### Electronic Engineering

#### Course List

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For M.Phil. Programme Only
ELE 801T-810T Research for Thesis I, II, III, IV, V, VI, VII, 3 each
VIII, IX, X

For Ph.D. Programme Only

Course Description

(Unless otherwise specified, all are 3-unit term courses.)

ELE 5010
Advanced Topics in Electronic Engineering
A series of lectures on current research in electronic engineering.

ELE 5020
Advanced Topics in Integrated Circuits and Systems
A series of lectures on current research in integrated circuits and systems.

ELE 5030
Advanced Topics in Wireless Communications
A series of lectures on current research in wireless communication technology.

ELE 5040
Advanced Topics in Signal Processing
A series of lectures on current research in signal processing.

ELE 5050
Advanced Topics in Solid State Technology
A series of lectures on current research in solid state technology.

ELE 5110
Electronic Instrumentation and Measurements in Biomedical Engineering
Characteristics of physiological signals; patient safety; electrodes and transducers for physiological measurements; analog and digital circuit techniques for biomedical instrumentations; ECG, cardiac emergency and support equipments; ECG, EMG and associated equipments; physiological measurements by impedance method; biotelemetry.

ELE 5120
Selected Topics in Biomedical Engineering
Selected topics in bio-medical engineering, emphasis is more on recent advances and development trend. Topics include: bioelectric phenomena, biological control systems, bio-instrumentations, non-invasive bio-measurement techniques, biomechanics, clinical engineering, rehabilitation engineering. Course will normally cover any 2-4 topics in any year.

ELE 5130
Prosthetics & Artificial Organs
Basic concepts of biological prosthetic systems and artificial organs; Functional electrical stimulation; Restoration of movement of paralysed arms and legs; Design of implantable devices and systems; Engineering replacements of kidney, lung, heart, and other organ functions and their electrical, mechanical, materials, chemical, pathological and surgical aspects. Prerequisite: ELE 3240 or permission of instructor.
ELE 5140
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.

ELE 5210
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. Prerequisite: ELE 3210.

ELE 5250
Advanced IC Design Methodology

ELE 5260
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.

ELE 5270
Computer-Aided Circuit Analysis

ELE 5280
Analog-Digital ASIC Design
1) Analog-digital ASIC design: market trends, integration requirements, design skills. 2) Technologies for mixed analog-digital integrated circuits: “digital” CMOS, “analog” CMOS, BiCMOS. 3) Design methodology: abstraction and hierarchy, impact of simulators on design, quality design. 4) Properties and layout techniques for basic analog elements: integrated resistors and capacitors, MOS transistors. 5) Component cells synthesis: operational amplifiers, comparators, voltage and current references. 6) Integrated filter synthesis: switched-capacitor filters, switched-current filters, continuous-time filters. 7) A/D and D/A conversion systems: basic parameters and properties, parallel, serial and algorithmic converters, oversampling converters. 8) Systems considerations and applications: case studies of relevant ASICs in wired and wireless communication systems.
ELE 5310
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, smart antenna, and software radio.

ELE 5350
Advanced Electromagnetism

ELE 5380
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.

ELE 5390
Monolithic Microwave IC

ELE 5410
Pattern Recognition
Introduction: pattern recognition, data processing and feature selection applications; pattern classifying systems: discriminant functions, training methods and theorems; statistical pattern recognition: Bayes classifier, feature selection and ordering, potential function methods; syntactic pattern recognition: description of patterns by grammers, stochastic grammars, grammatical inference, error correcting grammars.

ELE 5420
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, formant vocoder, LPC vocoder; other coding techniques: voice-excited vocoder, sub-band coding, adaptive transform coding, adaptive predictive coding, time-encoded speech.
ELE 5431
Advanced Techniques for Video Coding

ELE 5440
Non-linear Signal Processing
Deterministic and statistical properties; morphological theory; principle of threshold decomposition; introduction to median and order-statistics filtering; analysis of 1-D and 2-D median related filters; analog and digital hardware realization techniques for real-time non-linear signal processing.

ELE 5450
Advanced Computer Vision
Introduction, imaging, scene analysis, stereo vision, object representation and recognition, Hough transform, shape from shading, shape from contours, shape from texture, image modelling by Markov random fields, fractal modelling, data fusion, motion, trends and applications.

ELE 5460
Advanced Digital Signal Processing
Fundamentals of digital signal processing, spectral estimation, multirate processing of digital signals, computation algorithms for convolution and DFT, orthogonal transforms, adaptive signal processing and multidimensional signal processing.

ELE 5470
Wavelets
Basic wavelet analysis: background and notations, Windowed Fourier transforms, continuous wavelet transforms, generalized frames, discrete time-frequency analysis, discrete time-scale analysis, multiresolution analysis, Daubechies’ orthonomal wavelet bases. Physical wavelets: wavelet electromagnetics, application to scattering and wavelet acoustics.

ELE 5480
Detection and Estimation

ELE 5490
Automatic Speech Recognition

ELE 5510
Solid State and Semiconductor Theory
Review of quantum theory and energy band theory of solids. Semiconductor fundamentals and transport properties; high field phenomena and hot electron effects. Semiconductor heterostructures: band-edge discontinuity, 2D electron gas, quantum wells and superlattices, resonant tunneling diodes and transistors. Dielectric and optical properties; semiconductor structures for optical devices.

ELE 5520
Advanced Topics in Optoelectronics
The lecture course covers selected topics in optoelectronics. Possible topics that will be covered include the physical principles of optoelectronic devices (e.g., modelling the gain of quantum well laser diodes), the theory of ultrashort pulse propagation in nonlinear dispersive media, and case studies of practical optoelectronic systems. Coursework may include practical design exercises for optoelectronic systems.

ELE 5530
Characterization Techniques in Semiconductor Technology
Electrical measurements and capacitance methods. X-ray diffraction; electron paramagnetic resonance; microscopy: optical, SEM, TEM, STM and related techniques. Surface analysis techniques: AES, XPS, SIMS, RBS, ion channelling. Optical methods: ellipsometry, photoluminescence, Raman spectroscopy.

ELE 5540
III-V Compound Semiconductors: Materials and Devices

ELE 5550
Crystal Growth

ELE 5560
CMOS Devices and Technology for VLSI
ELE 5570
Solid State and Quantum Electronic Devices
Advanced III-V materials preparation technology. Heterojunctions and quantum wells, superlattices, high electron mobility transistors, heterojunction bipolar transistors, graded-index separate confinement heterojunction diode lasers, PIN photodetectors, MSM photodetectors, resonant tunneling devices, strained semiconductor devices.

ELE 5580
Solid State Magnetism and Magnetic Materials

ELE 5590
Ion Beam Materials Analysis
Energy loss, nuclear theory. Backscattering spectrometry; thin film analysis, surface layers of bulk materials, experimental considerations, examples: elastic recoil detection, nuclear reaction analysis, activation analysis. Channelling; theory, experimental methods, crystal alignment, epitaxial layers and strain, damage measurements, lattice site location, surface studies. Instrumentation, pitfalls, radiological safety.

ELE 801T
Research for Thesis I
To carry out research on a topic specified by the Division.

ELE 802T
Research for Thesis II
To carry out research on a topic specified by the Division. Prerequisite: ELE 801T.

ELE 803T
Research for Thesis III
To carry out research on a topic specified by the Division. Prerequisite: ELE 802T.

ELE 804T
Research for Thesis IV
To carry out research on a topic specified by the Division. Prerequisite: ELE 803T.

ELE 805T
Research for Thesis V
To carry out research on a topic specified by the Division. Prerequisite: ELE 804T.

ELE 806T
Research for Thesis VI
To carry out research on a topic specified by the Division. Prerequisite: ELE 805T.

ELE 807T
Research for Thesis VII
To carry out research on a topic specified by the Division. Prerequisite: ELE 806T.
ELE 808T
Research for Thesis VIII
To carry out research on a topic specified by the Division. Prerequisite: ELE 807T.

ELE 809T
Research for Thesis IX
To carry out research on a topic specified by the Division. Prerequisite: ELE 808T.

ELE 810T
Research for Thesis X
To carry out research on a topic specified by the Division. Prerequisite: ELE 809T.

ELE 901T
Research for Thesis I
To carry out research on a topic specified by the Division.

ELE 902T
Research for Thesis II
To carry out research on a topic specified by the Division. Prerequisite: ELE 901T.

ELE 903T
Research for Thesis III
To carry out research on a topic specified by the Division. Prerequisite: ELE 902T.

ELE 904T
Research for Thesis IV
To carry out research on a topic specified by the Division. Prerequisite: ELE 903T.

ELE 905T
Research for Thesis V
To carry out research on a topic specified by the Division. Prerequisite: ELE 904T.

ELE 906T
Research for Thesis VI
To carry out research on a topic specified by the Division. Prerequisite: ELE 905T.

ELE 907T
Research for Thesis VII
To carry out research on a topic specified by the Division. Prerequisite: ELE 906T.

ELE 908T
Research for Thesis VIII
To carry out research on a topic specified by the Division. Prerequisite: ELE 907T.

ELE 909T
Research for Thesis IX
To carry out research on a topic specified by the Division. Prerequisite: ELE 908T.

ELE 910T
Research for Thesis X
To carry out research on a topic specified by the Division. Prerequisite: ELE 909T.
ELE 911T  
Research for Thesis XI  
To carry out research on a topic specified by the Division. Prerequisite: ELE 910T.

ELE 912T  
Research for Thesis XII  
To carry out research on a topic specified by the Division. Prerequisite: ELE 911T.

ELE 913T  
Research for Thesis XIII  
To carry out research on a topic specified by the Division. Prerequisite: ELE 912T.

ELE 914T  
Research for Thesis XIV  
To carry out research on a topic specified by the Division. Prerequisite: ELE 913T.

ELE 915T  
Research for Thesis XV  
To carry out research on a topic specified by the Division. Prerequisite: ELE 914T.

ELE 916T  
Research for Thesis XVI  
To carry out research on a topic specified by the Division. Prerequisite: ELE 915T.

**Study Scheme**

**I. Ph.D. Programme (Full-time and Part-time)**

Applicable to students admitted in 2000-2001 and thereafter

1. **Coursework Requirement**

   (a) Students are required to complete a minimum of 6 units of graduate courses (coded 5xxx) selected from the above course list or those offered by other Divisions as prescribed by the supervisor or Division Head.

   (b) Students are required to take ELE 9xxT every term from the time of admission, throughout the preparation of thesis, until its completion.

   **First Year of Attendance**
   - ELE 901T (for 1st term)  
   - ELE 902T (for 2nd term)  

   **Third Year of Attendance**
   - ELE 905T (for 1st term)  
   - ELE 906T (for 2nd term)  

   **Fifth Year of Attendance**
   - ELE 909T (for 1st term)  
   - ELE 910T (for 2nd term)  

   **Seventh Year of Attendance**
   - ELE 913T (for 1st term)  
   - ELE 914T (for 2nd term)  

   **Second Year of Attendance**
   - ELE 903T (for 1st term)  
   - ELE 904T (for 2nd term)  

   **Fourth Year of Attendance**
   - ELE 907T (for 1st term)  
   - ELE 908T (for 2nd term)  

   **Sixth Year of Attendance**
   - ELE 911T (for 1st term)  
   - ELE 912T (for 2nd term)  

   **Eighth Year of Attendance**
   - ELE 915T (for 1st term)  
   - ELE 916T (for 2nd term)  

For students admitted in the 2nd term (i.e. January), the sequence of required courses ELE 901T, 902T, 903T and 904T should be the same.
2. **Comprehensive/ Qualifying Examination**

Students are required to pass a departmental qualifying examination before the advancement to Ph.D. candidature. ELE 903T is treated as a qualifying examination for full-time students and ELE 904T for part-time students admitted in 2000-01 and thereafter.

3. **Other Requirements**

(a) IT Proficiency Test. (Please refer to “Student IT Competence”.)
(b) Students are required to submit a research thesis and pass an oral examination for graduation.
(c) Complete an Improving Postgraduate Learning (IPL) course “Observing Intellectual Property and Copyright Law during Research”. (Applicable to students admitted in 2001-02 and thereafter.)

II. **M.Phil. Programme (Full-time and Part-time)**

Applicable to students admitted in 2000-2001 and thereafter

1. **Coursework Requirement**

(a) Students are required to complete a minimum of 12 units of graduate courses (coded 5xxx) selected from the above course list or those offered by other Divisions as prescribed by the supervisor or Division Head. At most two## one of the## courses can be taken at undergraduate level (coded 4xxx) with the approval from his/her supervisor and Division Head. In any case, at least 6 units of these courses must be coded ELE 5xxx.

Notes: * Applied to students admitted in 2001-02 and thereafter.
## Applied to students admitted in 2000-01.

(b) Students are required to take ELE 8xxT every term from the time of admission, throughout the preparation of thesis, until its completion.

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</table>

For students admitted in the 2nd term (i.e. January), the sequence of required courses ELE 801T, 802T, 803T and 804T should be the same.

2. **Other Requirements**

(a) IT Proficiency Test. (Please refer to “Student IT Competence”.)
(b) Students are required to submit a research thesis and pass an oral examination for graduation.
(c) Complete an Improving Postgraduate Learning (IPL) course “Observing Intellectual Property and Copyright Law during Research”. (Applicable to students admitted in 2001-02 and thereafter.)