DETAILED SYLLABUS OF M.Sc. ELECTRONICS

SEMESTER – I

PAPER I : BASIC CIRCUIT THEORY

a) **Network Analysis:** Circuit elements, Passive and Active circuit elements, concept of ideal voltage and current sources, graph, KCL, KVL, node/ cut set, mesh/ tie set analysis, Transient response of dc and ac networks, Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform; sinusoidal steady – state analysis, relation between impulse response and system function.

b) **Network Theorems:** Principle of Superposition, Tellegen's theorem, Thevenin, Norton, Millman and Maximum Power transfer theorem, T, π and L circuits.

c) **Two Port Networks:** Two port parameters, Relationship of two port variables, Short circuit admittance parameter, the open circuit impedance parameter, transmission parameter, the h – parameters, Relationship between parameter sets, interconnections of 2 – port networks.

d) **Frequency Domain Analysis:** Frequency domain analysis of RLC circuits, Phase diagram, magnitude of phase response curve in s – plane; poles and zeros, relation between location of poles, time response and stability, frequency response and bode plots, interrelation between frequency response and time response, convolution integral.

e) **Network Synthesis:** Positive real function, Hurwitz polynomials, reliability condition of network, Synthesis of one port network, Faster and Cauer forms; Two port synthesis by ladder network.

Books recommended:

1) Network Analysis and Synthesis by Franklin I. Kuo
2) Network Analysis by M.E. Valkenberg
3) Network Synthesis by M.E. Valkenberg
4) Network and System by D. Roy Choudhury
5) Network Analysis by Atre

6) A Course in Electrical circuit Analysis by Soni & Gupta

PAPER II : DEVICES AND LINEAR INTEGRATED CIRCUITS

a) Semiconductor Physics: Basic features of metals, Semiconductor, insulator, energy band diagram, degenerate and non – degenerate semiconductor, Drift and diffusion currents, Continuity equation.

b) Devices: PN junction, junction barrier and width of depletion layer in unbiased PN – junction, I-V characteristics and junction capacitance, Transistor; structure, characteristics and parameters, ebber – Moll model, JFET, MOSFET, CMOS, C – V characteristics.

c) Operational Amplifier: Op-Amp fundamentals (brief review of differential amplifier, current mirror, active load, level shifter, output stage, ac and dc characteristics). Basic building blocks using Op-Amps; Inverting/ Non-inverting VCVS, Integrator, Diffrentiators, CCVS and VCCS, Instrumentation Amplifiers, Biquad Filter (LP, HP, BP and Notch); Oscillators; Voltage regulators: Op-Amp regulators, IC regulators, Fixed voltage regulators (78/79XX), 723 IC regulators (Current limiting, Current foldback); SMPS; IC Timer (555) applications; PLL: Principle, Definition and Application.

d) Logarithmic Amplifiers: Log/ Antilog Modules, Precision rectifier, Peak detector, S/H circuits, Op-Amp as comparator, Schmitt Trigger, Square and Triangular wave generator, Monostable Multivibrator, IC Analog multiplier application, Analog Multiplexer and Demultiplexer.

e) IC OTA: Basic Building Blocks using OTA, Electronically Programmable Functional Circuit examples.

Books Recommended:

1) Physics of Semiconductor Devices by S.M. Sze
2) Transistor by D.L. Croissete
3) Integrated Electronics by Millman and Halkias
4) Electronics Devices and Circuit Theory by R.L. Boylestad & L. Nasheisky
5) Op-Amp and Linear Integrated Circuits by Ramakant A. Gayakwad

PAPER III : DIGITAL ELECTRONICS

a) **Introductory Digital Design Concepts:** Switching Networks, Number system and inter-conversion, Review of Logic Families, Boolean Algebra and its application, Positive and Negative Logic, Mintem and Maxtem, K-Map Reduction.

b) **Combinational Logic:** Complete set of Logic Gates, Multilevel Gate Network, Design of two level NAND and NOR gate Network; Multiple output networks: Multiplexers, Decoders, ROMs amd PLAs. Design of Combinational Circuit: Design of Network with limited gate fan-in, Design of network with XOR and XNOR gates, design of networks with Multiplexer.

c) **Sequential Logic:** Need for Sequential Circuit, Distinction between combinational and sequential circuits, concept of memory, Different Sequential Machines (i.e. Mealy and Moore Machine), The Flip-Flop, Clocks and Oscillators, S-R Flip-Flop, D-latch, J-K Flip-Flop, T-Flip-Flop, The Design of clocked Flip-Flop, Flip-Flop conversion from one type to other, excitation table and characteristics equation. Design of Sequential Corcuits: State diagram, State reduction, Design steps for traditional synchronous sequential circuit. Design of Binary Counters, Counters for other sequences, Shift Registers.

d) **Hazards:** Fault detection and fault location of single fault by fault table method, Path sensitizing method, method of Boolean difference and SPOFF method, Two level circuit fault detection and multilevel circit fault detection.

e) **Microprocessor Architecture and System Operation:** Architecture of a basic microcomputer, some general microprocessor system concepts: I/O ports and buses, internal architecture of a microprocessor, Microprocessor fetches, decode, execute cycle memory mapped and I/O mapped ports, I/O controls.

Books Recommended:

1) Fundamentals of Logic Design by Charles H. Roth
2) Digital System Design and Microprocessor by John P Hayes
3) Digital Fundamental by Floyed
4) An Engineering Approach to Digital Design by William I. Fletcher
5) Digital Design by M. Moris Mano
6) Digital Logic and Computer Design by M. Moris Mano

PAPER IV : PROGRAMMING IN 'C'

a) **Overview of Programming:** Introduction to computer based problem solving, requirements of problem solving by computer, problem definition, problem solving strategies, program and algorithm, construction of loops, Basic programming constructs, Programming language classification: Machine language, Assembly language, high level language, assembelers, compilers, interpreters.

b) **An Overview of C:** The origin of C language, middle level language, structure of C language, storage class specifiers and data types, constructs and variables, declaration of variables, operator and expression.

Program Control Statements: True and False in C, C Statements, conditional statements, if switch, for, while, do-while, break, exit(), continue, labels and goto.

Basic I/O: Formatted input/ output, unformatted input/ output.

Functions: return statements, local and global variables, scope rule of functions, function arguments, arguments to main(), parameter passing – call by value, call by reference, function prototypes, call function with array, recursion, implementation issues.

Arrays: Array declaration, one and two dimensional arrays, multidimensional arrays.

c) **Advance Features in C:** Pointers, pointer variables, pointer operators, pointer expression, near, far and hige pointers, dynamic allocation function – malloc(), free(), calloc(), alloca(), realloc(), Initializing pointers, pointers to function, pointers and arrays.

Structures, Unions and User defined variables: Basic of structures, declaration of a structure, array of structure, passing structure to function, structure pointer, array structure within structure, Bitfield, Union declaration, enumeration, typedef.

arrays.

d) **File management:** Stream and files, console I/O, File pointer, file management functions fseek(), Iseek() and random access files.

The Preprocessors: #define, #error, nclude, conditional compilation, #undef, #line, #pragma, #and ##preprocessors, predefined macro names.

Memory models, ROM, BIOS and direct access color graphics: The 8086 family of processors, address calculation, memory models, segment specifiers, a memory display and change programs, register for passing arguments to BIOS routines, function int86(), some function using BIOS routines, the PC video adopters and models of operations, the text screen functions, graphic function.

e) Interfacing to Assembly Language Routines

Books Recommended:

1) Programming with ANSI and Turbo C by Kamthane
2) Let Us C by Yashwant Kanitkar
3) C – How to Program by Deitel
4) The C Programming Language by Ritchie

SEMESTER – II

PAPER V : CONTROL SYSTEM AND DATA ACQUISITION SYSTEM

a) Input/ Output Relationship: Introduction to open loop and closed loop control system, Mathematical representation of Physical Systems, Transfer Function, Block diagram and its reduction, Signal flow graph, Reduction Algebra, Meson's gain.

b) Time – Domain Analysis: Test input signal for transient analysis, Time domain performance criterion, Transient response of first order, second order and higher order systems, Error analysis: Static and dynamic error coefficients, Error criterion, Introduction to system optimization.

c) Frequency Domain Analysis: Polar and inverse polar plots, Bode – Plot, Frequency domain specifications, Relative stability: Gain margin and Phase margin, correlation with time domain, M and N circles, Stability Theory: Concept of stability, Asymptotic and conditional stability, Routh Hurwitz criterion, Nyquist Stability criterion, Root locus plots.

d) **PID System:** Proportional, Integral and Derivative control, PI, PID control, Compensation technique: Concept of Lag, Lead, Lag and Lead Networks, Design of closed loop systems using compensation technique.

e) **Data Acquisition System:** Operation and application of sensors; Temperature, Pressure, Flow, Level etc. Analog signal acquisition and conditioning, Analog switches and Multiplexers, Sample and Hold, Digital to analog and Analog to digital converters.

Books Recommended:

1) Automatic Control System by B.C. Kuo
2) Modern Control Engineering by K. Ogata
3) Control System Engineering by I.J. Nagrath
4) Modern Control System by Doff and Bishop
5) Modern Electronic Instrumentation and Measurement Technique by Cooper

PAPER VI : ELECTROMAGNETIC THEORY

a) **Electromagnetics:** Continuity equation, Displacement current, Maxwell's equation, Boundary conditions, Plane wave equation and its solution in conducting and non-conducting media, Phasor notation, Phase velocity, Group velocity, depth of penetration, Conductors and Dielectrics, Impedance of conducting medium, Polarization, Reflection and refraction of plane wave at plane boundaries, Poynting vector and Poynting Theorem.

b) **Transmission Line:** Propagation of EM wave through Line, Differential equation of the line and their steady state solution; Distortion –less lines, Input impedance of a loss line, Open and short circuited lines, Reflection coefficient and standing wave ratio; Smith chart and their uses; Impedance matching.

c) **Wave Guide:** Propagation of EM wave through tubes, Wave equation in tubes and its solution for boundary medium, Propagation characteristics of TE and TM mode in rectangular wave guide, Idea of circular wave guide.

d) **EM Wave Propagation Through Free Space:** Ground wave propagation, Surface and space wave propagation, Sky wave propagation, Ionosphere, Virtual

heights, Critical frequency of layers, Skip distance and maximum usable frequency, Abnormal Ionospheric behaviour.

e) **Antenna:** Radiation from an oscillating current element, short monopole and dipole, Half wave dipole, Radiation pattern, Power radiated, Radiation resistance, Isotropic radiator, Directive gain, Power gain, Efficiency, Effective area, Effective length, Band width, Beam width and Polarizatioin, Directional patterns, Directives, Effective length, Antenna impedance; Uniform arrays-Broadside, End-Fire, Pattern multiplication. VHF and UHF antennas – Folded dipoles, Yagi, Corner reflector. Microwave antennas – Parabolic reflector, feed system, Lens antennas.

Books Recommended:

1) Electromagnetic waves and Radiating System by E.C. Jorden, D.G. Balmein
2) Electromagnetics by Hayt
3) Antenna Theory by Krauss
4) Electromagnetics by J.F.D. Krauss

PAPER VII : MICROPROCESSOR

a) **Introduction to Microprocessors:** Evolution of microprocessors, Register structure, ALU, Bus organization, Timing and control, Architecture: Architecture of 8086/ 8088, Intel organization, Bus cycle.

b) **Assembly Language Programming:** Addressing modes, Data transfer instructions, Arithmetic and logic instructions, Program control instructions (Jumps, Conditional jumps, Subroutine call), Loop and String instructions, Assembler Directives, Parameter passing and Recursive procedures.

c) **CPU Module Design:** Signal descriptions of pins of 8086 and 8088, Clock generation, Address and data bus, Demultiplexing; Memory organization, Read and write cycle, Timing, Interrupt structures, Minimum mode CPU module, Maximum mode operation (Coprocessor configuration), Features of numeric processor 8087.

d) **Interfacing:** Programmed I/O, Interrupt driven I/O, DMA, Parallel I/O (8255-PPI), Serial I/O (8251/ 8250, RS-232 Standard), 8259 – Programable Interrupt

Controller, 8237 DMA controller, 8253/ 8254 – Programmable Timer/ Counter, A/D and D/A conversion.

e) **Advanced Microprocessor and Microcontrollers:** Architecture and application of 8051 microcontroller, Elementary features of 8048/ 8096 families, Concept of Multitasking and Multiprocessing, Evolution of AT class Microprocessors: 80286/ 80386// 80486. Architecture and Functional studies of these 16/ 32 bit microprocessors.

Books Recommended:

1) Advanced Microprocessor and Interfacing by D.V. Hall
2) Microprocessor Systems: The 8086/ 8088 family Architecture, Programming and Design by Yu-Chehg Liu and Gibson
3) The Intel Microprocessor Architecture Programming and Interfacing by Barry B Brey
4) The 8051 Microcontroller by Ayala

PAPER VIII : COMMUNICATION

a) **Signal Representation:** Time domain and frequency domain representation, Fourier series and Fourier transform, Numerical computation of FT, Properties of Fourier transform; Linearity, Smmetry, Folding, Delay, Frequency shift. Cosine and Sine transform, Transforms of derivatives, Convolution theorem, Dirac Delta function, energy signal and Power signal, Energy spectral density, Power spectral, Cross – correlation, Auto – correlation function, Parseval's theorem.

b) **Noise:** External and internal source of noise, Voltage and current models of a noisy resistor, Calculation of thermal noise in RC circuit, Shot noise, Noise figure, Noise temperature, Equivalent noise bandwidth, Calculation of noise figure for the cascaded network. Review of Analog Communication System: Amplitude and Angle Modulation, Noise in DSB-Sc, SSB-SC and AM system, Noise in FM and PM, FM Threshold and its extension, Pre – Emphasis and De – Emphasis in FM.

c) **Digital Modulation System:** Sampling Theorem, Signal reconstruction in Time Domain, Practical and flat-top sampling, sampling of band pass signal; types of analog pulse modulation, method of generation and detection of PAM, PWM and

PPM, spectra of pulse modulated system; Dicretization in time and amplitude, Linear quantizer, Quantization noise power calculation, Signal to quantization noise ratio, non uniform quantizer, A-law and μ law companding; Encoding and Pulse Code Modulation, Band width of PCM, DPCM, DM, Idling noise and slope overload, ADM, Adaptive DPCM.

d) Digital Multiplexing: Fundamental of TDM, Electronic Commutator, T1 Carrier system, Synchronization and signaling of T1, North – America CCITT standards, T1 to T4 PCM TDM system (DS1 to DS4 signals), Digital Modulation Technique: Types of Digital Modulation, Waveform for ASK, FSK, and PSK, Differential Phase Shift Keying, QPSK and MSK.

e) Information Theory: Concept of Information Measure, Entropy and Information rate, conditional entropy and redundancy, Source coding, Fixed and variable length codes, Source coding theorem, Shannon – Fano and Hulfman coding for 1^{st}, 2^{nd} and 3^{rd} order extension, Mutual information and channel capacity of discrete memory less channel, Hartley – Shannon Law.

Books Recommended:

1) Modern Analog and Digital Communication by B.P. Lathi
2) Principle of Communication System by Taub and Schilling
3) Communication System by Haykin
4) Electronic Communication System by Tomasi
5) Digital Communication by Prokis
6) Electronic Communication System by Kennedy
7) Digital Communication by Haykin

SEMESTER – III

PAPER IX: IC TECHNOLOGY AND VLSI DESIGN

a) IC Technology: Silicon wafer preparation, Epitaxi: Vapour phase epitaxi and molecular beam epitaxi technology; Thermal oxidation, wet and dry oxidation, Oxidation system, Oxide thickness measurement; Diffusion: Diffusion eqns. Dopant profiles, diffusion furnace, liquid and gaseous dopants, Implantation: Ion Implantation Technique, dopant profiles, Implantation System; Device

Fabrication: Wafer preparation steps, Lithography techniques: photolithography, electron beam lithography, X-ray lithography, Mask making, Photo resist, Wet and Dry etching, Plasma etching, Metalization, Device packaging, Fabrication of BJT.

b) VLSI Design: MOS technology, CMOS fabrication, The p-well process, The n-well process, the twin – tube process, BiCMOS Technology, Modeling: Level1, Level2, Level3, Model equations; CMOS Digital Circuit Modeling: MOS Inverter, Static and dynamic Characteristics, $\beta n/\beta p$ ratio, Noise Margin, Combinational MOS Logic Circuits, Inverter, Difference Amplifier, Cascode Amplifiers, CMOS Op-Amp; Design methodologies: Stick diagram, Design rules and layout, Floor plan, Design Flow, Design Styles, Design quality, Packing techniques.

Books Recommended:

1) VLSI Fabrication Principles by S. Gandhi
2) VLSI Technology by S.M. Sze
3) The Science and Engineering of Microelectronic Fabrication by Campbell
4) Basic VLSI Design by Pucknell
5) Principles of CMOS VLSI Design by Weste
6) CMOS Digital Integrated Circuits Analysis and Design by Kang and Leblebici
7) CMOS Analog Circuit Design by Allen and Holberg

PAPER X: OPTO – ELECTRONICS

a) Optical Sources: Principle of laser action, types of lasers, fabrication and characteristics of semiconductor lasers and LEDs.

b) Optical Detectors: Type of photo detectors, Characteristics of photo detectors, Principle of APD and PIN diodes, Noise in Photo detectors, Photo transistors and Photo conductors.

c) Optical Fiber: Structure of optical wave guide, Light propagation in optical fiber, Ray and Wave Theory, Modes of optical fiber, Step and Graded index fibers. Transmission characteristics of optical fibers: Signal degradation in optical fibers; Attenuation, Dispersion and pulse broadening in different types of optical fibres.

d) **Fiber Joints and Couplers:** Fibre Alignments and Joint loss, Fiber Splices, Fiber Connectors. Optical Fiber Communication: Components of an optical fiber communication system, Modulation formats, Digital and Analog optical communication systems, Analysis and performance of optical receivers, System design for optical communication.

e) **Integrated Optics:** EO Retardation, Amplitude, Phase and Frequency modulation, Beam Deflection, Acousto-optics, AO devices.

Books Recommended:

1) Optical Electronics by Ghatak and Thyagrajan
2) Optical Fiber Communication by Keiser
3) Optical Fiber Communication by Senior
4) Optical Communication by Gower
5) An Introduction to Electro Optic Devices by Kaminov
6) Optical Information Processing by FTS Yu

PAPER XI: DIGITAL SIGNAL PROCESSING

a) **General Concepts of Digital Signal Processing:** Block diagram of a possible digital processing system, important tools for modern digital signal processing e.g. digital filters and fast Fourier transform.

b) **Discrete Time Signals and Systems:** Example of discrete signal, discrete time LTI systems, impulse response, casual and stable system, linear constant coefficient equation, structure of discrete time system, Solution of Difference Equation.

c) **Z – Transform:** Definition, region of convergence, property of z – transform, inverse z – transform, multi dimensional z – transform. Transfer function of discrete time systems: Poles, zeros and stability concept, realization of FIR and IIR filters, canonic and non canonic forms, quantization and round off error.

d) **Frequency Analysis of Discrete System:** Fourier transform and frequency response, Discrete Fourier transform and their properties, DFT as a linear transformation, computation of DFT, FFT, decimation in time and frequency.

e) **Design of Digital Filters:** FIR filter design, IIR filter design, frequency transformation in analog and digital domain. Introduction of adoptive filters.

Books Recommended:

1) Discrete Time Signal Processing by A.V. Oppenheim and Schafer
2) Digital Signal Processing: Principles, Algorithm and Application by Prokis and Manolakis
3) Introduction to Digital Signal Processing by J.R. Johnson
4) Digital Signal Processing by Mitra
5) Digital Signal Processing by Ifeachor and Javis
6) Digital and Analog Signal Processing by Amberdhar

PAPER XII: COMPUTER NETWORKING

a) **Review of Transmission Issue:** Analog and digital data, anlog modulation techniques, digitization, digital modulation and demodulation techniques, transmission impairments and corrective measures, line coding, data compression impairments and corrective measures, line coding, data compression error detection and correction methods, TDM-T1, T2, T3, T4. Data switching: circuit switched, message and packt switched, space division, time division switching. Communication data link control: Simple stop and wait, sliding window.

b) **Netork Topologies and Example:** TYMNET, ARPANT, SNA, LAN, Packet radio and satellites: TDM, FDMA, ALOHA, slotted ALOHA, CSMA.

c) **OSI reference model for Computer Networks:** Layer structure, PDU, SDU, IDU, protocols.

d) **Local Networks:** Topologies, protocols, TCP/IP, net beau etc. SPX/ IPX – 802 – 3/ 4/ 5, back bones, bridges, routers, Routing and congestion control: M/ M/ 1 queue, virtual circuits, data grams, routing techniques, congestion control, dead locks, X25, packet layer ISDN.

e) **TCP/ IP:** Introduction to TCP/ IP, IP addressing classification of networks and networking, DHCP, DNS, getwayong, network security, firewall. Application of

TCP/ IP: HTTP, STTP, archi, gopher, SMTP, IMAP, POP, telnet eject, ATM and ISDN: Introduction.

Books Recommended:

1) Computer networks by Tanenbaum
2) Computer Networking by Kurose and Ross
3) Introduction to Networking by Nance
4) TCP/ IP by Forouzan

COURSE STRUCTURE

- There shall be four theory papers and one laboratory course in each of first three semesters. The fourth semester will be entirely devoted to major project work of six month duration.
- In each laboratory course the candidates, besides the classroom experiments, may do Autocad design/ Mini project/ Project work.
- An outline of the syllabus is given below:

SEMSSTER – I

a) Theory Papers

Paper	Title	Max. Marks
I	Basic Circuit Theory	50
II	Devices and Linear Integrated Circuits	50
III	Digital Electronics	50
IV	Programming in 'C'	50

b) **Laboratory Course** 100

Experiments:-

I	Engineering Drawing
II	Applications of Microsim
III	Experiments on Analog Electronics
IV	Experiments on Digital Electronics
V	Experiments on C language

SEMSSTER – II

c) Theory Papers

Paper	Title	Max. Marks
V	Control System and Date Acquisition System	50
VI	Electromagnetic Theory	50
VII	Microprocessor	50
VIII	Communication	50

d) **Laboratory Course** 100

Experiments:-

I	Experiments on Power Electronics
II	Experiments on Control Systems
III	Experiments on Microprocessor (8085/8086) and Interfacing
IV	Experiments on Microcontroller
V	Experiments on Data Acquisition System
VI	Experiments on Communication System
VII	Experiments on application of MATLAB to Communication

SEMSSTER – III

e) Theory Papers

Paper	Title	Max. Marks
IX	IC Technology and VLSI Design	50
X	Opto Electronics	50
XI	Digital Signal Processing	50
XII	Computer Networking	50

f) **Laboratory Course** 100

Experiments:-

I	Experiments onDigital Signal Processing (MATLAB Simulation)
II	Experiments on Digital System Design using VHDL
III	Experiments on Circuit Simulation using PSPICE

The distribution of practical marks in semester Ist, IInd and IIIrd shall be as follows:

	Regular Students	Ex – Students
One Practical	45	65
Record	20	--
Viva	35	35
TOTAL	100	100

SEMESTER IV

There shall be no theory papers in fourth semester. The students are required to do a major project work for duration of six months in the institutions assigned to them by the Department.

The examination will consist of the following.

SL. No.	Examination	Max. Marks
01	A major project work	200
02	Viva-voce relating to major project work	50
03	A general seminar other than the discipline of major project work	50
		Total: 300

- A set of two internal and two external examiners will be appointed to evaluate the major project work as mentioned in sl.no. 01 above and to take viva-voce examination as mentioned in sl.no. 02 above.
- Another set of one internal and one external examiner will be appointed for the evaluation of seminar presented by the students as mentioned in sl. no. 03,