, 3630, 4410, 4480, 4530, 4540, 4550, 4560, 4570, 4580, 4581, 4590, 4591, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 5410, 5420, 5430, 5470, 5480, 5490, 5520, 5530, 5540, 5570, 5580, 5590, 5600, 5610, 5620, 5640, CSC3230#, FIN3010#, 3080#, 4110#, MAT4210#, 4250#	21 units
		Total: 81 units

Streams of Specialization

Students choosing a stream of specialization should take, among the seven elective courses, at least six courses from the corresponding list for their stream of specialization; the remaining courses can be chosen from outside their stream of specialization.

E-Commerce Systems Stream
SEG3490, 3510, 4530, 4540, 4610, 4620, 4630, FIN3080#
Financial Engineering Stream
SEG2520, 3490, 3580, 3590, 4480, 4560, 4630, 4640, FIN3010#, 3080#, 4110#, MAT4210#, 4250#
Information Systems Stream
SEG3420, 3490, 3510, 4410, 4530, 4540, 4560, 4570, 4630, CSC3230#
Logistics and Supply Chain Management Stream
SEG3470, 3490, 3500, 4480, 4540, 4550, 4600, 4610, 4660

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1110	3	CSC2100	3	SEG2530	2
ELT1111	3	SEG2420	3	SEG3440	3
ERG2018	3	SEG2430	3	SEG3460	3
ERG2020	3	SEG2440	3	SEG3600	2
				SEG3610	2
				SEG3810	1
	12		12		13
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
SEG3410	3	ERG4910	4	ERG4920	4
SEG3430	3	Major Electives for respective stream	9	Major Electives for respective stream	9
SEG3530	3				
SEG3550	3				
SEG3570	3				
Major Elective for respective stream	3				
	18		13		13

The Major Programme requirement for second-year entrants can be viewed on the homepage of the Academic and Quality Section, <http://www.cuhk.edu.hk/aqs/>.

C. Applicable to students admitted in 2005-06

There are four streams of specialization: E-Commerce Systems, Financial Engineering, Information Systems, and Logistics and Supply Chain Management. Students may choose to specialize in one of the four streams and select certain courses as prescribed. A student who does not wish to specialize in any of the four streams should follow a study scheme devised with the advice of the academic advisers of the Department.

Students are required to complete a minimum of 81 units of Major courses as follows:

(i) Required Courses: 60 units
ERG2018, 2020, 4910#, 4920#, SEG2420, 2430, 2440, 3410, 3430, 3440, 3450, 3460, 3530, 3550, 3560, 3570, 3810, ELT1111, CSC1110, 2100

(ii) Seven Elective Courses from: 21 units
SEG2520, 3420, 3470, 3490, 3500, 3510, 3580, 3590, 3630, 4410, 4480, 4530, 4540, 4550, 4560, 4570, 4580, 4581, 4590, 4591, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 5410, 5420, 5430, 5470, 5480, 5490, 5520, 5530, 5540, 5570, 5580, 5590, 5600, 5610, 5620, 5640, CSC3230#, FIN3010#, 3080#, 4110#, MAT4210#, 4250#

Total: 81 units

Streams of Specialization

Students choosing a stream of specialization should take, among the seven elective courses, at least six courses from the corresponding list for their stream of specialization; the remaining courses can be chosen from outside their stream of specialization.

E-Commerce Systems Stream
SEG3490, 3510, 4530, 4540, 4610, 4620, 4630, FIN3080#

Financial Engineering Stream
SEG2520, 3490, 3580, 3590, 4480, 4560, 4630, 4640, FIN3010#, 3080#, 4110#, MAT4210#, 4250#

Information Systems Stream
SEG3420, 3490, 3510, 4410, 4530, 4540, 4560, 4570, 4630, CSC3230#

Logistics and Supply Chain Management Stream
SEG3470, 3490, 3500, 4480, 4540, 4550, 4600, 4610, 4660

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
CSC1110	3	CSC2100	3	SEG3440	3
ELT1111	3	SEG2420	3	SEG3450	3
ERG2018	3	SEG2430	3	SEG3460	3
ERG2020	3	SEG2440	3	SEG3560	3
				SEG3810	1
	12		12		13
Term 4	**Units**	**Term 5**	**Units**	**Term 6**	**Units**
SEG3410	3	ERG4910	4	ERG4920	4
SEG3430	3	Major Electives for respective stream	9	Major Electives for respective stream	9
SEG3530	3				
SEG3550	3				
SEG3570	3				
Major Elective for respective stream	3				
	18		13		13

Notes: Applicable to all Major students

1. Major courses at 3000 and above level will be included in the calculation of the Major GPA for honours classification. Courses with "#" are to be included in the Major GPA as well.
2. Besides the Major courses mentioned in Note 1, the ACE, CEG, CSC, ELE, ERG, IEG and MAE courses at 3000 and above level taken by the students will also be included in calculation of the Major GPA.
3. Students are strongly advised to consult with the academic advisers of the Department in choosing elective courses.

2. Minor Programme

Engineering Management

Students are required to complete a minimum of 18 units as follows:

(i)	Required Courses: (SEG2500 or 3530), 2510	6 units
(ii)	Elective Courses: SEG2420, 2430, 2440, 3430, 3440, 3450, 3490, 3500, 4480, 4500, 4550, 4610, 4650, MGT3010, MKT3010	12 units
		Total: 18 units

Notes: 1. A maximum of 6 units can be used to fulfill both the Major and Minor Programme requirements.
2. Elective courses are subject to availability.

Financial Engineering

Students are required to complete a minimum of 18 units as follows:

(i)	Required Courses: SEG2510, 2520	6 units
(ii)	Elective Courses: SEG2430, 3440, 3570, 3580, 3590, 4480, 4630, ECO3410, 3420, FIN4110, MAT4210, 4250	12 units
		Total: 18 units

Notes: 1. A maximum of 6 units can be used to fulfill both the Major and Minor Programme requirements.
2. Elective courses are subject to availability.

3. Faculty Language Requirement

4. Major/Faculty Requirement for S6 Entrants