Electronic and Computer Engineering

ELEC 1010   Electronic and Information Technology   [3 Credit(s)]

[Previous Course Code(s): ELEC 001*]* This general-education course introduces the basics of electronic and information technology and their applications to daily-life consumer electronics and communication devices. Contents include the representation of signals in the time and frequency domains; digitization of information; coding for data compression and error protection; transmission of signals; cellular mobile phones and wireless communications; and the Internet. It is expected that through studying these technologies and how they address the problems encountered in the information technology area, students will also grasp the skills in solving problems with engineering approach and spirit and appreciate how these technologies impact the society

ELEC 1020   Media Production: Technology and Design   [3 Credit(s)]

[Previous Course Code(s): ELEC 005*]* The course focuses on both the high level design concepts for creative multimedia marketing, as well as equipping the students with the necessary tools to manipulate digital media. The course covers theories such as strategy formulation, company branding, human perceptions, as well as fundamental implementation skills such as audio data processing, special image effects, and video handling techniques. *Background:* Basic computer operation such as using Powerpoint. Students without any computer knowledge are recommended to take COMP 1001 first.

ELEC 1100   Introduction to Electro-Robot Design   [4 Credit(s)]

[Previous Course Code(s): ELEC 125, ELEC 300V*]* The course introduces the fundamental knowledge on the design, implementation and evaluation of a robot and its sub-systems. It covers the basic principles of analog and digital circuits as well as robot sensing and control mechanisms. Students have to apply the knowledge and principles learned to design and build a functional robot by the end of the course. Students who have completed ELEC 2200 and either ELEC 2400 or ELEC 2410 must obtain instructor's approval to take this course.

ELEC 1200   A System View of Communications: from Signals to   [4 Credit(s)] Packets

[Previous Course Code(s): ELEC 121, ELEC 300U*]* Have you ever wondered what technologies go into your mobile phone or a WiFi hotspot? Through hands on work with a simple but fully functional wireless communication system, you will understand the basic engineering tools used and tradeoffs encountered in the design of these systems. This course is centered on weekly laboratories, each designed to introduce an important concept in the design of these systems. The lab sessions are supported by two one-hour lectures and a tutorial that introduce the concepts for the next laboratory, as well as reviewing and expanding the concepts learned in the previous laboratory. *Prerequisite(s):* (COMP 1004 OR COMP 1021 OR COMP 1022P OR COMP 1022Q) AND (MATH 1003 OR MATH 1014 OR MATH 1018 OR MATH 1020 OR MATH 1024 OR a passing grade in AL Pure Mathematics / AL Applied Mathematics)

ELEC 1970   Industrial Training   [0 Credit(s)]

[Previous Course Code(s): ELEC 097*]* A practical training course for a total duration of four weeks. Topics include basic electronic practices, Linux system administration, Linux network administration, managing and maintaining a Windows server environment, and safety. For Computer Engineering students only. Graded P or F.

ELEC 1980   Industrial Training   [0 Credit(s)]

[Previous Course Code(s): ELEC 098*]* For Electronic Engineering (Information and Communication Engineering) students only. A practical training course for a total duration of four weeks. Topics include basic electronic practices, Linux system administration, Linux network administration, software engineering practice, and safety. Graded P or F.

ELEC 1990   Industrial Training   [0 Credit(s)]

[Previous Course Code(s): ELEC 099*]* For Electronic Engineering students only. A practical training course for a total duration of four weeks. Topics include Linux system administration, basic electronic practice and circuit board testing, SMT assembly design and manufacturing, software engineering practice, and safety. Graded P or F.

ELEC 2100   Signals and Systems   [4 Credit(s)]

[Previous Course Code(s): ELEC 211*]* This is an introductory course for signal and system analysis. The course covers signal analysis tools including continuous- and discrete-time Fourier series and Fourier transform, and Laplace Transform; interactions between signals and linear time invariant (LTI) systems, and differential and difference equations as LTI systems, sampling theorem; and application examples in communication and control systems. MATLAB introduced as an integral part of this course. *Prerequisite(s):*

MATH 2011/2111/2350/2351/2352, and ELEC 1100/1200/2400/2410
Reference(s):
  - Alan V. Oppenheim, Alan S. Wilsky and S.H. Nawab, Signals and Systems, Second Edition

ELEC 2200   **Digital Circuits and Systems**   **[4 Credit(s)]**
[Previous Course Code(s): ELEC 151*]* 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. *Prerequisite(s):* ELEC 1100 OR ELEC 1200
Reference(s):
  - M. Morris Mano, Digital Design, 3rd Edition, 2002

ELEC 2300   **Computer Organization**   **[4 Credit(s)]**
[Previous Course Code(s): ELEC 152*]* This is an introductory course to computer organization. The topics covered include instruction-set-design, digital design and computer arithmetic, controller and datapath design, memory systems, input-output systems, interrupts, pipelining, performance analysis, assembly language programming, and survey of advanced architectures. *Exclusion(s):* COMP 2611 *Corequisite(s):* ELEC 2200
Reference(s):
  - 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 2400   **Electronic Circuits**   **[5 Credit(s)]**
[Previous Course Code(s): ELEC 102*]* Fundamental concepts, Ohm's law, passive and active components, KVL and KCL, Thevenin and Norton Theorems, linearity and superposition, nodal analysis, transient analysis, sinusoidal steady state and phasor, transfer functions, op-amps, diodes, MOS transistors and related circuits. *Exclusion(s):* ELEC 2410 *Prerequisite(s):* ELEC 1100 AND (MATH 1003 OR MATH 1014 OR MATH 1018 OR MATH 1020 OR MATH 1024)

ELEC 2410   **Basic Electronics**   **[4 Credit(s)]**
[Previous Course Code(s): ELEC 101*]* 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(s):* ELEC 2400 *Prerequisite(s):* A passing grade in AL Pure Mathematics / AL Applied Mathematics / AS Applied Mathematics / AS Mathematics and Statistics *Corequisite(s):* (For students without AL Pure Mathematics) MATH 1013 OR MATH 1014 OR MATH 1018 OR MATH 1020 OR MATH 1023 OR MATH 1024

ELEC 2600   **Probability and Random Processes in Engineering**   **[4 Credit(s)]**
[Previous Course Code(s): ELEC 210*]* An introduction to statistical inference and random processes in electrical engineering, including the necessary probabilistic background. Random variables, distribution and density functions, characteristic functions, conditional statistics, expectation, moments, stochastic processes. *Exclusion(s):* MATH 2421, MATH 246 *Prerequisite(s):* A passing grade in AL Pure Mathematics OR MATH 1003 OR MATH 1014 OR MATH 1018 OR MATH 1020 OR MATH 1024

ELEC 2910   **Academic and Professional Development I**   **[0 Credit(s)]**
[Previous Course Code(s): ELEC 195*]* 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 2920   **Professional Development in Engineering Business I**   **[0 Credit(s)]**
[Previous Course Code(s): ELEC 196*]* A compulsory, one year course for students in Electronic Engineering - Entrepreneurship Option, and Electronic Engineering and BBA in General Business Management 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. Focus is on Engineering Marketing, working with Government Regulation, and Entrepreneurship. Graded P or F.

ELEC 2930   **Academic and Professional Development I**   **[0 Credit(s)]**
[Previous Course Code(s): ELEC 010*]* 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 3100   Signal Processing and Communications   [4 Credit(s)]
[Previous Course Code(s): ELEC 214*]* The course provides a comprehensive overview of signal processing and communications using quantitative modeling and analysis. Topics include: 7 layer communications model, discrete Fourier transform and z-transform, IIR and FIR filter design techniques and realizations, complexity and implementation considerations of FFT and FIR/IIR, source coding, digital modulation, PSD and spectrum, effects of noise to communication system designs, detection theory, matched filter, signal space and error analysis, channel models and channel coding. Application examples are provided to illustrate on how practical communication systems are designed using these quantitative tools. Design projects are set up 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(s):* ELEC 2100 and ELEC 2600
Reference(s):
  - R.E. Zeimer and W.H. Tranter, Principles of Communications: Systems; Modulation, and Noise, Fourth Edition, 1995

ELEC 3110   Digital Signal Processing   [4 Credit(s)]
[Previous Course Code(s): ELEC 212*]* 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(s):* ELEC 2100

ELEC 3200   System Modeling, Analysis and Control   [4 Credit(s)]
[Previous Course Code(s): ELEC 271*]* This course introduces basic concepts, tools and techniques for modeling, analysis, and control of dynamical systems. The course starts from the use of differential equations to model continuous time systems. Examples from a variety of Electronic and Computer Engineering disciplines will be given to illustrate the modeling process. Then, basic tools needed for analyzing the behavior of dynamical systems will be presented. Finally, techniques for controlling their behavior will be introduced. Throughout the course, laboratory experiments demonstrating the use of these analysis/design tools will be included. *Exclusion(s):* CENG 4120, MECH 3610 *Prerequisite(s):* ELEC 2100 and MATH 2111

ELEC 3210   Signals and Systems II   [4 Credit(s)]
[Previous Course Code(s): ELEC 215*]* This is the second course in the course sequence of signals and systems. It covers the signal analysis tools of Laplace Transform and z-Transform; transient analysis such as initial condition, natural response and forced response; steady state analysis and phasors; frequency response and Bode plots; stability; and state-space representation. *Prerequisite(s):* ELEC 2100

ELEC 3300   Introduction to Embedded Systems   [4 Credit(s)]
[Previous Course Code(s): ELEC 254*]* This course is designed to teach techniques on how to integrate machine-level software and hardware in ARM-core microcontroller based systems. It makes use of industry-standard techniques and technologies, from which students can interface, design and program microcontroller systems. The task of the course will be to complete five laboratory experiments which address different aspects of hardware/software interfacing, and one large microprocessor/microcontroller based project which should result in the design and implementation of a small working embedded system. *Prerequisite(s):* COMP 2611 or ELEC 2300

ELEC 3400   Introduction to Integrated Circuits and Systems   [4 Credit(s)]
[Previous Course Code(s): ELEC 202*]* This course presents an overview, applications, fundamentals and design flow of the state-of-the-art integrated circuits (IC) and systems. Course contents include fabrication process; diodes, bipolar transistors and MOS transistors and modes of operations; and fundamental of analog, digital and mixed-signal IC design. *Prerequisite(s):* ELEC 2200; and ELEC 2400 or ELEC 2410
Reference(s):
  - A.S. Sedra and K.C. Smith, Microelectronic Circuits, Fourth Edition, 1997

ELEC 3500   Microelectronic Devices and Technology   [4 Credit(s)]
[Previous Course Code(s): ELEC 321*]* This is an introductory course for semiconductor device operation principles and technology in common electronic products such as integrated circuit (IC), camcorder, solar cell, memory elements, smartcard, etc. Topics covered include Semiconductor properties, IC fabrication technology, PN junctions, Bipolar Junction Transistors (BJT), MOSFETs, CCD and the future technology trend in the electronic industry. *Prerequisite(s):* (Level 3 or above in HKDSE 1/2x Chemistry OR a passing grade in HKCEE Chemistry OR CHEM 1001 OR CHEM 1004) AND (ELEC 2400 OR ELEC 2410)

ELEC 3600   Electromagnetics: From Wireless to Photonic   [4 Credit(s)]
                    Applications

[Previous Course Code(s): ELEC 241*]* This area course introduces applied electromagnetics from fundamentals to applications. Topics include: Gauss', Faraday's and Ampere's laws; electrostatics and magnetostatics; Maxwell's equations; electromagnetic plane wave propagation; transmission lines; radiation and antenna fundamentals; light wave fundamentals. Students will also acquire hands-on experience to electromagnetics through laboratory sessions. *Prerequisite(s):* MATH 2011 and MATH 2111 and MATH 2351 *Reference(s):*
  - Matthew N. O. Sadiku, Elements of Electromagnetics, 3rd Edition
  - N. N. Rao, Elements of Engineering Electromagnetics, 5th Edition

ELEC 3900   Introduction to Electronic and Computer Technology   [1 Credit(s)]
[Previous Course Code(s): ELEC 290*]* For ECE and CPEG 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 3910   Academic and Professional Development II   [0 Credit(s)]
[Previous Course Code(s): ELEC 295*]* Continuation of ELEC 2910. Graded P or F.

ELEC 3920   Professional Development in Engineering Business II   [0 Credit(s)]
[Previous Course Code(s): ELEC 296*]* Continuation of ELEC 2920. Graded P or F.

ELEC 3930   Academic and Professional Development II   [0 Credit(s)]
[Previous Course Code(s): ELEC 020*]* Continuation of ELEC 2930. This is a compulsory, one year course for Computer Engineering students only. Graded P or F.

ELEC 4010   Special Topics   [1-4 credit(s)]
[Previous Course Code(s): ELEC 300*]* Selected topics in Electronic and Computer Engineering. May be repeated for credit, if different topics taken.

ELEC 4110   Digital Communications and Wireless Systems   [3 Credit(s)]
[Previous Course Code(s): ELEC 314*]* 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, mobile and wireless channels, diversity techniques, spread-spectrum communications, Resource Partitioning in Multiuser systems (FDMA, TDMA, CDMA) and their applications in cellular mobile and wireless personal communications. *Prerequisite(s):* ELEC 3100

ELEC 4120   Computer Communication Networks   [3 Credit(s)]
[Previous Course Code(s): ELEC 315*]* Overview of computer networks: network architecture and switching techniques. Introduction to the Internet, network programming, and layer architecture. Application layer: HTTP, FTP, SMTP, and CDN. Transport layer: TCP and UDP. Network layer: IP routing, NAT, and DHCP. Data link layer and local area networks: MAC protocols, Ethernet, and hubs/bridges/switches. *Exclusion(s):* COMP 4621 *Prerequisite(s):* (COMP 1004 OR COMP 1021 OR COMP 1022P OR COMP 1022Q) AND (ELEC 1100 OR ELEC 1200)

ELEC 4130   Digital Image Processing   [3 Credit(s)]
[Previous Course Code(s): ELEC 317*]* This course introduces methods to process images on a computer. Topics include the formation and quantification of digital images, morphological image processing, image enhancement in the spatial and frequency domain, image restoration, color image processing, image compression, image segmentation, image representation and description. This course is mathematics-oriented. It requires basic knowledge of linear algebra, calculus and linear filtering. Familiarity with the programming language MATLAB is needed. *Exclusion(s):* COMP 4421 *Prerequisite(s):* ELEC 3100 AND MATH 2111

ELEC 4140   Speech and Image Compression   [3 Credit(s)]
[Previous Course Code(s): ELEC 331*]* This course begins with an overview of some fundamental information theory related to data compression. Lossless techniques, including Huffman/arithmetic coding, LZ coding, and their applications; and lossy techniques, including quantization (both scalar and vector), transform coding, predictive coding and their applications will be discussed. Several international standards (such as GIF, and JPEG for image coding, and LPC vocoder and its variants) will be discussed. Programming exercises on various image and speech codes will be an integral part of this course. *Prerequisite(s):* ELEC 2100

ELEC 4150   Information Theory and Error-Correcting Codes   [3 Credit(s)]

[Previous Course Code(s): ELEC 332*]* Communication and information theory; self and mutual information measures; channel models and capacity; source coding; hamming codes; cyclic codes; BCH and Reed-Solomon codes; convolutional codes and the Viterbi algorithm; burst error correction; Turbo coding. *Prerequisite(s):* ELEC 3100

ELEC 4160   Introduction to Digital Speech Recognition   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 333*]* 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(s):* (COMP 1003 OR COMP 1004 OR COMP 1021 OR COMP 1022P OR COMP 1022Q) AND ELEC 2100

ELEC 4170   Digital Media and Multimedia Applications   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 360*]* 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. *Exclusion(s):* COMP 4431 *Prerequisite(s):* (COMP 1003 OR COMP 1004 OR COMP 104H (prior to 2009-10) OR COMP 1021 OR COMP 1022P OR COMP 1022Q) AND ELEC 2100

ELEC 4180   Wireless Communication Engineering   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 343*]* Introduction to issues and solutions in wireless communications; path loss, shadowing, and multi-path fading effects of the mobile radio propagation channel; cell planning and various capacity improvement techniques; fading channel classifications and modeling; time, frequency and antenna diversity; Spread Spectrum; OFDM; high level description of various practical systems including GSM, CDMA and WLAN. *Prerequisite(s):* ELEC 3100

ELEC 4210   Digital Control Systems   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 377*]* Digital computers for design and implementation of feedback control systems. State-space models, sampling, z-transform, stability, controllability and observability, design of digital control systems using state-space methods, digital PID controllers and tuning. *Prerequisite(s):* ELEC 3200

ELEC 4310   Embedded System Design   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 302*]* In this course, students will learn the important concepts and modern design practices of embedded computing systems. They will see how a complex embedded system can be systematically developed as a union of software and hardware. The course will cover several fundamental topics, such as design targets, hardware/software co-design methodology, common design techniques, processors, architectures, and physical implementations. It will also cover several advanced topics, such as behavioral modeling, low-power techniques, and systems-on-chip. *Prerequisite(s):* ELEC 3300

ELEC 4410   CMOS VLSI Design   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 301*]* 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(s):* ELEC 2200

ELEC 4420   Analogue Integrated Circuits Design and Analysis   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 304*]* Multiple-stage operational amplifiers, frequency response, feedback analysis, stability and compensation, Slew rate, advanced amplifier design techniques, analog VLSI building blocks. *Prerequisite(s):* ELEC 3400
Reference(s):
  - P. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer, Analysis and Design of Analog Integrated Circuits, 2001

ELEC 4430   Integrated Power Electronics   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 351*]* Power computation, diodes and rectifier circuits, power factor correctors, switch mode power converters, magnetic components, switch capacitor power converters, linear regulators, and integrated circuit techniques for controller design. *Prerequisite(s):* ELEC 3400

ELEC 4440   ASIC Design with Field Programmable Gate Arrays   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 303*]* 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(s):* ELEC 2200

ELEC 4510   **Semiconductor Materials and Devices**   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 221*]* 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(s):* ELEC 2400 OR ELEC 2410 OR ELEC 3500

ELEC 4520   **Integrated Circuit Fabrication Technology**   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 322*]* For UG students only. The course is intended to provide students with fundamental knowledge in device and integrated circuits (IC's) fabrication. The class covers the modules of device fabrication (including clean room concept, cleaning procedures, diffusion, lithography, wet processing, dry etching, chemical vapor deposition, sputtering) and process integration to form IC's. The lab section will bring the students with hands-on experience in IC fabrication facilities in Nanoelectronics Fabrication Facility of HKUST. *Prerequisite(s):* ELEC 3500 OR ELEC 4510

ELEC 4610   **Engineering Optics**   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 308*]* An introductory course in optics covering fundamentals of geometrical and physical optics. Topics include: review of geometrical optics, first order optical system and analysis, aberration, aperture and field stops; Basic wave theory, diffraction, interference, polarization, dispersion; fundamentals of optical instrumentation. *Exclusion(s):* PHYS 3038 *Prerequisite(s):* ELEC 3600

ELEC 4620   **Photonics and Optical Communications**   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 342*]* To introduce optoelectronics and fiber optics for communications. Topics include optical fibers, optical sources, optical detectors, and passive components for wavelength-division multiplexing. Laboratory gives hands-on experience in handling optical fibers, lasers and detectors, micro-optical components, opto-mechanical equipment, and building wavelength-division-multiplexed optical links. *Exclusion(s):* PHYS 3039 *Prerequisite(s):* ELEC 3500 AND ELEC 3600

ELEC 4630   **Radio Frequency Engineering**   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 344*]* Techniques of radio-frequency/microwave circuit technology. S-parameter design of passive components; computer-aided analysis and design of microwave circuits. Component structures such as microstrip lines, waveguides, power divider and directional combiner, resonators and filters. *Prerequisite(s):* ELEC 3600

ELEC 4640   **Modern Optics**   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 345*]* Advanced topics in optics and optoelectronics. Polarization effects and polarization manipulation, wave interference, diffraction, Fourier optics, optical signal processing, optical coatings, lasers and applications, LED and solar cells. *Exclusion(s):* ELEC 692X *Prerequisite(s):* ELEC 3600

ELEC 4710   **Engineering Business Development**   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 310*]* The course is intended to address different needs of engineers in operating and managing engineering business. Different topics will be covered in different semesters by experienced faculty members who have extensive working experience. Through the class, the students can acquire a sense on how to bridge their engineering training with the operation in the commercial world from the Engineering perspective.

ELEC 4810   **Introduction to Biosensors and Bioinstrumentation**   **[4 Credit(s)]**

[Previous Course Code(s): ELEC 383*]* This course builds on the fundamental knowledge of biosensors and bioinstrumentation. Lectures and hands-on laboratory experiments cover: (1) Basic concepts of biomedical signal analysis; (2) Measurements of bioelectrical, biomechanical and biochemical signals for medical diagnosis and clinical monitoring; (3) Principles of biosensors and biochips; (4) Simple design of new bioinstrumentation and biosensor to solve biomedical problems. *Prerequisite(s):* ELEC 2400 or ELEC 2410
Reference(s):
  - J. W. Webster, Medical Instrumentation

ELEC 4820   **Medical Imaging**   **[3 Credit(s)]**

[Previous Course Code(s): ELEC 384] This course introduces medical imaging methods to senior undergraduate and graduate students. It covers the following topics: radiation, radiography, computer tomography, radioisotope imaging, diagnostic ultrasound imaging, magnetic resonance imaging, and applications of different imaging modalities. This course requires basic knowledge of linear algebra, calculus, and geometry. Familiarity with a programming language such as MATLAB is needed. *Prerequisite(s):* ELEC 2100

ELEC 4902   Final Year Project in Entrepreneurship I   [1 Credit(s)]
[Previous Course Code(s): ELEC 397B] Each undergraduate student taking the Entrepreneurship Option of the Electronic Engineering program is required to take ELEC 4902, ELEC 4912 and ELEC 4922 in sequence. The project will have significant focus on starting new companies, improving manufacturing process, project management, meeting requirements of existing standards, and marketing strategy. It will be led by faculty members with startup and management experiences to provide first hand training to these students. Work normally commences in the summer following the second year. May be graded PP.

ELEC 4903   Computer Engineering Final Year Project   [8 Credit(s)]
[Previous Course Code(s): ELEC 363] Each Computer Engineering student is required to complete a final year project before graduation. The project is conducted under the supervision of faculty members from the Department of Computer Science and Engineering and/or the Department of Electronic and Computer Engineering. The credit load will be spread over 3 terms.

ELEC 4904   Computer Engineering Final Year Thesis   [8 Credit(s)]
[Previous Course Code(s): ELEC 364] Only for honors students of the BEng Computer Engineering Program. They are expected to conduct research/independent work under the supervision of faculty members from the Department of Computer Science and Engineering and/or the Department of Electronic and Computer Engineering, summarize their work in an individual thesis and make a presentation at the end of the sequence. The credit load will be spread over 3 terms.

ELEC 4905   Computer Engineering Final Year Project I   [2 Credit(s)]
[Previous Course Code(s): ELEC 394] [Also COMP 4991] Each Computer Engineering student is required to take COMP 4991, 4992 and 4993/ELEC 4905, 4915 and 4925. The project is conducted under the supervision of faculty members from the Department of Computer Science and Engineering and/or the Department of Electronic and Computer Engineering. May be graded PP.

ELEC 4907   Final Year Project   [9 Credit(s)]
[Previous Course Code(s): ELEC 367] Each undergraduate student enrolled in the Department of Electronic and Computer Engineering is required to complete a final year project before graduation. The student is expected to submit a project progress report by the end of the first term of the project, and to complete a final project report and to give an oral project presentation at the end. The project is conducted under the supervision of a faculty member. The credit load will be spread over 3 terms.

ELEC 4908   Final Year Thesis   [9 Credit(s)]
[Previous Course Code(s): ELEC 368] Each undergraduate student taking the Honors Research Option of the Electronic Engineering program is required to complete a final year thesis before graduation. The student is expected to complete an individual thesis and the thesis should summarize his/her work conducted under the supervision of a faculty member. The credit load will be spread over 3 terms.

ELEC 4909   Final Year Project in Entrepreneurship   [9 Credit(s)]
[Previous Course Code(s): ELEC 369] Each undergraduate student taking the Entrepreneurship Option of the Electronic Engineering program is required to complete a final year project before graduation. The project will have significant focus on starting new companies, improving manufacturing process, project management, meeting requirements of existing standards, and marketing strategy. It will be led by faculty members with startup and management experiences to provide first hand training to these students. The credit load will be spread over 3 terms.

ELEC 4910   Final Year Project II   [4 Credit(s)]
[Previous Course Code(s): ELEC 398] Continuation of ELEC 4900. May be graded PP. *Prerequisite(s):* ELEC 4900

ELEC 4911   Final Year Thesis II   [4 Credit(s)]
[Previous Course Code(s): ELEC 392] Continuation of ELEC 4901. May be graded PP. *Prerequisite(s):* ELEC 4901

ELEC 4912   Final Year Project in Entrepreneurship II   [4 Credit(s)]

[Previous Course Code(s): ELEC 398B*]* Continuation of ELEC 4902. May be graded PP. *Prerequisite(s):* ELEC 4902

ELEC 4915   Computer Engineering Final Year Project II   [3 Credit(s)]
[Previous Course Code(s): ELEC 395*]* [Also COMP 4992] Continuation of ELEC 4905. May be graded PP. *Prerequisite(s):* ELEC 4905

ELEC 4916   Computer Engineering Final Year Thesis II   [3 Credit(s)]
[Previous Course Code(s): ELEC 388*]* [Also COMP 4995] Only for honors students of the BEng Computer Engineering Program. Continuation of ELEC 4906 (prior to 2008-09). May be graded PP. *Prerequisite(s):* ELEC 4906 (prior to 2008-09)

ELEC 4920   Final Year Project III   [4 Credit(s)]
[Previous Course Code(s): ELEC 399*]* Continuation of ELEC 4910. *Prerequisite(s):* ELEC 4910

ELEC 4921   Final Year Thesis III   [4 Credit(s)]
[Previous Course Code(s): ELEC 393*]* Continuation of ELEC 4911. *Prerequisite(s):* ELEC 4911

ELEC 4922   Final Year Project in Entrepreneurship III   [4 Credit(s)]
[Previous Course Code(s): ELEC 399B*]* Continuation of ELEC 4912. *Prerequisite(s):* ELEC 4912

ELEC 4925   Computer Engineering Final Year Project III   [3 Credit(s)]
[Previous Course Code(s): ELEC 396*]* [Also COMP 4993] Continuation of ELEC 4915. *Prerequisite(s):* ELEC 4915

ELEC 4926   Computer Engineering Final Year Thesis III   [3 Credit(s)]
[Previous Course Code(s): ELEC 389*]* [Also COMP 4996] Only for honors students of the BEng Computer Engineering Program. Continuation of ELEC 4916. *Prerequisite(s):* ELEC 4916

ELEC 4930   Academic and Professional Development III   [0 Credit(s)]
[Previous Course Code(s): ELEC 030*]* Continuation of ELEC 3930. This is a compulsory, one year course for Computer Engineering students only. Graded P or F.

ELEC 4940   Independent Study   [1-3 Credit(s)]
[Previous Course Code(s): ELEC 390*]* Selected topics in electronic and computer engineering studied under the supervision of a faculty member. Enrollment subject to approval by the department.

ELEC 4950   Research Work Experience   [0 Credit(s)]
[Previous Course Code(s): ELEC 095*]* Each undergraduate student enrolled in the Honors Research Option of the BEng program in Electronic Engineering is required to have R&D work experience in a company or research lab. The job and the nature of work has to be approved by the department for fulfilling this course requirement. Graded P or F.