

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.)

ELE 1110

Basic Circuit Theory

1st term

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.

ELE 2110

Electronic Circuits

2nd term

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 ELE 1110 before taking this course.

ELE 2120

Digital Circuits and Systems

2nd term

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 ERG 2020.)

ELE 2210

Electrical Technology

2nd term

Electromagnetism and magnetic circuits. Single-, two- and three-phase circuits. Direct-current machines. Transformers. AC synchronous machines. Three-phase induction motors. Stepper motors. Two-phase servomotors and single phase induction motors. Power electronics. Electrical Measurements.

*ELE 2230

Computer-aided Electronic System Design

ELE 2240

Control and Electrical Technology

1st term

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 ERG 2030 before taking this course. (Not for students who have taken ACE 2030.)

* Course offered in 1999-2003.

ELE 2510

Microelectronic Devices

1st term

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.

ELE 2860

Professional Engineering Practice

2 U; 2 Lect.; 2nd term

Introduction to engineering: engineering practice; professional ethics; professional societies. Industrial environment: social structure; the trend of global and local industries. Engineering management: project management and design; health, safety and environmental issues; quality control and assurance. (Not for students who have taken ELE 2880 or MAE 2880.)

ELE 3010

Introduction to Lasers and Photonics

1st term

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.

ELE 3210

Analog Integrated Circuits

2nd term

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 ELE 2110 before taking this course.

ELE 3230

Microprocessors and Computer Systems

1st term

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 ELE 2120 or ERG 2020 before taking this course.

ELE 3240

Medical Instrumentation and Sensors

1st term

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

ELE 3310

Basic Electromagnetic Theory

1st term

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 ERG 2011 before taking this course.

ELE 3320

Introduction to Optical Communications

2nd term

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 ELE 2510 and 3310 before taking this course.

ELE 3330

Wireless Transmission Systems

2nd term

Common wireless systems and international communication standards. Antenna fundamentals. Antenna arrays. Applications: mobile phone handset, base station 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 ELE 3310 before taking this course.

ELE 3340

Analog and Digital Communications in Noise

1st term

Revision on noise, and filtering and bandpass noise. Effects of noise in AM and FM systems, pre-emphasis and de-emphasis; effects of noise in digital modulation systems, optimum binary receiver, coherent and non-coherent reception of ASK, FSK, PSK, DPSK, M-ary communications. Introduction to information and coding theory. Students are advised to take ELE 3410 before taking this course.

ELE 3410

Random Processes and Digital Signal Processing

1st term

Random variables and random processes. Gaussian processes. Correlation functions and power spectral density. Filtering of random processes. DTFT, DFT and FFT. z-transform and inverse z-transform. Frequency response and stability of discrete-time systems. Student are advised to take ERG 2030 before taking this course.

ELE 3510

Solid State Electronics

2nd term

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: semiconductors, dielectric and magnetic materials, superconductors, optoelectronic materials, and some other advanced applications. Students are advised to take ELE 2510 before taking this course. (Not for students who have taken ELE 4570.)

ELE 3520

Circuit CAA and HW Description Languages

2nd term

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 ELE 2110 and 2120 before taking this course. (Not for students who have taken ELE 2230.)

ELE 3820

Electronic Engineering Laboratory

1 U; 4 Lab.; 2nd term

ELE 4110

Bioelectronics

1st or 2nd term

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.

ELE 4120

Bioinformatics

1st term

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.

ELE 4190

Biomedical Modelling

2nd term

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. Prerequisite: ELE 3410.

ELE 4210

Network Synthesis

1st or 2nd term

Basic network theories. Analysis and synthesis of passive and active networks. Analog filter design. Approximation and optimization methods. Analysis and design of switched-capacitor filters. CAD for filter design. Recent trend.

ELE 4220

Multiprocessor System, Implementation and Applications

2nd term

Introduction and classification of parallel and multiprocessing. Multiprocessor architecture, analytical modelling, operational analysis, simulation and bench-marking. Applications: transputer system, fault-tolerant system, image and signal processing system. Prerequisite: ELE 3230 or its equivalent.

ELE 4230

Microprocessor Design and Organization

1st term

Advanced topics in microprocessors. Microprocessor design: CISC and RISC, processor design, control design. System organization. Memory organization: virtual memory and cache. Parallel computer architectures. Associative processors and memories.

ELE 4310

Telecommunication Systems

2nd term

Revision of communication fundamentals. Theoretical analysis of digital communication systems. Electronic communication circuits. Practical circuit realization and enhancement of noise performance of selected communication systems.

ELE 4320

Microwave Electronics

1st term

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.

ELE 4410

Advanced Digital Signal Processing and Applications

2nd term

Realization of discrete-time systems and finite word length effect. Design of FIR and IIR filters. Time-frequency analysis. Optimal statistical filtering. Adaptive filtering. Spectral estimation. Applications and hardware implementation using digital signal processors. Students are advised to take ELE 3410 before taking this course.

ELE 4430

Digital Image Processing

1st term

Acquisition and representation: 2D and 3D imaging, visual perception, sampling and digitization. Pre-processing: imaging geometry, radiometric and geometric corrections. Processing: transformations and filtering, enhancement, codings, and restoration. Analysis: segmentation, descriptions and recognition. Introduction to pattern recognition. Image processor and systems. Real time image processing. Selected topics in image motion, image morphology, multiscale image analysis and higher dimensional object modelling. (Not for students who have taken IEG 4160.)

ELE 4510

Physics and Technology of Semiconductor Devices

2nd term

Review of semiconductor physics. Advanced MOS devices. Special microwave devices: tunnel devices, transfer electron devices, etc. Photonic devices: LED, semiconductor lasers, photodetectors, solar cells. Semiconductor sensors and transducers. Introduction to materials and technology for advanced semiconductor devices. Heterojunction concepts and devices: HEMT, HBT, quantum-well devices. Introductory optoelectronic integrated circuits.

ELE 4520

Integrated Optics

1st term

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 ELE 3320 before taking this course.

ELE 4530

Integrated Circuits Fabrication Technology

1st term

Modern 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.

ELE 4540

VLSI Testing and Testability Design

1st or 2nd term

Difficulties and problems of conventional methods for testing LSI/VLSI circuitry. Design for testability: basic concepts and approaches. Software and equipment supports. Analyses of testability-design approaches and potentials. Discussion of test-related questions and future possible developments.

ELE 4550

Application Specific IC Technologies

1st term

Circuit techniques: bipolar, CMOS. 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.

ELE 4560

Electronic Thin Film Science

3 U; 3 Lect.; 1st term

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.

*ELE 4570

Solid State Electronics

ELE 5260

CMOS Integrated Circuits

3 U; 3 Lect.; 1st term

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.

ELE 5270

Computer-Aided Circuit Analysis

3 U; 3 Lect.; 2nd term

Formulation of circuit equations. LU decomposition and sparse-matrix solutions. Numerical integration and recursive convolution integration. Generalized characteristic model analysis and synthesis of distributed-lumped networks. Dynamic device modelling and simulation. Case studies.

ELE 5350

Advanced Electromagnetism

2nd term

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.

ELE 5370

Introduction to Radar

1st term

Fundamentals of radar system, radar functions and radar equation. Various types of radar. Monostatic and bistatic radar. Continuous Wave (CW) radar, Doppler radar. MTI radar. Frequency modulated radar (Chrlp radar). Pulse radar. Pulse Doppler radar. Monopulse radar. Ambiguity regions, clutter, meteorological radar. Examples: vehicular collision avoidance radar, cross harbour electronic toll system, doppler radar for vehicular velocity monitoring, wind shear radar at airport, terminal doppler weather radar (TDWR) on airport runway, harbour surveillance radar, etc.

* Course offered in 2000-03.

ELE 5380

RF Integrated Circuits and Systems

2nd term

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: ELE 4320.

Study Scheme

I. Major Programme

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

- | | | |
|------|--|----------|
| (i) | Required Courses:
ERG 1810, 2011, 2012, 2030, 2310, 2810, 3810#,
3820#, 4910#, 4920#, ELE 1110, 2110, 2120, 2510,
2860, 3210, 3230, 3310, 3820, CSC 1110, ELT 1111
Graduation Project as prescribed by ERG 4920 will carry
a separate weight of 6.79% in honours classification. | 55 units |
| (ii) | Elective Courses:
Group A: select any three courses with at least two
courses coded 3000:
ELE 2230, 2240, 3010, 3240, 3320, 3330,
3340, 3410, 3510, 3520, CSC 2100, IEG
3310#, SEG 2440
Group B: select any five courses:
ELE 4120, 4190, 4230, 4310, 4320, 4410,
4430, 4510, 4520, 4530, 4550, 4560, 4570,
5260, 5270, 5350, 5380, IEG 4100#, MSE
4210# | 24 units |

Total: 79 units

Recommended course pattern

Term 1	Units	Term 2	Units	Term 3 ³	Units
CSC 1110	3	ELE 2110	3	ELE 2510	3
ELE 1110	3	ELE 2120	3	ELE 3230	3
ELT 1111	3	ERG 2012	3	ELE 3310	3
ERG 1810	1	ERG 2030	3	ERG 3810	1
ERG 2011	3	ERG 2310/Elective ²	3	Group A Elective	3
Physical Education	1	ERG 2810	1	General Education/ Free Elective ¹	3
General Education/ Free Elective ¹	3	Physical Education	1		
	—		—		—
	17		17		16
Term 4 ³	Units	Term 5	Units	Term 6	Units
ELE 2860	2	ERG 4910	4	ERG 4920	4
ELE 3210	3	Group B Electives	9	Group B Electives	6
ELE 3820	1	General Education/ Free Elective ¹	3	Group A Elective	3
ERG 3820	2			General Education/ Free Elective ¹	3
Group A Elective	3				
General Education/ Free Electives ¹	6				
	—		—		—
	17		16		16

- Notes: 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.
- ² If students wish to take four 3-unit Major courses in Term 2, they can take ERG 2310 in the second year of attendance.
- ³ Students who have not taken ERG 2310 in Term 2 should take it in their second year of attendance.

SUMMARY

	Units
General Education	12
Physical Education	2
Major Required Courses	55
Major Electives	24
Free Electives	6
	99
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, the other ELE courses coded 3000 and above taken by the students will also be included in the calculation of Major GPA.

2. Minor Programme

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

- | | | |
|------|---|-----------------|
| (i) | Required Courses:
ELE 1110, ERG 2020 | 6 units |
| (ii) | Elective Courses (at least 6 units at 3000 level or above):
ERG 2030, 2310, ELE 2110, 2230, 2510, 3010,
3210, 3230, 3310, 3240, 3320, 3330, 3340, 3410,
3510, 3520, 4120, 4190, 4230, 4310, 4320, 4410,
4430, 4510, 4520, 4530, 4550, 4560, 4570, 5260,
5380 | 12 units |
| | | Total: 18 units |

- 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.