Undergraduate Courses:

ELEC 001 Electronic and Information Technology [2-1-0:3]

Microelectronics, lasers, computers, robotics, fuzzy logic, digital signal processing, multimedia technology, and wireless communication. Business issues relating to intellectual property and managing a high technology company.

ELEC 002 Academic and Professional Development I [0 credit]

A compulsory, one year course for Electronic Engineering and EE (Information and Communication Engineering) students only. This course is designed to provide academic advising to students and/or to develop students' communication skills in interacting with the technical and non-technical audiences in their professional careers. Graded P or F.

ELEC 003 Academic and Professional Development II [0 credit]

Continuation of ELEC 002. Graded P or F.

ELEC 010 Academic and Professional Development I [0 credit]

A compulsory, one year course for Computer Engineering students only. This course is intended to offer advice to students on academic and professional matters, and to improve the students' communication skills. This will be achieved through: (1) Small student group meetings with an assigned advisor; (2) Professional and academic seminars, and (3) Social activities. Graded P or F.

ELEC 020 Academic and Professional Development II [0 credit]

Continuation of ELEC 010. This is a compulsory, one year course for Computer Engineering students only. Graded P or F.

ELEC 030 Academic and Professional Development III [0 credit]

Continuation of ELEC 020. This is a compulsory, one year course for Computer Engineering students only. Graded P or F.

ELEC 098 Industrial Training [0 credit]

For Computer Engineering and EE (Information and Communication Engineering) students only. A practical training course for a total duration of about six to seven weeks covering basic electronic practices, testing and maintenance, UNIX system and network administration, Windows NT system administration, software engineering practice, and safety. Graded P or F.

ELEC 099 Industrial Training [0 credit]

For Electronic Engineering students only. A practical training course for a total duration of about seven weeks covering basic electronic practice, basic electrical engineering practice, engineering system appreciation, UNIX system and network administration, software engineering practice, CAD, drawing, and safety. Graded P or F.

ELEC 101 Basic Electronics [3-1-3:4]

Covers basic electronic concepts, DC and AC electric circuits, basic analogue electronics: theories and applications of semiconductor diodes, transistors and operational amplifiers, and basic digital electronics. *Exclusion:* ELEC 102 *Prerequisite:* AL Pure Mathematics/AL Applied Mathematics/AS Applied Mathematics/AS Mathematics and Statistics, or MATH 001 as co-requisite.

References: J.D. Irwin and D.V. Kerns, *Introduction to Electrical Engineering,* 1995
R.J. Smith, *Circuits, Devices and Systems,* Fifth Edition, 1992

ELEC 102 Electronic Circuits I [3-1-3:5]

Fundamental concepts, Ohm's law, passive and active components, KVL and KCL, Thevenin and Norton Theroems, linearity and superposition, nodal analysis, transient analysis, sinusoidal steady state and phasor, transfer functions, op-amps, diodes, MOS transistors and related circuits. *Exclusion:* ELEC 101 *Prerequisites*: AL Pure Mathematics; and one of AL/AS Physics, AL Engineering Science or AL Computer Studies

Reference: J.D. Irwin and D.V. Kerns, *Introduction to Electrical Engineering,* 1995

ELEC 151 Digital Circuits and Systems [3-1-2:4]

Design of combinatorial and sequential logic circuits; introduction to logic families (TTL and CMOS); programmable logic devices; special digital systems. Laboratory assignments make extensive use of computer-aided design (CAD) tools for design, simulation and testing.

Reference: Randy Katz, *Contemporary Logic Design*

ELEC 152 Computer Organization [3-0-1:3]

This is an introductory course to computer organization. The topics covered include instruction-set-design, digital design and computer arithemtic, controller and datapath design, memory systems, input-output systems, interrupts, pipelining, performance analysis, assembly language programming, and survey of advanced architectures. *Exclusion:* COMP 180 *Prerequisite*: ELEC 151

References: D. Patterson, J. Hennessy, *Computer Organization and Design: The Hardware/Software Interface,* 1994
B.B. Brey, *The Intel Microporcessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro Processor: Architecture, Programming, and Interfacing*

ELEC 190 Introduction to Electronic and Computer Technology [2-0-0:1]

For Engineering and Computer Engineering students. Topics of current interest presented by faculty and guest speakers. Selected from various fields of Electronic and Computer Engineering to provide a broad exposure. Graded P or F.

ELEC 202 Electronic Circuits II [3-1-3:5]

Bipolar and MOS transistor basics: Modes of operation, large-and small-signal analyses; Analogue circuits: Single-transistor amplifiers, differential pairs and multi-transistor amplifiers; CMOS digital circuits: Performance analysis of CMOS inverter, NAND gate, NOR gate; Applications: A/D and D/A converters, comparators, oscillator circuits. *Prerequisite:* ELEC 101 or ELEC 102

Reference: A.S. Sedra and K.C. Smith, *Microelectronic Circuits,* Fourth Edition, 1997

ELEC 210 Probability and Random Processes in Engineering [3-1-0:4]

An introduction to statistical inference and random processes in electrical engineering, including the necessary probabilistic background. Random variables, distribution and density functions, conditional statistics, expectation, moments, stochastic processes, Markov chains, introduction to queueing systems. *Exclusion:* MATH 246 *Prerequisite:* MATH 001 or AL Pure Mathematics

Reference: Leon-Garcia, *Probability and Random Processes for Electrical Engineering,* Second Edition, 1993

ELEC 211 Signals and Systems [3-1-0:4]

This is an introductory course for signal and system analysis. The course covers signal analysis tools such as Fourier series, Fourier transform, Laplace transform and z-transform; interactions between signals and linear time-invariant (LTI) systems; sampling theorem; differential and difference equations. MATLAB CAD tools are introduced as an integral part of this course. *Prerequisites:* MATH 150 /151/152 and ELEC 101/102

Reference: Alan V. Oppenheim, Alan S. Wilsky and S.H. Nawab, *Signals and Systems,* Second Edition

ELEC 212 Digital Signal Processing [2-1-2:4]

Discrete-time signal and systems; discrete Fourier transform and related discrete time orthogonal transform, and related fast algorithm; IIR and FIR filter design techniques, and realizations; multirate digital signal processing; response of linear systems to random processes. Laboratory experiments are designed so that the students can apply theory learnt in the class to physical problems. MATLAB CAD tools are being used as an integral part of this course. *Prerequisite:* ELEC 211

ELEC 214 Communication Systems [3-1-3:5]

This course provides a broad treatment of communication theory, beginning with communication networks, physical noise characteristics, probability theory and random signals, and noiseless modulation theory, proceeding through a treatment of the effects of noise in communication systems, and ending with an introductory treatment of digital communications, source coding and reliable communication in the presence of noise. *Prerequisite:* ELEC 211

Reference: R.E. Zeimer and W.H. Tranter, *Principles of Communications: Systems; Modulation, and Noise,* Fourth Edition, 1995

ELEC 221 Semiconductor Materials and Devices [3-1-3:5]

This is an introductory course for semiconductor materials and devices. The course content includes the following topics: the growth and properties of semiconductor crystals; the theory of the electronic structures of atoms and solids; the energy band and conduction mechanisms in semiconductors; the physics of junction diodes; excess carriers; bipolar junction transistors (BJT); metal oxide semiconductor field-effect transistors (MOSFET). *Prerequisite:* ELEC 102

Reference: Streetman, *Solid State Electronic Devices*, Fourth Edition

ELEC 241 Electromagnetism [3-1-0:4]

Electromagnetic wave concepts. Faraday's Gauss's and Ampere's laws; Maxwell's equations; distributed circuits; transmission lines; plane waves; microwave networks; radiation and antenna fundamentals; geometrical and physical optics. *Prerequisites:* MATH 100 and MATH 150

Reference: M.F. Iskander, *Electromagnetic Fields and Waves*

ELEC 254 Microprocessor Experiments [1-1-3:3]

[Previous Course Code: ELEC 154] This course covers the software and hardware aspects of Intel x86 family microprocessor input/output interfacing. After some experiments, students will be asked in the class project to design, build and test a significant microprocessor control device. *Prerequisites:* ELEC 151, and COMP 180 or ELEC 152

ELEC 271 Automatic Control Systems [3-0-1:3]

This is an introductory course on the modeling, analysis, and design of single-input-single-output control system. The emphasis is on the design of controllers for linear time-invariant systems using classical methods such as roots locus method and frequency response method. MATLAB CAD tools are introduced as an integral part of this course. Laboratory experiments are designed so that the students can apply theory learnt in the class to the control of real physical systems. *Exclusions:* CENG 302, MECH 261 *Prerequisite:* ELEC 101 or ELEC 102

Reference: Richard C. Dorf and Robert H. Bishop, *Modern Control Systems,* Eighth Edition, 1998

ELEC 300 Special Topics [1-4 credit(s)]

Selected topics in Electrical and Electronic Engineering. May be repeated for credit, if different topics taken.

ELEC 301 CMOS VLSI Design [2-0-3:3]

CMOS process and design rules; MOS device electronics; CMOS circuit and logic circuit characterization and performance estimation; VLSI design and verification tools. Laboratory work will be centered on industry standard tools. *Prerequisite:* ELEC 151

ELEC 303 ASIC Design with Field Programmable Gate Arrays [2-0-3:3]

This course introduces both design and testing of Application Specific Integrated Circuit (ASIC) with Field Programmable Gate Array (FPGA). Major topics include ASIC technology, FPGA design, placement and routing, design for testability and VLSI testing. Students will go through a complete ASIC design cycle, from specification, design, implementation to testing in this course. *Prerequisite:* ELEC 151

ELEC 304 Analogue Integrated Circuits Design and Analysis [3-1-0:4]

Current sources, output stages, operational amplifiers, frequency response, feedback analysis, stability and compensation, Slew rate, advanced integrated-circuit design techniques, analog VLSI building blocks. *Prerequisites:* ELEC 202 and ELEC 221
Reference: P. Gray and R. Meyer, *Analysis and Design of Analog Integrated Circuits,* 3rd Edition, 1993

ELEC 308 Physical Optics [3-1-0:3]

An introductory course in optics covering the basic concepts and principles of light. Topics include: electromagnetic theory, wave theory, geometrical optics, dispersion, polarized light, interference, diffraction, coherence, and birefringence. Special topics in modern optical devices and systems. *Exclusion*: PHYS 241
Reference: Hecht, *Optics,* Second Edition

ELEC 314 Digital Communications [3-1-0:3]

Representation of signals, optimum detection of signals in noise, matched filtering, error probability calculations for digital modulation. Multilevel modulation schemes, comparison of digital communications systems, signalling through band-limited channels, equalization, mobile and wireless channels, spread-spectrum communications, CDMA for cellular mobile and wireless communications. *Prerequisite:* ELEC 214
Reference: J.G. Proakis, *Digital Communications,* 3rd Edition, 1995

ELEC 315 Computer Communication Networks [3-1-0:3]

Overview of communication networks: network architecture and switching techniques. Introduction to network programming. Study of OSI model. Physical layer: transmission media and data communications. Data link layer: protocols and performance. Local area networks: Ethernet, Token Ring, FDDI, and DQDB. Network layer: flow and congestion control, and routing. Transport layer: introduction to TCP. Integrated networks: ATM. *Exclusion:* COMP 361
References: W. Richard Stevens, *UNIX Network Programming,* 1994
Andrew S. Tanenbaum, *Computer Networks*, 3rd Edition, 1996

ELEC 317 Digital Image Processing [3-0-0:3]

This course provides an introduction to basic concepts and methodologies for digital image processing and develops the foundation for further study in this diverse and rapidly evolving field. The topics covered range from visual perception and image formation/geometry through image enhancement and restoration to image encoding, segmentation, description, recognition, and interpretation. The course will be complemented by several (mini) projects. *Prerequisite*: ELEC 211
Reference: R.C. Gonalez and R.E. Woods, *Digital Image Processing,* 1993

ELEC 321 Integrated Circuit Devices [3-1-0:3]

This course is intended to provide an understanding on the device operation principles in common electronic products such as integrated circuit, camcorder, solar cell, memory elements, smartcard, etc. Emphasis are on design and applications instead of fundamental physics. Topics covered include PN junctions, BJT, MOSFET, JFET, MESFET, FLASH EPROM and the future technology trend in the electronic industry. *Prerequisites:* ELEC 202 and ELEC 221

ELEC 331 Speech and Image Compression [3-0-0:3]

This course begins with an overview of some fundamental information theory concepts. It then concentrates on various data and image compression techniques that can be lossless or lossy, including Huffman/arithmetic coding, predictive coding, transform coding, subband coding, vector quantizations, etc. Several international standards (such as JBIG, JPEG, MPEG, and H.261/263) will be discussed, and applications in speech, video, and database compression will be highlighted. *Prerequisite*: ELEC 211

ELEC 332 Information Theory and Error-Correcting Codes [3-0-0:3]

Communication and information theory; self and mutual information measures; channel models and capacity; source coding; hamming codes; cyclic codes; BCH and Reed-Solomon codes; algebraic codes; burst error-correcting codes; convolutional codes; rate-distortion theory. *Prerequisite*: ELEC 214
References: Blahut, R.E., *Digital Transmission of Information*
Gallager, R.G., *Information Theory and Reliable Communication*
Viterbi, A.J. and J.K. Omura, *Principles of Digital Communication and Coding.*

ELEC 333 Introduction to Digital Speech Recognition [3-0-0:3]
This is a UG final year introductory course to digital speech processing. The focus will be on speech recognition techniques. Topics to be covered include general paradigm for speech recognition, approaches to speech recognition, signal processing and analysis methods for speech recognition, pattern recognition techniques, speech recognition system design and implementation issues, hidden Markov Model, connected word and continuous speech recognition issues including training and language modeling. *Prerequisite:* ELEC 212

ELEC 341 Introduction to Intelligent Systems [3-0-0:3]
[Previous Course Code: ELEC 300C] Introduction to the fundamental concepts of neural networks, fuzzy logic, and genetic algorithms. Perceptron, Hebb net, back-propagation, radial basis functions; fuzzy sets, fuzzy relations, fuzzy controllers; genetic algorithm: principles and applications. *Prerequisite*: ELEC 211

ELEC 342 Optical Fibre Communication [2-0-3:3]
To introduce fibre optics and its applications in telecommunications. Topics include optical fibres, light source, photodetectors and fibre-optic communication systems. Laboratory gives hands-on experience in handling with optical fibres, micro-optical components and designing optic fibre communication systems. *Exclusion*: PHYS 242
Prerequisite: ELEC 241
Reference: Gerd Keiser, *Optical Fiber Communications, 1991*

ELEC 343 Wireless Communication Engineering [3-0-0:3]
Path loss models; noise, sample radio link analysis; mobile radio propagation; statistical nature of radio channels; channel simulation and coverage analysis; interference consideration; diversity; digital modulations; traffic engineering. *Prerequisite:* ELEC 214

ELEC 344 Microwave Engineering [3-0-3:4]
Techniques of high-frequency analogue circuit technology. S-parameter design of high-frequency active circuits; computer-aided analysis and design of microwave circuits. MIC structures such as microstrip and waveguides; Monolithnic microwave integrated circuits. *Prerequisite:* ELEC 241

ELEC 351 Introduction to Power Electronics [3-0-0:3]
Magnetic components, power devices, diodes and rectifier circuits, voltage references, linear regulators, switch mode power converters, power factor and correction, integrated circuit techniques for controller design. *Prerequisite:* ELEC 102
Reference: J.N. Ross, *The Essence of Power Electronics,* 1997

ELEC 360 Digital Media and Multimedia Applications [3-1-2:4]
[Previous Course Code: ELEC 300K] This course provides students with a background in digital media, multimedia applications development, and multimedia systems. Topics include digital media fundamentals, authoring, and multimedia systems design issues. Weekly laboratory and programming assignments introduce students to media editing tools and programming issues. A final project challenges students to apply what they learn. Enrollment in the course requires approval of the course instructor. *Exclusion:* COMP 343 *Prerequisite:* COMP 103 or COMP 104

ELEC 374 Introduction to Robotics [3-0-1:3]
Introduction to the fundamental concepts of robotics. Rigid body motion, forward and inverse kinematics of open-chain manipulators, force relations, dynamics and position control robot manipulators. Force control and trajectory generation. Collision-avoidance and motion planning. Second or third year standing required. *Exclusions:* ELEC 564, MECH 371
Reference: J.Craig, *Introduction to Robotics: Mechanics and Control*

ELEC 377 Digital Control Systems [3-0-0:3]
Digital computers for design and implementation of feedback control systems. Sampling, z-transform, digital filters and discretization of continuous compensation. Design of digital control systems using transform techniques and state-space methods. *Prerequisite:* ELEC 271

ELEC 383 Principles of Biomedical Instrumentation I [3-0-2:3]
Basic concepts of the signal analysis and measurement; Biopotentials; Blood pressure and flow measurement; Respiratory monitoring; Clinical chemistry. *Prerequisite:* ELEC 101 or ELEC 102
Reference: J. W. Webster, *Medical Instrumentation*

ELEC 384 Principles of Biomedical Instrumentation II [3-0-0:3]
Basic physics and hardware of medical imaging; Clinical applications of medical imaging; X-ray projection imaging; Computed tomography; Magnetic resonance imaging; Radioisotope imaging; Diagnostic ultrasound; Image processing and analysis. *Exclusion*: ELEC 381 (prior to 2000-01) *Prerequisite*: ELEC 211
Reference: Steve Webb (Ed.), *The Physics of Medical Imaging*

ELEC 394 Computer Engineering Project I [0-0-6:2]
[Also COMP 394] Each Computer Engineering student is required to take COMP/ELEC 394, 395 and 396. The project is conducted under the supervision of a Computer Science and/or Electrical and Electronic Engineering faculty member. May be graded PP.

ELEC 395 Computer Engineering Project II [0-0-9:3]

[Also COMP 395] Continuation of ELEC 394. May be graded PP. *Prerequisite:* ELEC 394

ELEC 396 Computer Engineering Project III [0-0-9:3]

[Also COMP 396] Continuation of ELEC 395. *Prerequisite:* ELEC 395

ELEC 397 Final Year Project I [0-0-6:1]

Each undergraduate student is required to take ELEC 397, ELEC 398 and ELEC 399 in sequence. The project is conducted under the supervision of a faculty member. Work normally commences in the summer following the second year. May be graded PP.

ELEC 398 Final Year Project II [0-0-9:4]

Continuation of ELEC 397. May be graded PP. *Prerequisite:* ELEC 397

ELEC 399 Final Year Project III [0-0-12:4]

Continuation of ELEC 398. *Prerequisite:* ELEC 398