

Proposed Scheme for M.Sc. Course in Electronics

There shall be an M.Sc. Course in Electronics in the Department of Electronic Science.

The duration of this course will be two years.

No person shall be qualified for admission to the M.Sc. course unless he is 20 years of age before 1st of the October of the year in which he is seeking admission. Provided that the Vice-Chancellor may, on the basis of individual merit, relax the age limit upto maximum period of six months.

Examinations, Minimum Pass Marks, Promotion and Classification of Successful Candidates

There shall be FOUR Semester Examinations comprised in the course. The minimum pass marks shall be 40% in each theory paper and 40% in practical in each of the three semesters (I, II \ III). In IV semester it will be 40% in each theory papers, 40% in Project/Thesis and 40% in Seminar. Minimum pass marks in Summer Training will also be 40%.

I Semester Examination: On completion of the course of study for the period prescribed therein in November/December of the first year of the course.

At the end of the first semester a student will be promoted to second semester provided he has not failed in more than two theory papers and has obtained not less than 40% marks in the aggregate of theory and practicals taken separately.

The student will have to essentially repeat and pass in those theory papers in which he has failed along with the papers of the second semester. A student who is not promoted to the second semester will have to repeat the first semester as a regular student as and when it runs in the following July-December session.

II Semester Examination: On completion of the course of study for the period prescribed therein in April/May of the first year of the course.

At the end of the second semester a student will be promoted to the third semester provided he has passed in all the first semester papers and has not failed in more than two theory papers of the second semester and has obtained not less than 40% marks in the aggregate of theory and practicals taken separately.

The student will have to essentially repeat and pass in those second semester theory papers in which he has failed along with the papers of the third semester.

A student who has not passed in all the first semester theory papers at the end of the second semester will be deemed failed in the first semester and will have to join back in the first semester as a regular student in the following month of July and repeat both first and second semesters in sequence.

A student who is not promoted to the third semester, but has passed in all the theory papers of the first semester will be considered pass in the first semester and will have to repeat the second semester as and when it runs in the following January-May session.

III Semester Examination: On completion of the course of study for the period prescribed therein in November/December of the second year of the course. At the end of the third semester a student will be promoted to the fourth semester provided he has passed in all the second semester papers and has not failed in more than two theory papers of the third semester and has obtained not less than 40% marks in the aggregate of theory and practicals taken separately. The student will have to essentially repeat and pass in those third semester theory papers in which he has failed along with the papers of the fourth semester.

A student who has not passed in all the second semester theory papers at the end of the third semester will be deemed failed in the second semester and will have to join back in the second semester as a regular student in the following month of January and repeat both second and third semesters in sequence.

A student who is not promoted to the fourth semester, but has passed in all the theory papers of the second semester will be considered pass in the second semester and will have to repeat the third semester as and when it runs in the following July-December session.

IV Semester Examination: On completion of the course of study for the period prescribed therein in April/May of the second year of the course.

At the end of the fourth semester a student will be declared successful provided he has passed in all the third semester papers and has obtained not less than 40% marks in the aggregate of theory, project/thesis and seminar taken separately.

If the end of the fourth semester a student has passed in all the third semester papers and has not failed in more than two theory papers of the fourth semester and has obtained not less than 40% marks in the aggregate of theory, project/thesis and seminar taken separately, the student will have to essentially repeat and pass in those fourth semester theory papers in which he has failed during the semester exams held in the following November/December.

A student who has not passed in all the third semester theory papers at the end of the fourth semester will be deemed failed in the third semester and will have to join back in the third semester as a regular student in the following month of July and repeat both third and fourth semesters in sequence.

A student who has not passed the fourth semester, but has passed in all the theory papers of the third semester will be considered pass in the third semester and will have to repeat the fourth semester as and when it runs in the following January-May session.

At the end of the fourth semester the successful candidates shall be classified on the basis of marks obtained as I, II and III division; 60% and above I division, 50% to less than 60% II division, 40% to less than 50% III division.

NOTE: A student who is deemed failed in any semester will join as a regular student over and above the allocated seats for the course Attendance in two-thirds of the theory classes and three-fourths of the practical classes is compulsory, failing which the student will not be allowed to appear in the examination.

Each Semester calendar will ensure a minimum of 40 lectures in each theory course of study.

In each theory paper 20 percent of marks are reserved for Sessional Tests, which will be awarded as the average of two best of three tests conducted by the teacher.

Students will be required to go for Industrial Training for two months in Summer Vacation between IInd and IIIrd Semester.

The total span period for the course will be four years.

A student's admission will be treated as cancelled if he is absent for two weeks continuously from the date of admission.

Scheme of Examination: The following shall be the scheme of examination for the course:

SEMESTER I

1.1	High-level Computer Languages and Operating Systems	50
1.2	Engineering Mathematics	50
1.3	Network Analysis and Synthesis	50
1.4	Advanced Analog and Digital Circuit Design	50
1.5	Practical I: Engineering Drawing\Workshop Practice	25
1.6	Practical II: Electronic Circuits	25

1.7	Practical III: Microprocessors	25
1.8	Practical IV: Computational Techniques	25
	Semester I total	300

SEMESTER II

2.1	Electromagnetics, Antenna and Propagation	50
2.2	Semiconductor Devices and Materials	50
2.3	Microprocessors	50
2.4	Signal Systems and Control	50
2.5	Practical I: Electromagnetics	25
2.6	Practical II: Materials and Semiconductor Devices	25
2.7	Practical III: Circuit Design and Simulation	25
2.8	Practical IV: Electrical Machines and Control Systems	25
	Semester II total	300
	Summer Training (8 weeks)	50

SEMESTER III

3.1	Optical Electronics	50
3.2	Integrated Circuit Technology	50
3.3	Digital Signal Processing	50
3.4	Communication Systems	50
3.5	Practical I: Optical Electronics	25
3.6	Practical II: Science and Technology of Semiconductor Devices	25
3.7	Practical III: Digital Signal Processing	25
3.8	Practical IV: Communication Systems	25
	Semester III total	300

SEMESTER IV

4.1	Quantum Electronics	50
4.2	VLSI Circuit Design and Device Modeling	50
4.3	Modern Communication Systems	50
4.4	Microwave Electronics	50
4.5	Seminar	25
4.6	Lectures from Industry	25
4.7	Project	200
	Semester IV total	450
	Grand Total	1400

SEMESTER I

1.1 High-level Computer Languages and Operating Systems

Operating Systems: familiarity with various operating systems like DOS, OSII, GUI like Windows, UNIX/LINUX. Details of one operating system such as UNIX: introduction, multitasking, multiuser capabilities, UNIX basics, files and directories, understanding the UNIX shell, text processing in the UNIX environment, editors like VI, EMAC, SED. Programming languages (one high level language such as C++): introduction to C++ and object oriented programming, development environment, compiling and linking the source code, brief look at crout, comments, variable and constants, expressions and statements, functions, classes, pointers, references, overloading, arrays, inheritance, special classes and functions, streams and files, the preprocessor, object-oriented analysis and design, templates, exceptions & error handling, standard libraries and bit manipulation.

1.2 Engineering Mathematics

Sturm-Liouville's problem: applications and examples. Calculus of variations with examples. Partial differential equations: Laplace, wave and diffusion equations in various coordinate systems. Integral equations and methods of solutions. Green's function technique and its application. Approximate techniques of engineering mathematics: perturbation method, variational methods, method of weighted residues, WKB method. Contour integration, conformal mapping. Transforms: Laplace, Fourier and FFT.

1.3 Network Analysis and Synthesis

Time domain analysis of networks (differential equation approach). Thevenin and Norton's theorems, reciprocity theorem, Tellagan's and Millman's Theorems. System function approach to network analysis, graph theory, mesh

and node analysis, poles and zeros. Laplace Transform, Hurwitz polynomials, positive real functions. Synthesis of reactive ports by Foster's and Cauer's Methods. Synthesis of R-L, R-C, and R-L-C networks.

1.4 Advanced Analog and Digital Circuit Design

Practical transistor (BJT, FET) circuit design of amplifiers (single and multistage, audio and RF range) and power amplifiers. Design process as a troubleshooting tool. Oscillators, Mixers and PLL. Review of Logic families, tabular and computer aided minimisation procedures. Programmable Logic Array. Clock mode sequential machines, incompletely specified sequential machines and fundamental mode sequential machines.

1.5 Practical I: High-level Computer Languages and Operating Systems

1.6 Practical II: Electronic Circuits

1.7 Practical III: Microprocessors

1.8 Practical IV: Computational Techniques

SEMESTER II

2.1 Electromagnetics, Antenna and Propagation

Transmission lines: transmission line equation in time and frequency domain, losses and dispersion, reflection from an unknown load; quarter wavelength, single stub and double stub matching; Smith Chart and its applications. Maxwell's equations, constitutive relations, wave equation, plane wave functions, rectangular waveguide, circular waveguide, dielectric slab waveguide, surface guided waves. Antenna parameters, radiation from simple dipole and aperture, concept of antenna arrays, end fire and broadside arrays, horn antenna, microstrip antenna, parabolic disc antenna. Ground wave, space wave and ionospheric propagation. Communication link budget for ground transmission.

2.2 Semiconductor Devices and Materials

Crystalline, polycrystalline and amorphous semiconductors: energy bands, carrier transport, excess carriers, injection and recombination of the excess carriers, the mechanisms involved. Basic equations for semiconductor device operations: continuity equation, current flow equation, carrier transport equation and their solutions. Binary, ternary and quaternary compounds and their applications. Characterisation of semiconducting materials. p-n Junction diodes: abrupt and linear, electrical breakdown, tunnel diode, Schottky barrier diode, majority carrier diodes. Microwave diodes : varactor diode, p-i-n diode, transferred electron devices. Optoelectronic devices: solar cell, photodetector, LED, semiconductor laser. JFET, MESFET, MOS capacitor, MIS diode, MOSFET. Basic idea of charge coupled Devices. Quantum well structures and low dimension physics.

2.3 Microprocessors

Microprocessor based design, design constraints, microprocessor selection, hardware implementation, software implementation, hardware debugging, software debugging. Introduction to 8086, 8088, 80186, 80188, 80286, 6800, 68000 and other latest chips of Intel/Motorola microprocessors. 8086 internal architecture, introduction to programming the 8086, 8086 family assembly language programming. 8086 hardware review, addressing memory and ports in microcomputer systems, 8086 timing parameters. Digital interfacing, programmable parallel ports and hand-shake, input/output, interfacing the microprocessor to keyboards, alphanumeric displays and high power devices. The 8086 Maximum code, DMA data transfer interfacing and refreshing dynamic RAM, processors with integrated peripherals, the 80186, the 8087 math coprocessor. Multiple bus microcomputer system.

2.4 Signal Systems and Control

Introduction with examples of various kinds of continuous and discrete time signals and their mathematical representation. Signal energy and power. Even and odd signals. Periodic, exponential and sinusoidal signals. Unit impulse and unit step functions for both discrete and continuous time signals. Examples and mathematical representation of continuous and discrete time systems. Difference equation. Basic vector matrix form of state equation. Basic system properties. Discrete time Linear Time Invariant(LTI) systems with convolution sum. Continuous time LTI system with convolution integral.

Fourier series and transform application to analysis of signals and systems.

Introduction to control with examples of feedback control systems from several fields. Block diagram, transfer function and signal flow graph. Mathematical modelling of physical systems. Time domain and frequency domain analysis of control systems. Stability criteria, root-locus techniques.

- 2.5 Practical I: Electromagnetics
- 2.6 Practical II: Electronic Materials and Semiconductor Devices
- 2.7 Practical III: Circuit Design and Simulation
- 2.8 Practical IV: Electrical Machines and Control Systems

SEMESTER III

3.1 Optical Electronics

Review of basic optics: wave propagation, polarisation, diffraction, Gaussian beams. Electro-optic effect, electro optic modulators and their design considerations. Acousto-optic effect, Raman Nath and Bragg diffraction acousto-optic modulators and deflectors. Principles of optical communication systems, optical sources and detectors. Optical fibers: modes of an optical fiber, multimode fibers, single mode fibers and their propagation characteristics. Dispersion management in optical fibers and link design considerations. Integrated optics: planar and channel waveguides, directional couplers, optical switch, electro-optic and acousto-optic waveguide devices. Display devices, holography and optical information processing.

3.2 Integrated Circuit Technology

Material purification. Epitaxial growth: LPE, VPE, MBE. Clean room specifications and requirements. Vacuum technology, sputtering, oxidation, growth mechanism and kinetics (thin and ultrathin oxides), oxidation techniques, redistribution of dopants at the interface and oxidation induced defects.

Diffusion: Fick's law, diffusion mechanism, measurement techniques, diffusion in SiO_2 . Ion Implantation: systems and dose control, ion range, ion stopping, knock on ranges, metallization choices. Etching: dry etching, pattern transfer, plasma etching, sputter etching, control of etch rate and selectivity, control of edge profile. Process simulation and process integration. Lithography: optical, electron beam, ion beam, X-ray lithography, lift off, dip pen. Pattern generation. Fabrication of few devices like MMIC, laser diode etc.

3.3 Digital Signal Processing

Discrete time signal analysis and linear systems. Sampling of continuous time signals. Z-transform, properties of region of convergence of z-transform, inverse z-transform, unilateral z-transform. Structures of discrete time systems, block diagram and signal flow graph representation of linear constant coefficient difference equation. Basic structures for IIR and FIR filters, lattice structures, effect of coefficient quantisation, effects of round-off noise in digital filters. Filter design techniques, Discrete Fourier Transform and Fast Fourier Transforms. Concept of multirate digital signal processing.

3.4 Communication Systems

Frequency allocation and standards. Analog Transmission: AM, FM and PM (modulation, demodulation techniques and noise Analysis), AM and FM transmitters and receivers. Digital transmission: sampling and digital multiplexing techniques, PAM, PWM, PPM, PCM, DM, line codes, information theory, ASK, FSK, PSK and QAM.

- 3.5 Practical I: Optical Electronics
- 3.6 Practical II: Science and Technology of Semiconductor Devices
- 3.7 Practical III: Digital Signal Processing
- 3.8 Practical IV: Communication Systems

SEMESTER IV

4.1 Quantum Electronics

Interaction of radiation with matter: light amplification and laser operation. Optical resonators. Properties of laser radiation, mode selection, Q-switching and mode locking. Various types of lasers and applications: gas lasers, solid-ion lasers etc. Semiconductor lasers. Optical amplifiers: semiconductor amplifiers, doped fiber amplifiers, design considerations, amplified spontaneous emission (ASE) and noise figure. Nonlinear optics: second and third order nonlinearity, second harmonic generation; sum and difference frequency generation, parametric amplification, stimulated Raman and Brillouin scattering, self phase modulation, temporal and spatial solitons.

4.2 VLSI Circuit Design and Device Modeling

Passive elements design, design of silicon integrated circuits. Basic MOS inverter design, transfer characteristics, logic threshold, NAND \ NOR logic, transit time and inverter time delay, depletion and enhancement modes, CMOS inverter, inverting and non-inverting type super buffers. Optimization of NMOS and CMOS inverters, noise margins MOS design rules. MOS layers, Stick diagrams, NMOS design layout diagrams, CMOS design, design rules and layout. Lamda based design rules. Scaling of MOS Circuits. Functional limitations to scaling, scaling of wires and interconnections. MOS memories and programmable logic arrays, non-volatile semiconductor memories with MOS technology. General considerations associated with VLSI design. Design of a four-bit shifter, design of an ALU subsystem. Physical model for Si VLSI, MOSFET modeling, short channel structures, scaled down MOS performance. Packaging of VLSI devices, packaging types. Packaging design consideration, VLSI assembly technology and fabrication technologies. Mechanism of yield loss in VLSI, modeling of yield loss mechanism, reliability requirements for VLSI. Failure mechanism in VLSI. Fault finding in VLSI chips.

4.3 Modern Communication Systems

Data transfer and computer networking: packet switching, ISDN, ATM, LAN, WAN, Internet and WAP. Digital Radio Communication Systems: Transmission media, sampling, multiplexing, digital modulation and multiple access techniques.

Satellite Communication Systems: principles of satellite communication, modulation, multiplexing and multiple access techniques; satellite services like DBS, VSAT etc. Mobile communication: specifications, design approach and details. Optical Communication Systems: network topologies, Fiber Distributed Data Interface (FDDI) network, Synchronous Optical Network (SONET/SDH), Asynchronous Transfer Mode (ATM), Wavelength Division Multiplexing (WDM) and its network implementation

4.4 Microwave Electronics

Introduction to microwaves and their applications; Klystron amplifiers: operation and analysis, power and efficiency, multi cavity klystron. Reflex klystrons: operation and analysis, electronic admittance, electronic tuning, power output and efficiency. Magnetrons: operation and analysis. Travelling wave tubes: operation, gain bandwidth, coupling and focusing methods, applications. Avalanche Diode, Gunn effect and Gunn diode oscillators. Solid state microwave amplifiers, oscillators and mixers. Microwave components: attenuator, phase shifter, slotted lines, frequency meter, directional couplers, E-plane Tee, Magic Tee and Ferrite devices. Basic measurements of frequency, SWR, impedance and power at microwave frequencies. Principles of microwave LOS communication. Introduction of RADAR.

4.5 Seminar

4.6 Lectures from Industry

4.7 Project