WEST BENGAL STATE UNIVERSITY

BARASAT, 24 PARGANAS (N)

M. Sc. in Electronics 4-Semister Syllabus

With Effect From: 2008-2009

Proposed Structure of 2-year (4-semester) *M. Sc*. Course in **Electronics**

Semester – I

ELEC 111	Mathematical and Numerical Methods	50	Theory
ELEC 112	Semiconductor Devices and Materials	50	
ELEC 113	Analog Circuits and Systems	50	
ELEC 114	Network Analysis and Synthesis	50	
ELEC 115	Analog Circuits	50	Practical
ELEC 116	Programming Language	50	
	Total	300	

Semester – II

ELEC 121	Digital Circuits	50	Theory
ELEC 122	Instrumentation and Control	50	
ELEC 123	Electromagnetics, Antennas and Propagation	50	
ELEC 124	Quantum Electronics and Quantum Computation	50	
ELEC 125	Digital Circuits	50	Practical
ELEC 126	Circuit Design and Simulation (Using VHDL and Pspice)	50	
	Total	300	

Semester – III

ELEC 211	Communication Systems	50	Theory
ELEC 212	Microprocessors and its Applications	50	
ELEC 213	Optoelectronics	50	
ELEC 214	Networking	50	
ELEC 215	Microprocessors	50	Practical
ELEC 216	Communication Systems and Fiber-Optics	50	
	Total	300	

Semester – IV

ELEC 221	VLSI Circuit Design and Device Modeling	50	Theory
ELEC 222	Digital Signal Processing	50	
ELEC 223	Microwave Electronics	50	
ELEC 224	Digital Signal Processing	25	Practical
ELEC 225	Microwave	25	
ELEC 226	Seminar	25	
ELEC 227	Lectures from Industry	25	
ELEC 228	Thesis	50	
	Total	300	
	Grand Total	1200	

Semester – I

Mathematical and Numerical Methods (*Theory*) (ELEC 111)

Integral Transform: Fourier Transform (FT) and its properties; Inverse Fourier Transform; Fourier transform of derivative; Parseval's Identity; Application of Fourier Transform in solving partial differential equations; Laplace Transform(LT) and its properties; Evaluation of Inverse L.T, Partial fraction Method; Convolution; Application of Laplace Transform in solving partial differential equations, Z-Transform and its properties.

Function of Complex Variables: Concept of Argand diagram; Cauchy-Riemann equation for existence of derivatives; Line integration – Cauchy's integral theorem, contour integration, Cauchy's integral formula; Infinite series – Taylor and Laurent's series; concept of poles and zeroes, Residue theorem – application in evaluating integrals; Conformal mapping – Schwartz-Christoffel transformation, applications to electrostatic potential; Solution of differential equation by contour integration, Numerically computing elliptic integral and evaluating elliptic functions.

Probability and Statistics: Mean, Median, Mode and Standard Deviation; Samples Space; Definition of Probability; Conditional Probability; General Multiplication Theorem; Independent Events; Bayes' Theorem; Random Variable; Discrete and Continuous Probability Distributions - Probability mass function; Probability density function; Distribution Function; Expectation; Variance; Probability Distribution— Binomial, Poisson and Normal Distribution; Four moments method for calculation of distribution; Monte Carlo method – its applications; Correlation and Regression; Method of Least Squares; Linear Curve Fitting.

Interpolation: Finite Difference operators and their algebra, Fundamental equations satisfied by the operators, Gregory-Newton interpolation formula, Differentiations and Integrations of tabulated function; Difference table; Polynomial Interpolation (Newton forward, Newton backward, Stirling's and Bessel's), differentiation and integration; of Lagrange's Interpolation, neviel's algorithm, integration by Gauss quadrature formula; Finite Difference Equations (FDE) and its numerical solutions.

Numerical Solution of Differential and Integral Equations: Numerical method for solution of first order differential equations – Euler's method, Modified Euler's method, Taylor Series method, Runge-Kutta method; Numerical solution of second order differential equations; Numerical solution of partial differential equations – elliptic, parabolic and hyperbolic equations, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.

Text Books:

1. Hiher Engineering Mathematics: Dr. B. S. Grewall
2. Engineering Mathematics: S. S. Sastri
3. Modern Probability Theory: Bhat, New Age International
4. Numerical Techniques: A.Dutta

Semester – I

Semiconductor Devices and Materials (*Theory*) (ELEC 112**)**

Junction phenomena : Depletion region and depletion capacitance, Abrupt junction, Diffusion potential and depletion layer width, linearly graded junctions, current voltage characteristics, Shockley equation, Diffusion capacitance, Junction breakdown, Tunneling effect, Avalanche multiplication, Transient behaviour and noise. Varistor, Varactor, Charge storage diode, P – I - N diode.

Metal Semiconductor Junction: Energy band diagram, Surface states, Depletion layer, Schottky effect, Current transport processes. Thermionic emission theory. Diffusion theory, Tunneling current, Minority – carrier injection ratio, Characterization of barrier height, Ohmic contact.

Bipolar Transistors: Device modelling, Ebers - Moll model, Gummer – Poon model, Microwave transistor, Cut off frequency, Microwave characterization, Power transistor, Switching transistor, Hot – electron transistor.

Field Effect Transistors: Structure: basic principle and I-V characteristics; Band diagram under depletion, inversion and accumulation; threshold voltage and its control; C-V curves; I-V characteristics; Channel length modulation; hot electrons; scaling issues. Short channel effects, Field dependence mobility, Two-region model, Saturated velocity model, Multichannel FET, IGFET, MISFET, c-MOS, Basic concept of fanout,

Advanced semiconductor devices: HEMT, Resonant-tunneling devices, IMPATTS and TUNNETS.

Semiconductor power devices: UJT, Schockley diode, SCR, Diac, Triac, Thyristor.

Heterojunction: Alloy band structure; Heterojunction: definition, band line-up and band offsets; Double Heterostructures; Heterojunction diode- Capacitance, Injection efficiency : Heterojunction Bipolar Transistors- Structures, Mechanism of amplification, Evaluation of terminal currents; Light Emitting Diodes – Principle, Structures, Advantages of heterojunctions, Power-current curve Modulation characteristics; Photodetectors- Principle; Different types: pin, APD, MSM, photoconductors- Responsivity, Quantum Efficiency, Structures and Materials, Heterojunction solar cell.

Text Books:

1. Physics of Semiconductor Devices: S. M. Sze
2. Solid State Electonics Devices: Ben. G. Streetman
3. Physics of Semiconductor Devices: M. Shur
4. Power Electronics: Rashid
5. Power Electronics: Singh
6. Power Electronics: Mohan

Semester – I

Analog Circuits and Systems (*Theory*) (ELEC 113**)**

Basic Amplifier and Oscillator circuits: General consideration, BJT, MOS and CMOS circuits, Load lines, Cascade Amplifiers, difference amplifiers, multistage amplifier, Darlington pair, direct-coupled amplifier, feedback in amplifiers, oscillators – frequency stability, noise.

Audio frequency power amplifier: Power amplifier requirements, Class A direct coupled and transformer coupled, Class B push-pull, complementary symmetry amplifiers, IC power amplifiers.

RF voltage and power amplifiers: Single, double and stagger tuned amplifiers, Class C tuned amplifier.

Operational Amplifiers: OP-Amp. Architecture, OP-Amp as Differential Amplifier, Solution of 2nd order differential equation using OP-Amp, Bridge Amplifier, Instrumentation Amplifiers, Logarithmic Amplifiers, Anti-log amplifiers, Analog multiplier, modulation, demodulation and frequency change using multipliers, summing integrator, chopper modulator, chopper-stabilized amplifier, pulse width modulator, voltage to frequency and frequency to voltage converters, OTA Amplifier, active filters – low pass, high pass and band-pass and band elimination, Butterworth and Chebychev filters of different orders, State variable analysis, State variable filter.

Clipping and Clamping Circuits: Wave shaping, diode, transistor and op-amp clippers and clampers, precision circuits.

Comparators and control circuits: Diode and IC comparators, Schmitt Trigger, Zero Crossing Detectors, Voltage Level Detectors, Window Detectors, Sample and Hold Amplifier.

Wave Generators: Sine – wave generators, Multivibrators, VCO, Monolithic Timers, Triangular wave generator, Sawtooth wave generator, Monolithic waveform generator,

Phase Locked Loop (PLL) & Applications: PLL operating principles, monolithic PLLs. Applications of PLL - Frequency multiplication, tracking, FM demodulation.

Text Books:

1. Integrated Electronics: J. Millman and C. C. Halkias

2. Op-amp and Linear Integrated Circuits: R. Gayakawad

3. Electronic Principles: A. P. Malvino

Semester – I

Network Analysis and Synthesis (*Theory***)** (ELEC 114)

Network Theorems: Special network configurations; Superposition; Reciprocity; Generalised maximum power transfer theorems; Generalised Thevenin's, Norton's, Millman's and Tellegen's theorems; Applications.

Graph Theory: Graph of network; Incidence matrix; Cut-set and Tie-set matrices; Network equations.

Analysis: Equivalent circuits, two-port parameters, Topological descriptions of different commonly used networks, π to T and T to π conversions, reduction of complicated network. Image impedance of a network, symmetrical network, characteristic impedance and propagation constant of a network.

Time domain response of linear L, C, R circuits and combinations. Frequency domain networks, transformation of R L, C mutual inductances and combination networks in frequency domain. Phasor diagram, driving point impedance and transfer impedances.

Two-Port Networks: Impedance, admittance, transmission and hybrid parameters; Matrix forms of input-output relations; Cascade, parallel and series connection of two ports; Iterative and image impedances; Characteristic impedance; Propagation function; Balanced and unbalanced networks; Bartlett's bisection theorem and its applications; Nonreciprocal and terminated two-ports, Gyrator; Negative Impedance Converter.

Fitter circuits: L fitter, π filter, Methods of development of different filters like high pass, low pass, band pass and band stop filter circuits.

Transient Response of Circuits: Laplace transformation; Transform of linear combinations and damped functions; Shifting, differentiation, integral, initial and final value theorems; Applications; RL, RC, RLC and multimesh circuits; Characteristic equation; Impulse response and transfer function; Convolution integral; s-domain circuit analysis; Time domain response from pole-zero plots; Fourier analysis for periodic signals; Fourier transform; Energy calculation in frequency domain.

Synthesis of Two-Terminal Reactive Networks: Foster's reactance theorem; Poles and zeros; Separation property; Foster and Cauer Canonic networks.

Synthesis of RL, RC and RLC Networks: RL driving-point impedance and admittance functions; RC driving-point impedance and admittance functions; Foster and Cauer type networks; Synthesis of RLC networks; Hurwitz polynomials; Positive Real Function.

Text Books:

1. Circuits & Networks:Analysis & Synthesis: Sudhakar
2. Engg Circuit Analysis: Hayt
3. Network Analysis: Valkenburg M. E. Van
4. Networks, Filters & Transmission Lines: A. Chakravarty
5. Networks & Synthesis: D. Roychoudhury
6. Electrical Circuits: D.Chattopadhyay and P.C.Rakshit

Semester – I

Analog Circuits (*Practical*) (ELEC 115)

Experiment on power supply:

(i) Design a regulated power supply using IC 78xx (find output voltage).
(ii) Design a regulated power supply using LM 317 (Variable output).

Experiment on BJT: 1. Design a two stage R-C Coupled CE amplifier for a given gain

i. Calculate input impedance and output impedance

ii. Study the frequency response and Calculate the Bandwidth

2. Design a transistorized push- pull audio power amplifier using complementary pair of transistor. Measure its efficiency, B.W. and total harmonic distortion. Compare the data using a standard IC audio power amplifier (IC).

Experiment on JFET: I-V characteristics, use as VVR (voltage variable resistor), and frequency response characteristics.

Experiment on MOSFET: I-V characteristics, use in AGC circuit

Experiment on OPAMP circuits: Comparators, Schmitt Trigger, audio oscillators and Butterworth active filters – design and measurements.

Experiment on SCR: Critical gate-current characteristics, amplitude control circuit to fire SCR

Experiment on UJT: I-V characteristics, UJT parameter estimation, saw-tooth wave generation, firing of SCR using UJT

Experiment on DIAC/TRIAC: Design of a phase-control circuit using RC-circuit, determination of phase angle and control voltage, range of power control, o/p power vs conduction angle.

Books:

1. Laboratory Manual for Electronic Devices and Circuits: David A. Bell
2. Up to date Diac,Triac, UJT, Thyristor: B.P.B Publication

Programming Language (*Practical*) (ELEC 116)

Numerical and non-numerical processing with C and C^{++} language of varying complexity.

Operation with LINUX.

Books:

1. Learning C^{++} : Eric Nagler
2. Let us C: Kanitkar
3. C^{++} : Bala Groshwami

Semester – II

Digital Circuits (*Theory*) (ELEC 121)

Introduction: Introduction to Digital Systems, Number systems, Arithmetic Operation and Codes, Boolean Switching Algebra.

Logic Families: TTL, NMOS logic, CMOS logic, Dynamic MOS, ECL logic family.

Combination of logic gates: Implementation of Switching function using AND-OR, NAND-NOR, NANDS AND NORs logic gates, Adders, Subtractors, Look-Ahead carry adder, Carry save adder, BCD-adder, multiplier, PAL, PLA, ALU.

Sequential Circuits: R-S, D, T, J-K flip flops; Registers; Counters; Synchronous and Asynchronous sequential circuit design.

MUX and DMUX: Digital Multiplexer, Analog Multiplexer, Digital Demultiplexer and Analog Demultiplexer, Introduction of related ICs

Memories: The role of memories in Computer System, Memory types and terminology, Memory organization, Address decoding, Access times, ROM, PROM, EPROM, RAM, Charge-Couple Devices (CCD), Introduction of several ICs used as memory and CCD.

.

D/A and A/D Converters: Weighted resistor and R-2R ladder type D/A converter; Parallel-comparator type; Successive approximation type; Dual slope; Counting A/D converters., Specification of D/A Converter, Introduction to DAC 0800, ADC 0804 and ADC 0808/0809, Optocouplers.

Multivibrators: Astable, Bistable, Monostable and multivibrators using transistors; Op-Amps and logic gates; Multivibrator IC's.

Digital Display: LED, 7-segment, LED display, Dot matrix display, Intelligent display devices and their driver circuits, Multiplexed display circuits.

Text Books:

1. Digital Circuits: Vol.1 and Vol.2. : D. Roychoudhury
2. Digital Design: M. Mano
3. Practical Digital Design with IC's: Greenfield
4. Digital Integrated Electronics: H. Taub and D. Schilling
5. Digital System Design: Gajeski
6. Digital Systems: Principles and applications: Tocci

Semester – II

Instrumentation and Control (*Theory*) (ELEC 122)

Instrumentation

Basic Instrumentation Circuits: Operational amplifier application, Instrumentation amplifier, Noise measurements and noise reduction techniques.

Time Domain Instruments: CRO, Dual and multi channel oscilloscopes, Storage oscilloscopes, High and low frequency limitations, Curve tracers.

Frequency Domain Instruments: Distortion analyzer, Wave and spectrum analyzer, Signal generators.

Transducers and Sensors: Photo-transducer, thermistor, photoelectric transducer, photo-conductors, phototransistors.

Control:

Introduction to Control Systems:

Introduction to automatic control, open loop and closed loop control systems.

Mathematical modeling of a system: Block diagrams, Signal flow graph and its construction; Mason's gain formula, Different feedback characteristics of control system

Transfer function: Linear time-invariant (LTI) systems; concept and definition of transfer function; zero-state and zero-input response; free and forced responses, Performance indices

Stability: absolute and relative stability; Routh-Hurwitz criterion; Nyquist stability criteria; Nyquist plot; interpretation of Nyquist plot; gain-margin and phase-margin; Liapunov stability criterion, System with transportation lag

Frequency Response analysis: Frequency responses; Bode diagrams; Relative stability and Bode diagram, All pass and minimum phase system

Root Locus Analysis and design: Root-locus principles; rules for root-locus construction; construction techniques of root-locus; properties of root-locus and root-locus design

Controllers:

Response of first order and second order systems with proportional control, derivative control, integral control, P&D control, P&I control, PID control, practical method.

Introduction to Digital Control system. PLC & Application Case Studies: Speed control of DC Motors, Temp control. Fuzzy logic.

Discrete control systems: Z-transform, simulation diagram and flow graphs.

Text Books:

1. Control systems engineering: Nagrath & Gopal, New Age International Ltd.
2. Modern control Engineering: 4/e – Ogata, PHI/Pearson
3. Control System: Madan Gopal, MH
4. Automatic Control System: Kuo, PHI
5. Digital control & state variables: M.Gopal
6. Process Control: Harriot

Semester – II

Electromagnetics, Antennas and Propagation (*Theory*) (ELEC 123)

Transmission Lines: Transmission Line Equations; Reflection and Standing Waves on a lossless line; Low loss lines as impedance elements; Techniques of impedance transformation and matching on transmission lines.

Waveguides at Microwave Frequencies: Dispersive and non-dispersive waves; Rectangular and Circular waveguides – Modes and Modal characteristics, Attenuation, Power handling capability, Methods of excitation of modes.

Waveguides at Millimeterwave Frequencies: Surface Waves on impedance planes; Open Dielectric Waveguides – Image guide and its variants; Non-radiating Dielectric (NRD) Guide; H-guide; Groove guide.

Planar Transmission Lines: Striplines; Microstrip and its variants; Slotline; Co-Planar Waveguide (CPW); Finlines.

Electromagnetic Cavity Resonators: Resonant modes and resonant frequencies; Equivalent Circuit; Q-factors; Excitation of resonant modes; Microstrip resonators; Dielectric resonators (DR) for mm-waves.

Transmission Lines at Optical Frequencies: Optical Fibres – Types, Modal characteristics; Transmission media limitations – Attenuation, Dispersion effects, Pulse broadening; Special purpose fibres – Polarization maintaining fibres, Dispersion Shifted (DS) and Dispersion Flattened (DF) fibres.

Antennas: Radiation from elementary dipole, Directivity, Gain and Effective aperture, Resonant and non-resonant antennas, Field pattern Radiation resistance and radiation power, antenna resistance, band width, grounded antenna, effects of antenna heights, linear antenna, antenna arrays, array of arrays.

Microwave antennas: Antenna with parabolic reflectors, horn antennas, lens antennas. Wide band and special purpose antennas, Helical antennas, Discone antenna, Log-periodic antennas, Loop antennas, Practical transmitting antennas, Behaviour of receiving antennas.
Planar Antennas: Review of Microstrip basics; Microstrip Patch Antennas – Radiation mechanism, Configurations; Printed Dipole. Conformal Antenna.
Slot Antennas: Radiation from slots in waveguide walls; Arrays
Elements of Ultra Wide Band (UWB) antennas.
Radio Wave propagation: Ground waves, Space wave, Ionospheric wave and their characteristics, reflection and refraction of radio waves in ionosphere, critical frequency, skip distance, Maximum useable frequency, fading, secant law, duct propagation.

Text Books:

1. Electromagnetic Waves & Radiating Systems: E. C. Jordan and K.G. Balmain
2. Foundation for Microwave Engineering: Robert E. Collin
3. Microwave Engineering: David M. Pozar
4. Microwave Engineering: Peter A. Rizzi
5. Microwave Engineering: Annapurna Das
6. Microwave devices and circuits: S. Y. Liao
7. Antennas: J. D. Kraus
8. Antennas: Balanis
9. Antennas and Wave Propagation: G. S. N. Raju
10. Antennas Analysis: Edward A. Wolf
11. Optical Fiber Communication: Keiser
12. Optical Fiber Communication: Gower
13. Optical Fiber Communication: Senior

Semester – II

Quantum Electronics and Quantum Computation (*Theory*) (ELEC124)

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, MESER.
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.
Semiconductor lasers.
General principle, Loss process in semiconductor lasers, Laser gain, Hetero junction lasers, Quantum well, Quantum wire and Quantum dot lasers, MQW, SCH and GRINSCH lasers.
Junction Photodectors: Super lattice and Quantum well APDS Noise in APDS, Graded gap, SAM and Stair case APDS, Solid State Photomultiplier tube, Quantum well Infrared photo detectors.

Text Book:

1. Lasers, Theory and Applications: K. Thyagarajan and A. K. Ghatak
2. Lasers and nonlinear optics: B. B. Laud
3. An introduction to laser and Maser: A. E. Siegman

Quantum Computation

Single Q-bit operation, universal quantum gate, two level, single qubit and CNOT are universal. The Quantum simulation algorithm.
Conditions for quantum computation, preparation of initial states and measurement results, Harmonic oscillator quantum computer, optical photon quantum computer, optical cavity electrodynamics, Iron traps, nuclear magnetic resonance.

Text Book:
Quantum computation & quantum Information,M.A.Nielsen & I.L.Chuang (Cambridge Univ. Press)

Semester – II

Digital Circuits *(Practical)* **(ELEC 125)**

1) 1 Experiment on TTL NAND gates.
2) Design and testing of a) half adder circuits b) full adder circuits c) 9's complement generator d) 2 bit digital comparator using NAND gates & 7485IC.
3) Experiments on multiplexer using 74153.
4) Experiments on demultiplexer using 74155.
5) Experiments on a) debounce switch b) seven segment display chips.
6) Experiment on counter using 7474.
7) Experiments on Semiconductor memories using 7489.
8) Experiments on asynchronous counters, shift registers.
9) Design a DAC and ADC using 741 IC.

Semester – II

Circuit Design and Simulation *(Practical)* **(ELEC 126)**

Design of active RC filters: low pass, high pass and band pass filters; determination of the frequency response curve of filters by measurements; modeling of OPAMP and simulation of active RC filters using PSpice; simulation of integrator and differentiator circuits using PSpice, simulation of single stage and two stage RC coupled amplifiers using PSpice.

Semester – III

Communication Systems (*Theory*) (ELEC 211)

Introduction to electronic communications, difference between analog and digital communication processes, simplex and duplex processes.

Signal processing technique: Fourier transforms, DFT, FFT, convolution, correlation.

Analog Communication:

i) Basic Signal theory, Fourier transform, transform pairs, standard functions and their transform, transform theorems, Perseval power theorem and Raylaigh's energy theorem, spectral density, linear time invariant systems and their analysis, convolution and convolution theory, transfer functions, Ideal filters and their transfer function, Real passive and active filters, Noise and noise analysis.

ii) Amplitude Modulation: Basic principle of DSB, SSB, and VSB-AM systems, Modulation and Demodulation principles. Modulators and Demodulators, Super heterodyne receivers, Quadrature amplitude Modulation (QAM), Principle of stores effect, noise in AM systems.

iii) Frequency and Phase modulation: Basic principles of angle modulation, Frequency and Phase modulation, Modulators and demodulators, Frequency discriminators and Phase Locked Loops Receivers, Noise in FM and PM systems, comparison of the effect of noise in different modulation processes, comparison of receivers etc.

Digital communication:

i) Basic principles of Digital Communication: Principles of data transmission, Elementary data transmission, Nyquist theorem applied to data transmission, Data transmission in presence of noise, matched filters, Fundamentals of digital signal processing, sampling theorem, operations on discrete time signals, correlations and autocorrelations, convolution, Finite length and periodic sequence, Discrete time random processes, strength of discrete time signals, uncertainty principle and notion of Aliasing, Fourier transform of discrete time signals, Linear time invariant discrete time systems, Z-transform.

ii) Digital filters and FIR filters, IIR filters, all pass filters.

iii) Pulse Code Modulation: Basic principle, Introduction to quantization, companding, Basic idea of digital compression of speech signals, Echo control, Delta modulation, etc.

iv) Pulse Modulation: PAM, PWM, PPM, TOM, FDM, FSK, PSK and others.

General Communication Applications: Basic principles of telephony, Mobile and cellular telephony.

Spread Spectrum systems: Definition, types, process gain, pseudo-random sequences, Direct SSS, Frequency hop SSS, Hybrid SSS, Analyses of spread spectrum systems, near and far problems, acquisition and tracking of SSS

Text Books:

1. Electronic Communications: D. Roody and J. Coolen
2. Communication Systems: S. Haykin
3. Communication Systems: A. B. Carlson
4. Principle of Communication Systems: H. Taub and D.L. Schilling
5. Modern Digital and Analog Communication Systems: B. P. Lathi

Semester – III

Microprocessors and its Applications (*Theory*) (ELEC 212)

Introduction to Microprocessors:
The evolution of microprocessors (from 4 bits onwards). Basic functions of a microprocessor. Programmer's model, data formats

Architecture of 8085 microprocessors:
Pin-out configuration o 8085, Instruction timing & execution, Demultiplexing & buffering of system buses of 8085 CPU.
Instruction set, classification of instructions, addressing modes, software model of 8085 CPU

Assembly Language Programming using 8085 CPU:
Program writing for different arithmetic operation with 8-bit & 16-bit binary numbers and BCD numbers, program for searching & sorting. Code conversion, concept of look-up table. Use of SID and SOD pins of 8085, writing program using time delays & calculation of T-states. Stacks & Sub-routines

Interrupt structure of 8085 & their uses.

Memory & their interfacing:
Interfacing of RAM, ROM, EPROM & DRAM etc.Battery backup of memories, EPROM programming algorithm & its software implementation.

I/O interfacing technique:
Addressing the I/O devices, data transfer schemes-synchronous & asynchronous data transfer, interrupt driven data transfer, DMA.

Support chips:
8255, 8253, 8251, 8279, 8259, 8237,8212.

Interfacing of DAC, ADC, keyboards, printer, and displays using 8255.

Architecture of 8086/8088 microprocessors:
8086-pin assignment, addressing modes, software model, instruction sets, classification of instructions, assembly language programming, memory interfacing, interrupts, I/O interfacing, interfacing of support chips, interfacing of ADC, DAC , keyboards, displays etc.

Introduction to Microcontroller:
8051 microcontroller, 8051 pin description connection, I/O ports memory & memory organization, addressing modes & instruction set, 8051 assembly language programming, interrupts-a few applications of Microcontroller.

Industrial applications of Microcontroller: Traffic Control, Stepper motor, Scrolling Display.

Text Books:

1. Microprocessor Architecture, Programming & Application-R. Gaonkar, Wiley
2. Advanced Microprocessor & Peripherals-Ray & Bhurchnadi, MH
3. Microcontroller, Deshmukh, MH 2/e
4. Microprocessor & Microcontroller, Krishnakant, PHI
5. 8085 Microprocessor Programming & Interfacing- N.K Srinath-PHI
6. Microprocessor-Theory & Application-M. Rafiquezzaman;PHI

Semester – III

Optoelectronics (*Theory*) (ELEC 213)

Optical fibers: Modes of an optical fiber, multimode fibers, single mode fibers and their propagation characteristics. Step-Index, Graded Index Fiber.

Integrated Optic Waveguides: Dielectric Slab Waveguide, Integrated Optic Network.

Optical Sources:

i) LEDs: LED structure, Light Source Materials, Quantum Efficiency and LED power.

ii) Laser Diode: Laser Principles, Laser Diodes, Laser Diode operating Characteristics.

Optical Detectors: Principle of photodetection, photomultiplier, semiconductor photodiode, PIN photodiode, Avalanche photodiode.

Power Launching and Coupling: Source output pattern, power coupling calculation, power launching versus wavelength, lensing schemes, fiber connector.

Distribution System: Distribution networks, directional couplers, star couplers, switches, WDM.

Modulation: LED modulation and circuits, Laser diode modulation and circuits, analog modulation format, digital modulation format, optical heterodyne receivers.

Noise and Detection: Thermal and shot noise, S/N ratio, error rates, additional noise contribution, receiver circuit design.

System Design: Analog and digital system design.

Text Books:

1. Optical Fiber Communication: J. C. Palais
2. Optical Fiber Communication: G. Keise
3. Fiber Optics: E. Lacy
4. Semiconductor Optoelectronic Devices: Pallab Bhattacharya

Semester – III

Networking (*Theory*) (ELEC 214)

Overview: History, Communication principles (TDM, FDM, Serial & Parallel communication, Simplex, Duplex, Half Duplex), Data communication concepts, Circuit & Packet Switchings, Different types of networks – LAN, MAN & WAN, Need for layered Architecture (OSI & TCP/IP), Protocol Hierarchies and Functions of different layers.

Computer Networking principles: Design issues, Data handling by the Data Link Layer and Physical Layer. Framing, Error Detection & Control, Flow Control.

Local Area Network: Introduction, Ethernet, Access Control, Token Rings, FDDI, Wireless 802.11, Advanced Ethernets.

Wide Area Networks: Switching and Forwarding in WAN, Packet Switching, Datagram Forwarding, Virtual Circuit Switching, Source Routing, Circuit Switching, Routing Strategies, Routing Algorithms, Congestion Control Algorithms, Packet Size, External & Internal Connections, Cell Switching or Asynchronous Transfer Mode (ATM), SONET.

Internetworking: Introduction, Service Model, Fragmentation & Reassembly, IP Packet, IP Address, Subnetting, Classless Routing, IP Version 6 (IPv6)

Internet and TCP/IP Protocol Suite: Introduction, TCP Overview, Address Resolution Protocol (ARP), Internet Protocol, Domain Name System (DNS), Transport Protocol, Connection Established by the Transport Layer, The Client-Server Model, Sockets Interface, Socket Addressing, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), API and Socket Programming, End-to-End Protocols.

Text Books:

1. B A. Forouzan, "Data Communication and Networking",4/e, McGraw Hill,2006.
2. A Tanenbarum, "Computer Networks" –4th Edition, PHI, 2004/Pearson Education 4th Edition.
3. W Stallings, "Data and Computer Communication" –7/e Pearson

Semester – III

Microprocessors *(Practical)* **(ELEC 215)**

1. Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical) Assignments based on above.

2. a) Familiarization with 8085 simulator on PC.
Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator. Assignments based on above

3. Programming using kit and simulator for:
i) Table look up
ii) Copying a block of memory
iii) Shifting a block of memory
iv) Packing and unpacking of BCD numbers
v) Addition of BCD numbers
vi) Binary to ASCII conversion
vii) String Matching Multiplication using Booth's Algorithm

4. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.

5. Study of timing diagram of an instruction on oscilloscope.

6. Interfacing of 8255: Keyboard and Multi-digit Display with multiplexing using 8255 6
7. Study of 8051 Micro controller kit and writing programs for Interfacing of Keyboard, DAC and ADC using the kit.

8. Serial communication between two trainer kits

Semester – III

Communication Systems and Fiber-Optics *(Practical)* (ELEC 216)

Communication Systems

1. Generation and characteristic studies of Amplitude Modulation (AM) and Demodulation Techniques.
2. Generation and characteristic studies of DSBSC and Demodulation techniques.
3. Generation and Characteristic studies of SSBSC and Demodulation techniques.
4. Generation and characteristic studies of FM and Demodulation techniques.
5. Generation and characteristic study of Pulse Amplitude Modulation (PAM).
6. Generation and characteristic study of Pulse Width Modulation (PWM).
7. Generation and characteristic studies of PCM and DPCM techniques.

Fiber-Optics

1. Study of the characteristics of LED & LDR.
2. Numerical aperture of optical fibre.
3. Frequency response character of LDR.
4. Optical conversion of digital to analog signal.
5. Holography recording and reconstruction.
6. Measurement of dimension of circular aperture by laser.
7. Study of broadening character of a pulse in an optical fibre

Semester – IV

VLSI Circuit Design and Device Modeling (*Theory*) (ELEC 221)

Digital VLSI Circuits

Introduction to ASIC Design:a. Design Strategies: Hierarchy, Regularity, Modularity & Locality b. Chip Design Options: Gate Array, Field Programmable Gate Array, PLA, PLD, Standard Cell, Full Custom Design

Fabrication & Layout of CMOS: a. Fabrication Process Flow: Basic steps b. CMOS n-Well Process c. Layout & Design Rules d. CMOS inverter Layout Design

MOS Inverter Characteristics: a. Transfer Characteristics: MOS with resistive load, n-MOSFET Load (Enhancement & Depletion), CMOS inverter b. Transient Analysis of CMOS Inverter and Delay analysis

CMOS Logic Circuits: a. NAND & NOR Gates b. Complex Logic Circuits c. Pseudo n-MOS logic d. CMOS Full adder circuit e. CMOS Transmission Gate (Pass transistor Logic)

Advanced CMOS Logic circuits: a. Dynamic CMOS Logic b. Domino CMOS Logic c. Differential Cascode voltage switch logic d. NORA Logic

Sequential CMOS logic circuits: a. Behaviour of Bi-stable elements b. SR Latch Circuit c. Clocked JK Latch/Master-Slave JK d. CMOS D-latch and edge triggered Flip-flop

Subsystem Design: a. Adders: Carry ahead adder, carry save adder, Manchester carry chain.b. Multipliers: Serial-parallel Multiplier, array multiplier c. High Density Memory: ROM, Static RAM, Dynamic RAM, SD RAM, Flash Memory

Physical Design: a. Floor Planning Methods: Block Placement & Channel Definition, Global and Channel Routing

Analog VLSI Circuits

Introduction: a. Analog Signal Processing b. Analog VLSI Mixed Signal Circuits c. Basic Building Blocks in Analog Circuits

Basic Building Blocks:a. MOS Switches b. Resistor realisation using Switched Capacitor c. Voltage level shifter d. CMOS Current Sources and sinks e. CMOS Voltage and Current references f. CMOS Differential Amplifier g. Output Amplifier

Analog Circuits: a. CMOS Operational Amplifier b. Comparator c. Switched Capacitor Filter d. ADC & DAC (FLASH ADC, Delta-Sigma Modulator) e. Phase locked Loop f. FPAA

Text Books:

1. Neil H.E Weste, Kim Haase, David Harris, A.Banerjee, "CMOS VLSI Design: A circuits & Systems Perspective", Pearson Education (For module 1)
2. Wayne Wolf," Modern VLSI Design – System-on-chip Design", Prentice Hall India/Pearson Education (For module 2,5,6,7,8)
3. Sung-Mo Kang & Yusuf Lablebici, "CMOS Digital Integrated Circuits, Analysis & Design", Tata McGraw-Hill Edition (For Module 2,3,4,5,6)
4. Philips E. Allen & Douglas R. Holberg, " CMOS Analog Circuit Design" , Oxford University Press (For Module 9,10,11)
5. David Hodges, Horace G Jackson, & Resve A Saleh, "Analysis & Design of Digital Integrted Circuits", Tata McGraw-Hill Edition (For Module 2,3,4,5)
6. Ken Martin," Digital Integrated Circuits", Oxford University Press (For Module 2,4,5,6)
7. R. L. Geiger, P.E.Allen, Noel R. Strader," VLSI Design techniques for Analog and Digital Circuits", McGraw-Hill International Edition.(For Module 9, 10 & 11)

Semester – IV

Digital Signal Processing (*Theory*) (ELEC 222)

Discrete-time signals:
Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, Sampling Theorem sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.

LTI systems:
Definition, representation, impulse response, derivation for the output sequence, Concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions.

Z-transform: Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of z-transform, z-transform on sequences with examples and exercises, characteristic families of signals along with ROCs, convolution, correlation and multiplication using z-transform, initial value theorem, Persevals relation, Inverse z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.

Discrete Fourier Transform: Brief recapitulation of Fourier Series, Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT / IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolutions, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Add & Overlap Save methods with examples and exercises.

Fast Fourier Transform: Radix-2 algorithm, decimation –in time and decimation-in-frequency algorithms, signal flow graphs, Butterflies, computation in one place, bit reversal, examples and exercises.

Filter Design: Basic concepts behind IIR and FIR filters, Butterworth IIR analog filter, Impulse Invariant and Bilinear transforms, design of IIR digital filter, design of linear phase FIR filter with rectangular window.

Digital Signal Processor: Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor (any one), writing of small programs in Assembly Language.

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications - J.G.Proakis & D.G.Manolakis, Pearson Education/ PHI.
2. Digital Signal Processing Signals, Systems and Filters – A. Antoniou
3. Digital Signal Processors Architectures, Implementations and Applications – S.M.Kuo & W. Gan, Pearson Education
4. Digital Signal Processing – A Computer Based Approach – S.K.Mitra, TMH Publishing Co,
5. Digital Signal Processing – P. Rameshbabu, Scitech Publications (India)
6. Digital Signal Processing – S. Sharma, Kataria & Sons S.K

Semester – IV

Microwave Electronics (*Theory*) (ELEC 223)

Matrix description of multi-port network: Definitions of a multi-port networks; Matrix description of N-port networks; Impedance, Admittance and Scattering matrix of N-port networks, Relations between the matrices of N-port networks. Reciprocal, Loss-less, Symmetrical multi-ports. Properties of Microwave junctions.

Discrete passive circuit components: application and design aspects, matched terminations, attenuators, directional couplers, sliding short tuner, E-H tuner, slide screw tuner, E, H and E-H plane tee, E and H-plane bend, waveguide twist, circulator, isolator, phase shifter, frequency meter, flanges, connectors and adapters.

Sources: Tubes – Klystron, Magnetron, Traveling wave tube, principle of dielectric heating and microwave oven, solid state devices – varacter diode, PIN diode, Schottky diode and step recovery diode – features and fields of application, Gunn, IMPATT and MESFET as oscillators and amplifiers, microwave and millimeter wave power combiners.

Microwave Filters and matching circuits: Periodic structures, Filter design - Image Parameter Method, Insertion Method, Filter Implementation, Couple-line filters, Filters using coupled resonators.

Measurements: Impedance measurement - V.S.W.R method; Reflectometer technique; Use of Smith chart; Bridge method. Detection and measurement of power - Diode detector; Bolometer; Themocouple and calorimeter as microwave power sensors; Balanced and self-balancing bridges. Q-measurement - Transmission method; V.S.W.R method; Transient decay or decrement method; Dynamic methods. Attenuation measurement; Frequency measurement.

Concept of Remote Sensing: Intooduction, Distance Remote Sensing, Remote Sensing Process, Sources of Energy , Interaction with atmosphere , Advantage of remote sensing , Limitation of remote sensing , Ideal remote sensing .

Microwave systems: Antennas – Pattern characteristics, efficiency, Gain & Temperature. Smart Antenna, MIMO, Microwave communication systems – Friis power transmission formula, Noise in microwave transmitters & receivers, Principles and applications of RFMEMS, Industrial application of microwave.

Radar- Basic Rader system, Rader equation, CW radar, pulsed radar, MTI radar, phased array radar

Satellite: Direct Broadcast satellite receiving system, earth station design, VSAT, bandwidth compression, principles of FDMA and CDMA, SPADE, DMAS, Different tropospheric effects, Ionospheric effects, Degradation of performance of transionospheric satellite-based navigation systems, Multipath and fading in signals, co-channel suppression, GPS application.

Text Books:

1. MI Skolnik: Introduction to Radar Systems
2. B Bhatta: Remote Sensing and GIS

Semester – IV

Digital Signal Processing *(Practical)* **(ELEC 224)**

Simulation Laboratory using Standard Simulator:

1.Simulation of sampled Sinusoidal signal, various sequences and different arithmetic operations.
2.Simulation of convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.
3.Simulation of z-transform of various sequences - verification of the properties of z-transform.
4.Simulation of Twiddle factors – verification of the properties.
5.Simulation of DFTs/IDFTs using matrix multiplication and also using commands,
6.Simulation of circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
7.Verifications of the different algorithms associated with filtering of long data sequences and overlap-add & overlap-save methods.
8.Simulation of DIT & DIF Radix-2 FFT algorithms

Microwave *(Practical)* **(ELEC 225)**

1. Measurement of coupling factor and Directivity of a Directional coupler using calibrated attenuator.
2. Study of Gunn Oscillator characteristics using power meter with bolometer and calibrated wave-meter.
3. Measurement of reflection coefficient using two directional couplers and one calibrated attenuator.
4. Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at Xband.
5. Frequency response of low-pass filter, high-pass filter, band-pass filter using spectrum analyser with tracking generator
6. VSWR and Reflection coefficient of a coaxial line for various load condition using frequency domain Technique
7. Radiation Pattern of aperture antennas e.g., Horn antennas, Open-ended Waveguides, Parabolic Reflectors.
8. Gain, Directivity and Bandwidth of a three-element Yagi-Uda antenna

Semester – IV

Seminar (ELEC 226)

Lectures from Industry (ELEC 227)

Thesis (ELEC 228)