

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.)

IEG 1001

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.

IEG 1810

Electronic Circuit Design Laboratory

1 U; 3 Lab.

Transistor and RC circuit, amplifier, oscillator, active filter, design project. Corequisite: ELE 1110.

IEG 2051

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.

IEG 2810

Digital Systems Design Laboratory

1 U; 3 Lab.

Combinational logic, sequential logic, finite state machine, PLAs, design project. Corequisite: ERG 2020.

IEG 3010

Digital Communications

Source and channel models. Modulation and detection. Intersymbol interference and equalization coding, multipath fading, spread spectrum, synchronization.

IEG 3050

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.

IEG 3080

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 CSC 3100 or ERG 3820.)

IEG 3310

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.

IEG 3810

Microprocessor System Design Laboratory

1 U; 3 Lab.

Address decoder, CPU bus demultiplexing, memory subsystem, I/O subsystem, interrupt handling, design project. Corequisite: ELE 3230.

IEG 3821

Information Engineering Laboratory

2 U; 4 Lab.

Baseband and carrier modulation and demodulation; local-area and wide-area network protocol analysis and measurement; optical transmission and attenuation measurement; telephone subscriber loop and central office switching experiments; implementation of information services.

IEG 3830

Product Design Project

3 U

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.

IEG 4020

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.

IEG 4030

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.

IEG 4060

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.

IEG 4100

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: IEG 3010.

IEG 4130

Introduction to Channel Coding and Cryptography

Hamming distance and error correction. Finite field, linear code, cyclic code. Hamming, Reed-Solomon, BCH codes, their decoding and performance. Convolutional code, trellis-coded modulation, turbo code, their decoding and performance. Applications to CD, modem. Introduction to number theory and cryptography models. Chinese and Western classic cyphers. Private-key cryptography, public-key cryptography. Digital signature, digital certificate. Authentication in mobile telephony, secure email, network security. (Not for students who have taken MAT 4260.)

IEG 4140

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.

IEG 4160

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 ELE 4430.)

IEG 4180

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.

IEG 4190

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.

IEG 5124

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.

IEG 5154

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 IEG 2040.

IEG 5240

Cryptography, Security and E-Commerce

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 CSC 5470.)

Study Scheme

Major Programme

A. Applicable to students admitted in 2002-03 and thereafter

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

- | | | |
|------|---|----------|
| (i) | Required Courses:
ERG 2013, 2020, 2040, 2310, 4910 [#] , 4920 [#] , IEG 1001,
1810, 2051, 2810, 3010, 3080, 3310, 3810, 3821,
CSC 1110, 2100, ELE 1110, 3230 [#] , ELT 1111
Graduation Project as prescribed by ERG 4910/4920
will carry a separate weight of 10% in honours
classification. | 54 units |
| (ii) | Electives Courses:
Select a total of eight courses (24 units) from Group I
and Group II, in which at least four courses should be
from Group II.
Group I : ACE 2050, CSC 2110, 3160 [#] , 3170 [#] , 3230 [#] ,
3260 [#] , 5280 [#] , ELE 3310 [#] , 3330 [#] , 4220 [#] ,
4320 [#] , 4550 [#] , MAT 3080 [#] , 3260 [#] , 3310 [#] ,
IEG 3050, 3830, 4060, 5240, SEG 2420,
2440, 3430 [#] , 3490 [#] , 3500 [#] , 4410 [#]
Group II: IEG 4020, 4030, 4100, 4130, 4140, 4160,
4180, 4190, 5124, 5154 | 24 units |

Total: 78 units

Plus workshops, training sessions and industrial visits.

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
General Education	3	General Education	3	General Education	3
Physical Education	1	Physical Education	1	ELE 3230	3
CSC 1110	3	CSC 2100	3	ERG 2310	3
ELE 1110	3	ERG 2020	3	IEG 3310	3
ERG 2013	3	ERG 2040	3	IEG 3810	1
IEG 1001	2	IEG 2051	3	Elective*	3
IEG 1810	1	IEG 2810	1		
	—		—		—
	16		17		16
Term 4	Units	Term 5	Units	Term 6	Units
General Education	3	ERG 4910	4	ERG 4920	4
ELT 1111	3	Electives*	12	Electives*	12
IEG 3010	3				
IEG 3080	3				
IEG 3821	2				
Electives*	4				
	—		—		—
	18		16		16

* 4 elective courses from Group II, 4 Group I/II courses not otherwise taken, plus 7 units of free electives.

SUMMARY

	Units
General Education	12
Physical Education	2
Major Required Courses	54
Major Electives	24
Free Electives	7
	—
Total	99

- Notes: 1. Major courses coded 3000 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. Besides the Major courses mentioned in Note 1, all other ACE, CEG, CSC, ELE, ERG, IDE, INE and SEG courses coded 3000 and above taken by the students will also be included in the calculation of the Major GPA.

B. Applicable to students admitted in 2001-02

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

- (i) Required Courses: 52 units
 ERG 2013, 2020, 2040, 2310, 4910#, 4920#, IEG 1810, 2051, 2810, 3010, 3080, 3310, 3810, 3821, CSC 1110, 2100, ELE 1110, 3230#, ELT 1111
 Graduation Project as prescribed by ERG 4910/4920 will carry a separate weight of 10% in honours classification.

(ii) Electives Courses: 24 units

Select a total of eight courses (24 units) from Group I and Group II, in which at least four courses should be from Group II.

Group I: ACE 2050, CSC 2110, 3160[#], 3170[#], 3230[#], 3260[#], 5280[#], ELE 3310[#], 3330[#], 4220[#], 4320[#], 4550[#], MAT 3080[#], 3260[#], 3310[#], IEG 3050, 3830, 4060, 5240, SEG 2420, 2440, 3430[#], 3490[#], 3500[#], 4410[#]

Group II: IEG 4020, 4030, 4100, 4130, 4140, 4160, 4180, 4190, 5124, 5154

 Total: 76 units

Plus workshops, training sessions and industrial visits.

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3	Units
General Education	3	General Education	3	General Education	3
Physical Education	1	Physical Education	1	ELE 3230	3
CSC 1110	3	CSC 2100	3	ERG 2310	3
ELE 1110	3	ERG 2020	3	IEG 3310	3
ELT 1111	3	ERG 2040	3	IEG 3810	1
ERG 2013	3	IEG 2051	3	Elective*	3
IEG 1810	1	IEG 2810	1		
—	—		—		—
	17		17		16
Term 4	Units	Term 5	Units	Term 6	Units
General Education	3	ERG 4910	4	ERG 4920	4
IEG 3010	3	Electives *	12	Electives*	12
IEG 3080	3				
IEG 3821	2				
Electives*	6				
—	—		—		—
	17		16		16

* 4 elective courses from Group II, 4 Group I/II courses not otherwise taken, plus 9 units of free electives.

SUMMARY

	Units
General Education	12
Physical Education	2
Major Required Courses	52
Major Electives	24
Free Electives	9
Total	99

Notes: 1. Major courses coded 3000 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. Besides the Major courses mentioned in Note 1, all other ACE, CEG, CSC, ELE, ERG, IDE, INE and SEG courses coded 3000 and above taken by the students will also be included in the calculation of the Major GPA.