DEPARTMENT OF PHYSICS

JADAVPUR UNIVERSITY

SYLLABUS FOR CHOICE BASED CREDIT SYSTEM

IN

M.Sc. ELECTRONIC SCIENCE

2020

Two-Year, Four-Semester Programme

<u>MSc Electronic Science course under CBCS system at a glance</u>

Year	**Semester**	**Marks Distribution**	**Credit Distribution**
1st	1st	Theory: 200 Practical :100 Total: 300	Theory: 16 Practical :8 Total: 24
	2nd	Theory: 200 Practical :100 Total: 300	Theory: 16 Practical :8 Total: 24
2nd	3rd	Theory: 200 Practical :100 Total: 300	Theory: 16 Practical :8 Total: 24
	4th	Theory: 200 Practical :100 Project:50 Total: 350	Theory: 16 Practical:8 Project: 4 Total: 28
1st + 2nd	**Total:1250**		**Total : 100**

Curriculum Structure

Semester	Paper Code	Subject	Mode of Teaching	Marks	Credit
1st	ELSC/T/01	Mathematical and Computational methods of Electronics	Theory	50	4
	ELSC/T/02	Elements of classical, statistical, and quantum mechanics	Theory	50	4
	ELSC/T/03	Semiconductor Device I	Theory	50	4
	ELSC/T/04	Electronic circuit -I	Theory	50	4
	ELSC/P/01	Computer Lab	Practical	50	4
	ELSC/P/02	Electronics Circuit Lab	Practical	50	4
	Total			**300**	**24**

Semester	Paper Code	Subject	Mode of Teaching	Marks	Credit
2nd	ELSC/T/05	Network analysis and Synthesis	Theory	50	4
	ELSC/T/06	Materials Science and Technology	Theory	50	4
	ELSC/T/07	Microprocessor and microcontroller	Theory	50	4
	ELSC/T/08	Quantum Electronics	Theory	50	4
	ELSC/L/03	Materials and Device Lab	Practical	50	4
	ELSC/L/04	Microprocessor Lab	Practical	50	4
	Total			**300**	**24**

Semester	Paper Code	Subject	Mode of Teaching	Marks	Credit
3rd	ELSC/T/09	Electronic circuit - II	Theory	50	4
	ELSC/T/10	Semiconductor Device II and Opto-Electronics	Theory	50	4
	ELSC/T/11	Microwave Electronics	Theory	50	4
	ELSC/T/12	Integrated Circuit technology	Theory	50	4
	ELSC/L/05	Microwave and Optoelectronics Lab	Practical	50	4
	ELSC/L/06	IC Lab	Practical	50	4

	Total			**300**	**24**

Semester	Paper Code	Subject	Mode of Teaching	Marks	Credit
4th	ELSC/T/13	Electronic Communication	Theory	50	4
	ELSC/T/14	Applied Electronics	Theory	50	4
	ELSC/TE/01	Elective paper theory**	Theory	50	4
	ELSC/L/07	Communication Lab	Theory	50	4
	ELSC/L/08	Applied Electronics Lab	Practical	50	4
	ELSC/EL/01	Elective paper Practical##	Practical	50	4
	ELSC/P/01	Project	------------	50	4
	Total			**350**	**28**

ELSC: Electronic Science T: Theory L: Laboratory
ET: Elective Theory EL: Elective Laboratory
For all subjects (both theoretical and practical papers) 20% marks is allotted to internal assessment and 80% marks is allotted to end semester examination

**Elective Theory(Any One):
1. EM field and Plasma Electronics
2. Quantum electronic devices
3. Instrumentation and Control devices
4. Instrumentation for Materials Characterisation

##Elective laboratory (Any One):
1. Fault Diagnosis and maintenance
2. Wireless and smart phone based instrumentation
3. Web design
4. Industrial control

Subject Wise Syllabus

ELSC/T/01

Mathematical and Computational Methods of Electronics

1. **Elements of FORTRAN and C language**. Realization of following numerical techniques in FORTRAN and C languages

2. **Numerical analysis:**
a) Computer arithmetic: Representation of integers, Real numbers, Floating point representation, floating point operators. IEEE standards of floating point number. Absolute and relative errors, Error propagation,Stability and ill conditioning, Order ofapproximation, Truncation error.

b) Numerical differentiation: Derivatives from Divided—DifferenceTable. Central difference formula.

c) Numerical integration: Trapezoidal rule, Simpson’s rule. Newton—Cotes formula, Gaussian quadrature, multidimensional integrals.

d) Interpolation and extrapolation: Lagrange’s, spline and rational- function interpolation and extrapolation.

e) Solving of polynomial equations: Bisection, Regula—Falsi, Newton-Raphson methods.

f) Solving set of linear equations : Gauss and Gauss—Jordan method, Ill conditioned systems.

g) Ordinary differential equation: Euler’s method, Runge-Kutta method, Adams—Moulton, Adams—Bashforth method.

3. **Digital signal processing**: Fourier series; Fourier transform, calculation of coefficients, DFT,FET, convolution, correlation, digital filters.

4.**Simulation:**Monte-Carlo and) Molecular dynamic simulation, Random numbers, properties of random numbers, functions of random variables, Monte-Carlo integration, Metropolis — algorithm, Transport equation simulation.

5.**Graphics:**Graphics screen, Basic graphic elements. Manipulation of graphics elements, Symbolic representation graphics screen. Noise and distortion.

Reference Books:

1. Numerical Mathematical Analysis : J. B. Scarborough

2. Computer Oriented Numerical Methods : V. Rajaraman

3. Numerical Techniques :A. Dutta

4. Numerical Methods for Scientist and Engineer : H.M. Antia

Course Outcomes

CO1. To learn basic elements of FORTRAN and C languages and realization of different numerical techniques in FORTRAN and C languages

CO2. To know about computer arithmetic, Representation of integer and real numbers and to have some idea about absolute and relative error and error propagation

CO3. To learn different numerical techniques like,

i) Numerical differentiation, using divided difference table and central difference formula

ii) Numerical integration using trapezoidal rule, Simpson's rule, Newton's Cotes formula, Gaussian quadrature formula, multidimensional integrals

iii) Interpolation and extrapolation using spline, Lagrange's and rational function interpolation formula

iv) Solving of polynomial equations using bisection, Regula Falsi and Newton-Raphson methods

v) Solving set of linear equations using Gauss and Gauss-Jordon methods

vi) Solution of ordinary differential equations using Euler's, Runge-Kutta, Adams-Moulton and Adams-Bashforth methods

CO4. To learn about Fourier series, Fourier transform

CO5. Tohave some idea about random numbers, Monte Carlo and Molecular dynamic simulation using random numbers, Metropolis algorithm, transport equation simulation

CO6. Finally, to learn about basic graphic elements, manipulation of graphic elements, symbolic representation graphic screen, noise and distortion.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/02 Elements of Classical, statistical and quantum Mechanics	CO1	3	2	3	1	2	1	1	1	2	1	1	1
	CO2	3	3	3	2	3	3	2	1	2	1	2	2
	CO3	3	3	3	2	3	3	2	1	2	2	1	2
	CO4	3	3	2	1	2	1	1	1	2	1	1	1
	CO5	3	3	3	2	3	3	2	2	2	2	1	2
	CO6	3	1	1	1	2	1	1	1	2	2	1	1

ELSC/T/02

Elements of Classical Mechanics and Statistical Mechanics

Classical Mechanics

1. **<u>Lagrangian Formalism</u>**: Concepts of degrees of freedom, generalized coordinates, generalized forces, constraints, virtual displacement and virtual work. The d'Alembert's principle, derivation of Lagrange's equations using variational principle and using Lagrange's undetermined multipliers. Cyclic coordinates. Simple examples of Lagrangian mechanics. The central-force problem. Symmetry principles and conservation of energy, linear and angular momenta.
2. **<u>Hamiltonian Formalism</u>**: Legendre transformations and the connection between Lagrangian and Hamiltonian. The Hamilton's equations of motion. Concept of phase space and Liouville's theorem. Poisson brackets. Canonical transformations and generating functions. Infinitesimal canonical transformations and conservation theorems using Poisson brackets. Examples.
3. <u>Small oscillations</u>: The eigenvalue equation and the principal axis transformation, Frequencies of free vibration, normal coordinates and normal modes, Simple problems.

Reference Books:

1. Classical Mechanics : H. Goldstein (Second Edition)

2. Classical Mechanics : A.K. Roychoudhury

Statistical Mechanics

l. Overview of basic methods and results of statistical mechanics, Ensembles representative of situations of physical- interest.Ensembles used as approximation, Grand canonical and other ensembles.

2. Quantum Statistics of ideal gases: Maxwell—Boltzmann, Bose—Einstein and Fermi-Dirac Statistics.

3. Kinetic theory of transport process: Collision time, Collision time and scattering cross-section. Transport process and distribution functions, Boltzmann equation.Path integral formulation. Illustrative examples.

4. Near exact formulation of transport theory. Description of two particle collisions. Scattering cross-section and symmetry properties. Derivation of Boltzmarin equation. Equation of change for mean values. Conservation equations. Illustrative examples. Approximate methods for solving Boltzmann equation. Relaxation
time approximation.

5. Fluctuations: Correction functions, Calculation of mean square velocity increment.

Velocity correlation function and mean squaredisplacement, Ensemble and time averages,Ergodic theorem:

Reference Books:

1. Fundamentals of Statistical and Thermal Physics: F. Reif-

2. Statistical Mechanics: K. Huang

3. Statistical Physics : L.D. Landau & E. M. Lifshitz

Elements of Quantum Mechanics

1. Fundamental Postulates and Definitions

a) Basic Postulates regarding state of a system, dynamic variables;prediction about the outcome of measurements. Discussion of Vector spaces, linear operators, eigenvalues and eigenvectors of linear operators. Completeness, orthogonality, normalization, discrete and continuous spectra. Quantum condition and quantization procedure

b) Representation: Setting up of a representation,matrix representation; Coordinate and momentum representation;transformation of basis

2. Equation of motion: Schrodinger, Heisenberg and Interaction picture and their relationship, conservation of probability,stationary states.

3. Some exactly solvable problems:

One dimensional problems

a) Potential well problems : bound and unbound states
b) Potential barrier problems: réflection.and transmission.
c) Linear harmonic oscillator: Schrodinger method, Matrixmethod, Symbolic method of Dirac.Problems in two and three dimensions
a) Two and three ‘dimensional boxes; three dimensional harmonicoscillator
b) Spherically symmetric potentials, spherical well; the hydrogenatom, spherical harmonic oscillator.
c) Electron in a magnetic field—Landau levels.

4. Some approximation methods for bound states:

a) Time independent problems with stationary perturbation theory,non-degenerate case—first and second order perturbation,degenerate case.

b) Time-dependent problem: Time dependent perturbation theory:Constant and periodic perturbation, transition probability, Fermi’sgolden rule, Matrix elements, collision of charge carriers with crystalline imperfections, Randomising and elastic collisions,simple examples including radiative transitions. Einstein coefficients. .

c) Adiabatic and sudden approximation as disturbed harmonicoscillator

5. Scattering theory:
a) Scattering amplitude, differential and total cross—sections.
b) Spherically Symmetric potential, partial wave analyses, elastic and absorption cross sections, phase shift, Born approximation.
c) Coulomb Scattering.

6. Some Time Dependent Approximate Methods:
a) Variational method: Ground and excited states, simple applications.
b) WKB approximation: Potential barrier problems.

7. Quantum theory of radiation and its interactions with matter, quantisation of radiation field, spontaneous and stimulated emission

Reference Books:

1. Quantum Mechanics : L. I. Schiff

2. Quantum Mechanics : E. Merzbacher

3. Quantum Mechanics : A. S. Davydov

4. Quantum Mechanics Non relativistic theory : L. D. Landau and E. M. Lifshitz

5. Quantum Mechanics : A. Ghatak and S. Lokanathan

Course Outcomes

CO3. Introduce the various constrained systems, identify the limitations of Newtonian mechanics.

CO4. Analyze equations of motion by Introducing an alternative methods namely Lagrangian and Hamiltonian of the system.

CO5. Study and classify the four different types of generating functions in canonical transformation.

CO6. Apply contract transformation and Introduce the Poissions bracket.

CO7. To understand the physics of small oscillations and apply to the system executing small vibration.

CO8. To understand the motion of a particle in terms of action angle variables.

CO7. Addressing the limitations of classical Mechanics and requirements of statistical Mechanics.

CO8. Foundations of statistical mechanics, microscopic and macroscopic systems.

CO9. Addressing statistical mechanics in classical and quantum mechanical systems.

CO10. To study the equilibrium condition of a system, introduction of micro canonical,

canonical and grand canonical systems.

CO11. To understand statistical behavior of natural particles namely MB, BE, FD types, their distribution functions.

CO12. To find out the fluctuations of the thermodynamic variables in a physical system.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/02 Elements of Classical, statistical and quantum Mechanics	CO1												
	CO2												
	CO3												
	CO4												

ELSC/T/03
Physics of Semiconductor Devices I

1. **p-n junction diode**: Basic device technology; Depletion region and depletion capacitance; Abrupt junction; Diffusion length and depletion layer width, linearly graded junctions, current voltage characteristics. Shockley equation, Generation — recombination processes. Diffusion capacitance. Junction breakdown. Tunnelling effect. Avalanche multiplication. Transient behavior and noise,Terminal functions. Rectifier, Voltage regulator: Varistor, Varactor. Fast-recovery diode, Charge storage diode, p-i-n diode.

2. **Bipolar Transistor**: Static characteristics: Basic current-voltage relationship, current gain, output characteristics; Device modeling, Ebers—Moll model. Gummel—poon model, Microwave Transistor, Cutoff Frequency, Microwave characterization, Power transistor, Switching transistor. Hot-electron Transistor.

3. **Metal-semiconductor contacts:** Energy band relation; surface states, Depletion layer, Schottky effect. Current transport processes. Thermionic emission theory. Diffusion theory, Tunneling current, Minority-carrier ~ injection ratio, characterization of barrier height. Device structures, Ohmic contact.Field effect transistors:

4. **FET:** Basics characteristics of JFET and MOSFET, FET: uniform charge distribution, arbitrary charge distribution, normally off FET, field dependent mobility, two-region model, saturation velocity model, pinch-off, saturation, gate control, I-V characteristic, MESFET and related field effect device, short channel effect, microwave performance;

5. **MOSFET:** Basic characteristics, non-equilibrium condition,linear and saturation regions, sub-threshold region, mobility behavior, temperature dependence, short-channel effects, scaling, hot electron degradation, LDD and LDS structures, sub threshold current, Threshold voltage, MOSFET structures, HMOS, DMOS,VMOS, Thinfilm transistor, HEXFET, Nonvolatile memory devices, MIOS devices.

6. **MIS Diode and charge coupled Devices:** Ideal MIS diode.Surface Space-charge region, charge coupled devices, chargestorage, Basie CCD Structure, charge transfer and frequency response, Buried channel CCD.

7. Opto-electronic Devices: LED: Radiative transitions, emission spectra, luminescent efficiency, light emitting materials, working of LED, visible and infrared LEDs, Photo detectors: general features, gain, band width and signal to noise ratio, principle of operation: photodiode, p-i-n, meta-semiconductor photo diode, Solar cells: current and voltage in illuminated junction, p-n junction solar cells, I-V characteristics, solar radiation, conversion efficiency and spectral response, applications, Semiconductor Laser: Basics of laser physics, population invasion, stimulated emission and lasing action in p-n junction, spectral response of p-n junction Laser.

8. **Heterojunction:** Basics, isotype and anisotype heterojunctions, hetrojunction transistor, FET, photodiode, solar cell, laser.

Reference Books:

1. Physics of semiconductor devices : S.M. Sze

2. Physics of semiconductor devices : M. S. Shur

3. Fundamentals of Solid State Electronics: Chin-Tang Sah

4. Solid State Electronic-Devices: B.G. Streetman & Sanjay Kumar Banerjee

Course Outcomes

CO1: To know about the PN junction theory, barrier potential, junction capacitance

CO2: To know about the bipolar transistors and basic current voltage characteristics and Ebres Moll model and FET

CO3: To know about the Metal Semiconductor junctions and band bending mechanism and different current transport mechanism

CO4: To know about the MOS devices and different opto electronic devices such as LED, Solar cell and Photo detectors etc.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/03 Physics of Semiconductor Devices I	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/T/04

Electronic Circuits I

1. Tuned voltage and power amplifiers; small signal case — single Stage and multistage, large signal case —Class B and Class C Operations, unsaturated and saturated Class C Amplifier, Harmonicgenerator.

2. Regulated Power Supply: Series regulation using op-amp. Monolithic Voltage regulator, details of a power supply unit,switch made power supply.

3. PNPN devices — SCR, SCS, Diac, Triac, UJT and their uses

4. Wave shaping circuits -Multivibrators and Timers, Astable, Monostable and Bistable multivibrators

5. Review of op-amp parameters and applications as inverting and non-inverting amplifiers, voltage follower, summing amplifier,differentiator and integrator, set up for solution of 2nd order differential equation. Analog computer, details of active filers.

6. Logic gates, logic families, Boolean Algebra and Karnaugh Mapping.

7. Sequential Digital Circuits; Flip-flops; RS latches, Level Clocking D latches, Edge-triggered D flop-flops, JK flip flops, JK Master slave flip-flops,

8. Registers and counters: Buffer register, Shift register, Ripple counter, Synchronous counter, Ring counter, Three-state register, Bus organized computer.
9. PSPICE and its applications

Reference Books:

1. Op-amp and Liner Integrated Circuits:R. Gayakwad

2: Electronic Principles:A. P. Malvino

3. Digital Computer Electronics: A. P. Malvino

4, Digital Integrated Electronics: H. Taub and D. Schilling

5. PSPICE: P. W. Tuinenga

6. Integrated Electronics: J. Millman & C. C. Halkais

Course Outcomes

CO1: To know about tuned voltage and power amplifier, Class B, Class C amplifier.

CO2: To know about the power supply, regulated power supply system. To know about PNPN devices — SCR, SCS, Diac, Triac, UJT and their uses.

CO3: To know about OP Amps, different applications of Op-Amp. To study different wave shaping circuits, multi vibrators etc.

CO4: To understand sequential circuits. Different Flip Flops, Registrars, Counters etc.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/04 Electronic Circuits I	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/L/01
Computer Lab

Use of the computer language taught in theory paper I, Group — A: "Mathematical and Computational Methods of Electronics" in solving various problems relevant to Electronics.

Course Outcomes

CO1: To learn the use of computer language taught in theory paper ELSC/T/01 in solving variousproblems relevant to Electronics.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/04 Electronic Circuits I	**CO1**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**2**

ELSC/L/02
Electronic Circuits Lab.

1. Identification of various discrete electronic components.

2. Handling of various meters and CRO.

3. Measurement of parameters of an A. C. signal.

4. V-I characteristics of a Zener diode.

5. Design, construction and experimental study of a power supply:
(i) Regulation with a Zener diode,(ii) Current booster,(iii) Regulation with monolithic voltage regulator, (iv) Line regulation and voltage regulation, (v) SMPS.

6. Operational characteristics of (1) FET, (IT) MOSFET, (iii) UJT,(iv) COS/MOS inverter.

7 Experiment on transformer: (i) Secondary voltage,(ii) Secondary current (iii) Power characteristics of a transformer.

8. Frequency response characteristics of a cascade voltage amplifier.

9. Experiment with a feedback amplifier.

10. Experiment with a power tuned amplifier.

11. Experiment with a tuned amplifier.

12; Experiment with an oscillator, Multivibrator.

13. Circuit analysis and synthesis using PSPICE,

Course Outcomes

CO1: To know about the operation of transformer, current, voltage, power relationship with the variation of the primary and secondary turns ratio.

CO2: To understand the different characteristics of OP-AMP, inverting, non –inverting, unity gain amplifier, Schmitt Trigger circuit, Hysteresis etc.

CO3: To understand the performance of unregulated and regulated power supply. To draw the load regulation, line regulation curve of a power supply.

CO4: To verify the different relationship of the digital logic gates, design half adder, full adder circuits.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/L/02 Electronic Circuits Lab	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/T/05
Network Analysis and Synthesis

1. **Basic Concepts**: Units and Notations, Circuit Elements: resistance, capacitance, inductance, mutual Inductance, independent and dependent voltage and current sources, Source Transformation, Electrical Signals, Power, Energy, Electrical Circuit and Network, Branches. Nodes. Loops. Meshes. AC Response: Sinusoids and Phasors, Phasor Algebra, AC response of basic circuit elements, AC impedance.

2. **Frequency Domain Analysis of AC Circuits:** Problems on AC circuits in steady state using KVL, KCL, Mesh method, Node method; Thevenin's, Norton's, Maximum Power Transfer Superposition Theorems

3. **Network Topology**: Graph Representation of Electrical Circuits— Path, Tree, Spanning Tree, Circuits; Matrix Representation of Graph — Cut-set, Tie-set.

4.**Transient Response of First-Order Circuit**s: Continuity Condition for Capacitor and Inductor, Representation of Initial Conditions, Exponential Circuits, General solution for transient response of First—Order Circuits, Step, Pulse and Pulse Train Response Problems on First—Order Circuits.

5. **Transient Response of Second-Order Circuits:** Natural response, Step Response, Problems on Second—Order Circuits.

6. Network Analysis in Complex Frequency Domain: Complex Frequency (s), Complex exponential signal, Generalized representation of circuit element in s-domain, Problems on s-domain circuit analysis

7. **Network Analysis Using Laplace Transform**: Relevant Properties of Laplace Transform, Laplace Transform of functions used in electrical circuit. Initial and Final Values, Network Function, Inverse Laplace Transform, Partial Fraction Expansion, Convolution Integral, Application to differential equations, Circuit Models, Application to circuit analysis: Problems on dc circuits, steady state AC response, Transient response.

8. **Network Synthesis**: Concept of Transfer Functions, Impedance Function and its application, Poles and Zeros, Pole-zero plot, Definition of Positive Real Functions, Testing procedure for Positive Real functions, Derivation of Synthesis technique for passive network, Synthesis of Two-port networks by ladder technique, Problems on network synthesis: General LCR network, Foster & Cauer Form.

9. Frequency Response of Networks: Frequency Response Plots for Impedance Functions, Bode Plot, Frequency Response Analysis of Two-port Network.

Reference Books:

1. Theory and problems of electric circuits: M. Nahvi and Joseph A. Edminister
2. Theory and Problems of Basic Circuit Analysis: John O'Malley
3. Electric Circuits Fundamentals: S. Franco

4. Network Analysis: M. E. Van Valkenburg.
5. Introduction to Modern Network Synthesis : M. E. Van Valkenburg
6. Circuit Synthesis and Design: G.C. Temes and J. W. La Patra
7. Network Analysis and Synthesis: F. F. Kuo
8. Networks and Systems: D. Roychoudhury
9. Circuit Analysis with Computer Applications to Problem Solving : S.C. Gupta J. W. Bayless, B. Paikan

Course Outcomes

CO1: Knowledge on basic concepts of terms and symbols of electrical circuits, laws and theorems of circuit, network topology and abstract graph representation of electrical network

CO2: Learn the methodology of solving problems on AC circuit in steady state in frequency domain using algebra and matrix method as tools.

CO3: Learn the technique of analyzing of transient response of 1st order and 2nd order circuits starting from standard solution of 1^{st} order and 2^{nd} order solution of differential equation and finding the unknown constants from model circuit representing the initial and final condition of the circuit

CO4: Knowledge on basic mathematical concepts of Laplace transform in connection to network analysis and framing the Laplace model of electrical circuit. Acquire adequate skill of solving problems on dc, steady state ac and transient response of circuits in common platform of complex frequency (S) domain using Laplace model of electrical circuit

CO5: Learn the knowhow of network (LC, RC, LCR) synthesis.

CO6: Learn to analyze frequency response of the circuits using Bode plot.

CO7: Intuition and insight required for circuit analysis and network synthesis.

CO8: Develop thinking style, aptitude and problem solving skill required to deal with practical circuit and system using mathematical tools and physical concepts.

CO9: Get the confidence of solving critical problems on network analysis and synthesis.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/05 **Network Analysis and Synthesis**	CO1	3	3	3	3	3	2	1	3	3	2	1	3
	CO2	3	3	3	3	3	2	1	3	3	2	1	3
	CO3	3	3	3	3	3	2	1	3	3	2	1	3
	CO4	3	3	2	3	3	2	1	3	3	2	1	3
	CO5	3	3	3	3	3	2	1	3	3	2	1	3
	CO6	3	3	3	3	3	2	1	3	3	2	1	3
	CO7	3	3	3	3	3	2	1	3	3	2	1	3
	CO8	3	3	3	3	3	2	1	3	3	2	1	3
	CO9	3	3	3	3	3	2	1	3	3	2	1	3

ELSC/T/06
Materials Science and Technology

1. a) Thermal properties of materials: Quantisation of lattice vibrations, phonons, overview of lattice heat capacity. Heat capacity of glasses and amorphous solids

b) Mechanical properties like plastic deformation, Brittle fracture.

2. Energy bands in crystals: Electron in a periodic field of a crystal. Brillouin zones, Wigner Seitz cells, Translation vectors and Reciprocal lattice, Free electron bands, Band structure of some important metals and semiconductors. Density of states, Effective mass.

3. Electrical properties of materials: Electrical conduction in metals and alloys. Conductivity, classical] electron theory and quantum mechanical considerations. Experimental results and interpretation, Thermoelectric phenomena.

4. Semiconductors:

a) Electrical Conduction: Fermi Levels, Dominant relaxation process in different materials and at different temperatures. Low field transport coefficient, Hall effect, Magnetoresistance, Recombination process, transport in strong electric and magnetic fields

b) Formation of two dimensional electron gas. Subband energy and density of states. Relevant relaxation processes. Transport in inversion layers and quantum well heterostructures, Energy band in superlattices and their transport coefficients.

c) Heavily doped materials, Alloy, Amorphous and organic semiconductors, quantized

Hall Effect.

d) Purification (zone melting, zone refining etc), Crystal growth (Czochralski, LPE, CVD, MOCVD), Doping characterization (measurement of resistivity, carrier concentrations, mobility, lifetime etc.)

5. Electrical conduction in polymers,ceramics and amorphous Materials: Conductors, polymers and organic metals. Ionic conduction, Mechanism of conduction in superionic conductors,Conduction in Metal oxides, Amorphous materials, metallic glasses, xerography.

6. Optical properties of materials: Optical constants, Atomic theory of the optical properties. Absorption of light by interband transitions. Optical spectra of materials, pure metals, alloys, semiconductors, dielectric materials and glass fibers.

7. Magnetic properties of materials: Overview of the dia, para and ferromagnetism, Antiferromagnetism, Ferrimagnetism, Applications of soft magnetic materials, Hard magnetic materials, Magnetic recording, Magnétic memories.

8. Superconductivity: Occurrence, destruction by magnetic fields Meissner effect, Heat capacity, Energy gap, Microwave and Infrared properties, Superconducting transitions, Coherence length, Flux quantization in Superconducting ring, Josephson Superconductor, Tunneling, Typical superconductors, High Tc superconductivity.

Reference Books:

1. Electronic Properties of Materials : R. E. Hummel
2. Electronic processes in materials : L. V. Azaroff and J. J. Brophy
3. Electronic properties of crystalline solids : R. H. Bube
4. Introduction to solid state physics : C. Kittel [Sixth Edition]
5. Theory of Electrical Transport in semiconductors : B. R. Nag

Course Outcomes

CO1: To know about the optical properties of different types of solids (for example Metal, Dielectrics, Semiconductors etc).

CO2. To understand how to use a photo- conductor for advanced solid state Experiment.

CO3. To know about the Magnetic properties of solids to have an idea what type of solids are applicable for different experiments.

CO4. To understand the superconducting materials, Josephson's effect and Josephson's tunnelling.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

ELSC/T/06 Materials Science and Technology	CO1												
	CO2												
	CO3												
	CO4												

ELSC/T/07
Microprocessors and Microcontroller

1. Digital computers, Store program computers, computer languages, Microprocessors and - Microcomputers, Microcomputer Applications.

2. Microprocessor architecture and its operations. Data transfer between memory, Input/ Output 8088/86 microprocessor architecture overview. Instruction sets, timings and status.

3. Assembly language programming for one specific processor (say8088): Arithmetic and logical processing. Time delay loop procedures, Data tables, Macro—modular programming, Hardware and software integration.

4, Memory, Types of memory, ROM, SRAM and DRAM, Access time and wait states. Interfacing memory modules, Memory management units.

5. Basic interfacing concepts, D/A and A/D converters, Memory mapped and I/O mapped interfacing, Serial and parallel data transfer. Different interfacing techniques, Interrupts — Software and hardware, Interrupt service routines.

6. 8255A programmable ~ peripheral interface $259 programmable interrupt controller, 8251A USART.

7. Current loop interface, RS—232 serial interface standard, JEEE—488 standard, Error detection and correction.

8. Instrument control packages.

Reference Books:

1. Microprocessor architecture, programming and application with 8085/8080A: R.S. Gaonkar

2. The 8086/8088 Family: Design,

Programming and interfacing: J. Ullenbeck

3. Microprocessors and interfacing, Programming and Hardware : D.V.Hall

4. Text book on microprocessor based Laboratory experiments and projects: A.K.Mukhopadhyay

Course Outcomes

CO1: learn about the general building blocks of microprocessors to execute stored program and evolution of microprocessors in different generation.

CO2: learn about the registers and memory addressing techniques of 8085, 8086 and 8088 microprocessor.

CO3: learn the instruction set of mentioned microprocessors set and apply to write assembly language program for 8085, 8086 and 8088 microprocessors using macros and procedures.

CO4: develop the concept of hardware and software compatibility in interfacing I/O devices and be able to design, test and implement the codes.

CO5: be able to develop and implement program optimization process and real time programming.***CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)***

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/07 Microprocessors and Microcontroller	**CO1**												
	CO2												
	CO3												
	CO4												
	CO5												

ELSC/T/08
Quantum Electronics

1. The Einstein Coefficients and Light Amplification: The Einstein Coefficients. Stimulated emission, lasing conditions, population inversion, Accurate solution for the two-level system. Line broadening mechanisms, Saturation behavior of homogeneouslyand inhomogeneously broadened transitions
Interaction of Radiations Field with Matter: Overview of quantization of electromagnetic field. The coherent states, Transition rates

2. Rate Equations: The three level system. The four level system. Variation of laser power around threshold. Optimum output coupling. Laser spiking

3. Optical Resonators: Overview of the cavity modes, resonator types, polarization of the cavity medium, quality factor, ultimate line width of Laser, Stability of resonators, Transverse and Longitudinal mode selection. Q switching, mode locking in Lasers.

4. Properties of Laser Beams and Types of Lasers: Coherence properties, Temporal coherence, Spatial Coherence, Directionality, Ammonia Maser, Ruby laser, Helium —

Neon laser, Four level solid state laser, carbon-dioxide laser, Dye lasers, Semiconductor lasers.

5, Application of Lasers: Spatial frequency Filtering, Holography,Laser—Induced Fusion, Application of lasers in machining, drilling,cutting, Surgery

Reference Books:

1. Lasers - Theory and Application : K. Thyagarajan and A. K. Ghatak

2. Introduction to Laser Physics : B. A. Lengyel

3. Lasers and nonlinear optics: B. B. Laud

4. An introduction to laser and Maser: A. E, Siegman

5. Essentials of Lasers: L. Allen

6. Quantum Electronics: A. Yariv

Course Outcomes

CO1:Understand the basic principles of LASERs.

CO2:Explore the interaction of radiation field with matter

CO3:Discuss about properties LASER beams and various types of LASERs

CO4: Explore the applications of LASERs

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/08 Quantum Electronics	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/L/03

Materials and Devices Lab

1. To Measure the variation of resistivity of a semiconductor with temperature and hence to find the band gap.

2. Measurement of different transport characteristics of common semiconductors.

3. Determination of the Hall coefficient for a semiconductor sample.

4. Capacitance-voltage (C-V) characteristics of the junction capacitance and determination of various parameters.

5. Switching characteristics of a Pi n junction using a storage Oscilloscope.

6. Study of Dielectric constant and Curie Temperature of Ferroelectric Ceramics.

7. Temperature dependence of the order ‘parameters in a liquid crystal.

8. Study of the Fréedericksz transitioninduced by an electric field.

9. B-H loops of Ferrite samples.

10. Resistivity of Ionic conductors.

Course Outcomes

CO1:Understanddifferent transport characteristics of common semiconductors

CO2:To measure the band gap and Hall coefficient of a semiconductor

CO3:To understand different semiconductor junction parameters and switching characteristics of PIN junction

CO4: To explore different parameters of ferroelectric ceramics and ferrites

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/08 Quantum Electronics	CO1	3	3	2	3	2	2	2	2	2	2	1	2
	CO2	3	3	2	2	2	2	1	1	2	2	1	2
	CO3	3	3	3	3	3	2	1	2	2	2	1	1
	CO4	3	3	2	3	2	2	1	1	2	2	1	1

ELSC/L/04
Experiments on Microprocessors Lab

1. Simple programming, assembling and their execution.

2. Use of procedures and macros.

3. Program using software and hardware interrupts.

4. Timing of instructions and real time programming.

5. Programming of 8255 (PPI). 8251A (USART) and 8259A (PIC)including real time programming.

6. Interfacing with ADC and DAC over RS 232C and/or GPIB, for data acquisition and instrument control.

7. Writing drivers for printers, mouse screen control etc.

ELSC/T/09
Electronic Circuits II

l. **Counter Timer:** Introduction to counter timers, high speed and precision type comparators, programmable timer counter IC XR 2240, astable multivibrator, XR 2240 monostable multivibrator, timer Counter applications, IC Function Generator, problems on counter timer.

2. Analog Multiplier: Gilbert Cell multiplier, block diagram and working principle of analog multiplier ICs, Applications: Multiplication, Squaring, frequency doubling, phase angle detector, divider, square root extractor, amplitude modulation, demodulation, frequency shifting, problems on analog multiplier.

3. Phase Looked Loop (PLL): Block diagram, voltage controlled oscillator (VCO), phase angle detector (analog and digital), operating principles, capture and tracking, PLL ICs, Application: frequency multiplier, frequency synthesizer, frequency shift keying demodulator, problems on PLL.

4. **Combinational logic circuit:** Problems on combinational logic circuit, encoder, decoder, MUX, DEMUX ICs and their cascading, MUX and Decoder as logic function generator.

5. Synchronous Counters: Synthesis of truncated counters, MOD-N counters with initial rest state and $N_1 - N_2$ counter, arbitrary count sequence generator, pulse train generator (all with examples and problems).

6. Sequential Circuit: State table, state diagram, Mealy and Moore model, state assignment, state reduction, equivalence of Mealy and Moore model, excitation table, excitation equation of FFs, problems on sequential circuit: synthesis of sequential circuit from state diagram, state table, obtaining state diagram and sate table from circuit diagram.

7. **Programmable Logic Devices**: RAM, ROM, PROM, EPROM, EEPROM, PLA. memory IC chips, charged coupled devices (CCD).

8. DAC and ADC: A/D signal conversion, quantization, sampling, weighted resistor, R-2R ladder type D/A convertors, S/H circuit, interconnection of S/H circuit and A/D converter, block diagram and working of ramp type, dual slope type, SAR type, flash type A/D converter, microprocessor compatibility, problems on DAC and ADC.

9. PSPICE and its applications.

Reference Books:

1. Operational Amplifiers and Linear Integrated Circuits: Robert F. Coughlin and Frederick F. Driscoll
2. Opamps and Linear Integrated Circuits: R. A. Gayakwad
3. Design With Operational Amplifiers and Analog Integrated Circuits: Sergio Franco
4. Phaselock Techniques: Floyd M. Gardner
5. Electronic Principles : A. P. Malvino
6. Digital Computer Electronics : A. P. Malvino
7. Digital Fundamentals: Thomas L. Floyd
8. Digital Circuits, Volume I & II: D. Ray Chaudhuri
9. Fundamentals of Digital Electronics: Anand Kumar
10. Digital Designee: Mano
11. Modern Electronic Instrumentation and Measurement Techniques: A. D. Helfrick and W. D. Cooper
12. SPICE for circuits and electronics using PSPICE: Md. H. Rashid

Course Outcomes

CO1: Learn about working principle of programmable timer counter IC XR 2240 and its application as astable multivibrator, monostable multivibrator, IC Function Generator through problem solving.

CO2: Understand and be able to explain the different techniques of multiplying two analog voltages. Learn about use of analog multiplier ICs and solving problems on circuits designed by using analog multiplier ICs.

CO3: Knowledge on the concept of phase locked loop, locking amplifiers and frequency multiplier using PLL.

CO4: Acquire the skill of solving critical problems on combinational logic circuit as preparation of NET GATE examination. Learn to use MUX and Decoder as logic function generator.

CO5: Knowledge about designing different types of synchronous counters and acquire the skill of solving critical problems on counter circuit.

CO6: Learn the knowhow of designing sequential circuits from its state table, state diagram and description and techniques to extract state table and state diagram from circuits and vice versa.

CO7: Learn electrical and analog electronic circuit simulation using PSPICE.

CO 8: Building the confidence of facing the piratical challenges of electronic instrumentation.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/09 Electronic Circuits II	CO1	3	3	2	2	3	1	1	3	3	2	1	3
	CO2	3	3	2	2	3	1	1	3	3	2	1	3
	CO3	3	3	2	2	3	1	1	3	3	2	1	3
	CO4	3	3	3	3	3	1	1	3	3	2	1	3
	CO5	3	3	3	3	3	1	1	3	3	2	1	3
	CO6	3	3	3	3	3	1	1	3	3	2	1	3
	CO7	2	2	2	2	2	1	1	3	3	2	1	2
	CO8	3	3	3	3	3	1	1	3	3	2	1	3

ELSC/T/10
Physics of Semiconductor Devices II and Optoelectronics

Physics of Semiconductor Devices II

1.**Tunnel devices:** Basic idea of tunneling phenomena, non-degenerate and degenerate semiconductor, band structure of degenerate semiconductor; band structure, I–V characteristic and principle of operation, tunneling probability, I–V relationship, microwave performance: equivalent circuit, cutoff frequency, self-resonance frequency, series and parallel loading, Backward diode, MIS Tunnel Diode, MIS switch diode, MIM Tunnel diode, Tunneling emitter bipolar transistor.

2. Gunn Diode**:** Transferred Electron effect Bulk negative resistance, Gunn effect, transferred electron mechanism, RWH theory, modes High field domain, Gunn oscillation mode, LSA mode, stable amplification mode, device performance.

3. Avalanche Transit-time Devices: Physical description, structure, working of IMPATT, TRAPATT and BARITT diodes.

4. Quantum Well Devices and Nano Electronics: Traditional Low dimensional structures, semiconductor Microstructures and super lattices, Materials for nano electronics. Electron transport in low— dimensional structures. Resonant tunneling diode, quantum well Laser, Detector, Modulator and switch. Single electron transfer
Devices, potential effect transistors

Reference Books:

1. Physics of Semiconductor Devices : S. M. Sze

2. Physics of Semiconductor Devices : M. Shur

3.Fundamentals of Solid State Electronics : Chin—Trans Sah

4. Physics of Quantum well Devices : B. R. Nag

5. Introduction to Nan electronics: V.V. Mitin, V.A. Kochelap & M. A. Stroscio

6. Physics of Low-dimensional Semiconductors : John H. Davies

Optoelectronics

1. Electromagnetic analysis of the simplest optical wave guide:Classification of modes for a planar waveguide, TE and TM modes of a symmetric step index planar waveguide, power associated with a mode, Radiation modes, Excitation of guide modes.

2. Leaky modes in optical waveguide: Quasi modes in a planar structure, Leakage of Power from the core, matrix method for determining the propagation characteristics of planar structures,Bending loss.

3. Optical fibre waveguides: Optical fibre, numerical aperture,pulse dispersion, Multimode fibres with optimum profilés, First and second generation fibre optic communication systems. Single mode fibres, Cables, Splices and connectors, Splice loss.

4. Integrated optics : Modes in an asymmetric planar waveguide,Ray analysis of planar waveguides; WKB analysis of inhomogeneous planar waveguides, strip waveguides, Guided wave devices phase modulator, Mach-Zehnder interferometer modulator and switch optical directions coupler, bulk and integrated optical modulators.

5. Electro Optic Effect: Electro optic effect in KDP crystals, phase modulation, amplitude modulation, Electro optic effect in lithium niobate and lithium tantalate crystals modulator design.

6. Acoustic Optic Effect: Raman Nath and Bragg's regimes of diffraction, Small Bragg angle diffraction, Large Bragg angle diffraction, application to periodic media.

7. Acousto-Optic Device: Acousto-optic modulation, Bragg modulator, Acousto-optic deflectors.

8. Unguided optical communication system: Transmission parameters, Sources Detectors, Examples of unguided optical communication system.

Reference Books:

1. Optical Electronics : A. Ghatak and K. Thyagrajan

2. Optical Electronics : A. Yariv

3. An introduction to optical Waveguides : M. J. Adams

4. Integrated Optics : T. Tamir

5. An Introduction to Electro—optic Device : I. P. Kaminow

6. Optoelectronics and Fiber Optics Communications : C.K. Sarkar and D.C. Sarkar

Course Outcomes

CO1: To understand the working principle of semiconductor devices like Gunn diode, Tunnel diode.

CO2: To understand the quantum well devices. Electron transport in low— dimensional structures. Resonant tunneling diode, quantum well Laser, Detector, Modulator and switch. Single electron transfer.

CO3: To know about the optical fiber wave guides, single mode and multimode optical fibers, different mode propagation through optical fibers.

CO4: To know about electro optic and acoustic optic device and optical modulators, switches, directional couplers etc.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/10 Physics of Semiconductor Devices II and Optoelectronics	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/T/11
Microwave Electronics

1. Basic ideas of microwave frequencies, devices and systems.

2. Plane electromagnetic wave propagation in metallic film coating on plastic substrate. Microwave attenuation and light transmittance.

3. Microwave Cavities and - Gotnienents: Rectangular cavity resonator, circular Cavity resonator, Q-factor of a cavity resonator, Microwave hybrid circuits, S-matrix, wave guide tees. Magic Tees, Directional couplers.

4. Microwave Ferrite Device: Ferrite and its properties. Circulators,Gyrators, Isolators, Switches, Filters

5. Microwave Generation and Amplification: Unsuitability of Conventional tubes,

Microwave linear beam tubes (O-type),Klystron, Multicavity Klystron—Amplifiers, Reflext+ Klystron, Helix Travelling wave tubes.

6. Microwave crossed-field tubes (M type): Magnetron oscillator, Forward-wave crossed-field amplifier. Backward wave crossed field amplifier.

7 Microwave Strip Lines: Microstrip lines, Parallel strip lines, Coplanar strip lines, Shielded Strip lines.

8. Microwave Measurements: Detection. of microwave signal, Measurement of (i) Power (ii) Attenuation (ii) VSWR(iv) Impedance (v) Frequency (vi) Phase, (vii) Cavity OQ (vill) Noise factor

9. Application of Microwaves: (i) In communication (ii) In industry and (iii) Based on dielectric heating.

Reference Books:

1. Microwave devices and circuits : S. Y. Liao

2. Introduction to microwave theory : H.A. Atwater

3. Microwave Engineering : Monojit Mitra

Course Outcomes

CO1: To have basic idea about microwave frequencies, devices and systems

CO2: To know the basics of plane electromagnetic wave propagation in different media, attenuation and transmittance

CO3: To know about microwave cavities, hybrid circuits, waveguide tees and directional couplers.

CO4: To know ferrite materials and its properties and have some idea about different ferrite devices like circulators, gyrators, isolators, switches and filters

CO5: To know about microwave crossed-filled tubes and microwave strip lines

CO6: To know how to detect microwave signal and how to measure power, attenuation, VSWR, impedance, frequency, phase and noise factor

CO7: Finally, to know about the application of microwave in communication, in industry and in devices based on dielectric heating.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/11	CO1	3	2	2	2	3	3	3	2	1	1	1	2
	CO2	3	2	2	2	3	2	2	2	1	1	1	2
	CO3	3	2	2	1	2	2	2	1	1	1	1	1

Microwave Electronics	**CO4**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**2**
	CO5	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**2**
	CO6	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**1**	**2**
	CO7	3	2	2	2	3	3	2	2	1	1	2	2

ELSC/T/12
Integrated Circuits and Technology

1. Voltage and current controlled voltage and 'current sources, Negative impedance converter, Gyrator, circulator, Emitter follower, complementary emitter follower, complementary emitter followers, electronic current limiters, LernBie pairs, outputbuffering open—collector gate.

2 Internal circuit blocks of IC 555 timer, 741 op- amp, IC 7400.

3. Level of integration, standard product IC, User programmable IC, ASIC, microcircuit design, device layout and packaging.

4. Crystal purification and growth, zone refining, Czohariacki process, Float zone process, Epitaxial growth, LPE, VPE, MBE, MOCVD, Wafer preparation.

5. Atomic diffusion, Ion implantation, deposited vaslides, thermal: oxides, Nitride films, Lithographic technologies, Masks, positive and negative photoresists, Electron beam lithography, fabrication process, simulation modeling of fabrication process.

6. Interconnection, contacts, metallization, surface passivation, circuit quality, performance and reliability.

7. Microelectronic bipolar device, Microelectronic field effect devices, CCD, SOS and MOS integrated circuits, Microelectronic devices including transducers, sensors, delay lines, filters and amplifiers, acoustic devices.

8. Software packages for fabrication, device layout.

Reference Books:

1. Integrated circuit design and technology : M. J. Morat

2. Introduction to semiconductor microtechnology: D. V. Morgan & K. Board

3. Analysis and design of analog integrated circuits : P. R. Gray and R. G Meyer

4. VLS design techniques for analog and digital circuits : R. L.Geiger, P. E Allen & N. R. Strader.

CO1: To understand the internal circuit blocks of IC 555, 741 Op Amp and IC 7400: level of integration, standard product IC

CO2. To gain knowledge about Micro Circuit design, device layout and packaging

CO3. To know about crystal purification and growth process, zone refining, float zone processes, epitaxial growth, LPE, VPE, MOCVD, wafer preparation.

CO4. To understand about atomic diffusion, ion implantation, lithographic technologies, electron beam lithographic process

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/12 Integrated Circuits and Technology	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/L/05
Microwave and Optoelectronics Lab

l. a) Microwave measurements : Measurement of (i) Power (ii) Frequency and Wavelength (iii) Impedance (iv) SWR (v) Attenuation.

b)Experiment on EMI and EMO, Interference compatibility.

2. Illumination characteristics of LED and LDR.

3. Experiments with photoconductor, measurement of pain and response time.

4. Experiments with Solar Call: V-I characteristics under illuminated and dark conditions and measurement of various parameters.

5. Experiments with Laser: (i) Alignment bf Laser (ii) Setting up of a beam expander (iii) Acquaintance of Laser safely criterion

6. Study of the beam parameters of a Laser: (i) Power distribution(ii) Spot size (iii) Coherence length (iv) divergence angle(v) Mode

7. Experiments with optical fibres: Measurements. of (i)Parameter of an optical fibres (ii) Absorption characteristics(iii) Efficiency of transmission (To be done with experimentalkit)

8. Experiments of coherent optics.

Course Outcomes

CO1: To draw the current voltage relationship of LED, Photodetectors.

CO2: To estimate the numerical aperture of optical fibers.

CO3: To draw the electrical and optical characteristics of a Solar cell and estimation of Fill Factor and Power conversion efficiency of the solar cell.

CO4: To verify the characteristics of a Gunn diode.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
ELSC/L/05 Microwave and Optoelectronics Lab	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/L/06
IC Lab

1. Circuits using OP AMP: (i) Active filters (ii) Voltage regulator (iii) Comparator (iv) Multivibrators (v) Triangular wave generator (vi) Oscillator.

2. Digital circuits : (i) Realisation of different logic gates,(ii) Seven segment display (iii) Encoder (iv) Decoder (v) adder and subtractor (vi) Experiment using IC 555 Timer (viii) Clock Pulse Generator (viii) Flip-Flops (ix) Counters with dual J-K Flip-Flops: (x) Monolithic decade counter (xi) Shift Register (xii) Memory.

3. Experiments on Device fabrication: (i) Operation of high vacuumcoating units (ii) MOS and Schottky diode fabrication(iii) Measurement of oxide thickness of MOS diode

4. Experiments on design of IC using IC CAD Packages SPLICE, VHDL etc.

Course Outcomes

CO1: Detailed study of Digital Synchronous and ripple counter with formation of clock pulse.

CO2: Study of different electronic circuits using operational amplifier.

CO3: To study and ability to construct regulated power supply.

CO4: To clear the understanding of Load and line regulation and to acquire the ability to check efficiency of a power supply.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
	CO1												

ELSC/L/06 **IC Lab**	**CO2**												
	CO3												
	CO4												

ELSC/T/13
Electronic Communication Systems

1. Amplitude Modulation: Frequency translation, Recovery of base band signal. Principle of modulation. Maximum allowable modulation. Spectrum of A. M. Signal, SSB, VSB modulation. BJI and FET modulator and mixer. Detection of A. M. SSB and VS signals. Balanced modulator circuit. Square law detector andenvelope detectors

2. Angle modulation: Phase and frequency modulation, Relationship between them. Spectrum of angle modulated signal (sinusoidal modulation), band width of angle modulated signal, effect of modulation index on band width. Narrow band and wide band F.M. generators. Parameter variation circuits, Armstrong modulator, F. M. demodulator circuits, discriminator and ratio detector, stereophonic F. M. broadcasting, Super heterodyne receiver and T.V. receiver

3. Pulse modulation: Introduction, Pulse Transmission, Pulse Amplitude: Modulation, Time division multiplexing, T.- Digital carrier system, CODECS, Comb Chip, Line encoding, T—Carriers, Framé Synchronization, Frequency Division Multiplexing.

4. Digital modulation: Digital transmission, advantage and disadvantages, sampling theorem, Time division multiplexing, quantization, pulse code modulation, delta modulation and adaptive delta modulation.

5. Digital Communication: Amplitude shift keying, Frequency shift Keying (FSK), Phase Shift keying (PSK), Differential phase shift keying, coherent and non-coherent detector of ASK, PSK and FSK signals, Data Communications.

6. Microwave Communication: Microwave System, Microwave transmitter and receiver, Microwave repeater, Diversity—frequency, space and polarization, protection switching. Microwave Radio stations — Microwave system gain, Free space path loss, Fade margin, Receiver threshold, Noise figure.

7. Satellite communication: E Review of orbital satellites,Geostationary satellites, Station keeping, Satellite Altitude, Transmission Path, Path Loss, Noise considerations, Satellite system.

8.Fibre Optic Communication: Fibre optic communication system basic system components, Photo Detectors, Connectors and Splices. coupling to and from the fibre, modulation, multiplexing and coding, repeaters, Bandwidth and rise time budgets, noise, bit error rate and eye pattern,

9. Advanced Communication System: Data switching, message and packet switching, network routing, flow control, access techniques, protocols and interfaces, terminal

equipment, typical networks, LAN, ISDN and ATM.

10. Fundamentals of Troposcatter Communication System: Basic theory of propagation in GHz range, handling of high power transmitter, dual and quadruple diversity, TED, multiplexing, base band, orderwire, use of Frequency modulation RF carrier. TROPO and L system and specialized subsystems and special controls usedin this type of communication network.

Reference Books:

1. Electronic Communications: D. Roody and J. Coolen

2. Principles of communication system: H. Taub and D. L. Schilling

3. Modern Digital & Analog Communication System: B. P. Lathi

4. Optical' Fibre Communication : G. Keise

5. Fibre Optics: E. Lacy

6. Communication Systems: A. B. Carlson

7. Communication Systems : S. Haykin

Course Outcomes

CO1: Clearly narrates the necessity and utility of Modulation and Demodulation.

CO2. Tells about the understanding about different techniques Digital Communications.

CO3. Detailed study of optical fiber communications.

CO4. Tells about the Satellite communication techniques with up and downlink channels.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/13 Electronic Communication Systems	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/T/14
Applied Electronics

Control theory and applications:Differential equations and transfer functions. State space models,Principles of feedback, Characteristics of closed loop systems,Performance and control system

Stability of linear system, Root locus method, Routh and Nyquist Criteria for stability, Frequency response, Nicol's chart,Compensation technique

Servo motors, Stepper motors

On-off, ratio, cascade and feed forward controllers, P, Pl, PD and PID controllers

Digital Control: Overview and simple use of PLO to control AC and DC drivers

Nonlinear systems:Phase plane method, stability in Lyapunoy's direct method

2. Instrumentation:Transducers and Sensors: Active and passive transducers,Resistive, Inductive and Capacitive transducers.Electromagnetic, Hall effect, Piezoelectric, Photovoltaic andThermoelectric transducers, Optical sensors, Optical fibre sensors, Efficiency, responsivity and resolution of sensors.
Instrumentation amplifier, A/D and D/A converters, Errors, Band width noise reduction, multiplexing, filtering data encoding,recording, decoding, and displaysStandards and Calibrations.

3. Power Electronics: Semiconductor power devices: Shockley diodes, BJT, SCRDIAC, DIAC, UJT, PUT, TRIACS, Field controlled Thyrister, GTO's and MOSFETs. Static characteristics and principle of operations, Triggering and communications, Application of these devices for voltage multiplier, regulated supplies chopper, inverter, cyclo converters for single phase and multiphase systems(wherever applicable), power loss, utilization factors, Voltage andcurrent harmonics.

Reference Books:

1. Control Systems: Naresh K. Singh

2. Process Control: PeterHarriot

3. Thyristors and their applications: Ramamoorthy

4. Principles of thyristorised converters : G. De

5. Power Electronics: H. C.Rai

Course Outcomes

CO1: To know about control theory and applications: Differential equations and transfer functions. State space models, Principles of feedback, Characteristics of closed loop systems, Performance and control system.

CO2: To know about stability of linear system, Root locus method, Routh and Nyquist Criteria for stability, Frequency response, Nicol's chart, Compensation technique, Servo motors, Stepper motors etc.

CO3: To understand different Transducers and Sensors: Active and passive transducers, Resistive, Inductive and Capacitive transducers. Electromagnetic, Hall effect, Piezoelectric, Photovoltaic and Thermoelectric transducers, Optical sensors, Optical fibre sensors, Efficiency, responsivity and resolution of sensors.

CO4: To know about Power Electronics: Semiconductor power devices: Shockley diodes, BJT, SCRDIAC, DIAC, UJT, PUT, TRIACS, Field controlled Thyrister, GTO's and MOSFETs.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/T/14 Applied Electronics	**CO1**												
	CO2												
	CO3												
	CO4												

ELSC/L/07
Communication Systems Lab

1. Experimental study of (i) Mixer (ii) LF Amplifier (iii) Demodulator

2. Generation and study of (i) Pulse Amplitude Modulation (PAM)(ii) Pulse code Modulation (PCM) = (iii) Pulse Position Modulation (PPM) Waves.

3. Experimental study on digital communication: (i) Frequency Shift Keying (FSK) (ii) Phase Shift key (PSK) (iii) Amplitude Shift Keying (ASK) (iv) Auto Correlation of P-N sequence (v)Phase Locked Loop (PLL) (vi) Adaptive Delta Demodulation

4. Experimental study of digital signaling.

Course Outcomes

CO1: a vivid picture of all types of Analog and Digital amplitude modulation and demodulation.

CO2. Pros and cons of digital communication over analog communication.

CO3. Digital to analog and analog to digital data transfer.

CO4. A clear understanding of communication techniques having high bandwidth, low noise and having directivity.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1												

ELSC/L/07 Communication Systems Lab	**CO2**												
	CO3												
	CO4												

ELSC/L/08
Applied Electronic Lab

1.a) Study of the operational characteristics of (i) UJT (ii) SCR (iii)DIAC (iv) TRIAC

b) Their uses in Electronic circuits.

c) Study of protective circuits in Power Electronics.

2. D. C. Motor Study: (i) Torque—Space characteristics (ii)Evaluation of inertia and friction parameters (iii) Back emf constant (iv) Mechanical time constant (v)Transform function of the Motor and the Generator.

3. D. C. Position Control : (i) Operation of the position control system for different values of the forward gain and angular position commands (ii) Step response studies for various values of forward gain (iii) Study of effect of velocity feedback on the transient and steady state performance of the system and its stability.

4. A. C. Position Control System: (i) Error detector characteristics— phase reversal (ii) Phase difference between control and reference winding (iii) Step response study.

5. D. C. Speed Control System: (i) Effect of loading on the speed of motor in the open loop (ii) Steady state error variation with forward gain (iii) System time constant vibration with forward~ gain. (iv) Effect of forward gain on disturbance rejection(v) Determination of the motor transfer function and tachometer characteristics.

6. Temperature Control System (i) Study of the ON-OFF temperature control with adjustable relay characteristics (ii) Study of P, P.I., P D and PID control having adjustable coefficients.

7 Study of Synchro Devices: (i) Stator Voltage as a function of the rotor angle (ii) Error Study of the transmitter receiver pair (iii) To develop D.C. error signal with appropriate polarity.

8.Relay Control System (i) Relay Characteristics and display ofthe same on CRO (ii) Effect of hysteresis on system stability(iii) Phase Panel analysis of relay control system for variousvalues of Hysteresis and Dead Zones.

9. Optical Transducer: Characteristics of (i) Filament lamp (ii)Photo voltaic cell (iii) Photo conductive cell (iv) Phototransistor (v) PIN photodiode (vi) Light Controlled Switching system.

10. Temperature Transducers: Characteristics of (i) IC-temperature sensor, (ii) NTC Thermistor (iii) NTC Bridge Circuit (iv) Platinum RTD (v) K-type thermocouple

(vi)Temperature Controlled Alarm System

11. Strain measurement using strain gauges and cantilever assembly (ii) Determination of linear range of operation of strain measurement. ,

12. With the help of a PLC trainer, study of (i) Tank level control(ii) Step sequence (iii) Creation of delays (iv) Stepper motor clockwise, anticlockwise directional control.

Course Outcomes

CO1: To understand experimentally the performance of PI and PID control system

CO2: To draw the current voltage characteristics of UJT, DIAC, TRIAC, SCR etc.

CO3: To study the Temperature Control System (i) Study of the ON-OFF temperature control with adjustable relay characteristics (ii) Study of P, P.I., P D and PID control having adjustable coefficients.

CO4: To study the of Synchro Devices: (i) Stator Voltage as a function of the rotor angle (ii) Error Study of the transmitter receiver pair (iii) To develop D.C. error signal with appropriate polarity.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ELSC/L/08 Applied Electronic Lab	**CO1**												
	CO2												
	CO3												
	CO4												

ElSC/P/01
Design Thesis

Syllabus of Elective Papers
Theory (Any One)
ELSC/ET/01

Electromagnetic Fields

1. Maxwell's equations, Displacement current, Vector and Scalar Potentials. Fresnel's relations for reflection and transmission coefficient, Poynting Theorem, Plane waves in dielectric and conducting medium

2. Transmission lines — Reflection coefficient and – transmission coefficient, Line impedance and .admittance; Smith Chart:Impendence matching; Standing Wave Ratio; Stubs and baluns, Co-axial cables, twin wire transmission line.

3. Wave Guides — Wave propagation in rectangular and circular waveguides, Wave guide modes, wave guide coupling, Power transmission and power losses, matching and attenuation, Impedance measurement; microwave grating, Excitation of modesin wave guides. Kraus & Carver

4. Antennas — Advanced and retarded' potentials; Radiation from elementary dipole; Field patterns; Radiation resistance and radiated power, antenna resistance, band-width; grounded antennas, effects of antenna heights, Linear antenna, antenna arrays, array of arrays.

5. Microwave antennas — Antennas with parabolic reflectors, horn antennas, lens antennas, wide band and special purpose antennas; Helical antennas, Disc antenna, Log-periodic antennas, Loop antennas, Practical Transmitting antennas, Behaviour of receiving antennas.

6. Radio Wave Propagation — Ground wave propagation, space waveand surface wave; wave tilt of surface wave, Tropospheric Wave.Sky wave propagation, ionospheric reflection and refraction,regular and irregular variation of ionosphere, attenuation factor ofionospheric propagation, Effects of earth's magnetic field onpropagation, Faraday rotation and other ionospheric phenomena

Plasma Electronics

1. Introduction to plasma, Debye shielding and different characteristic parameters of plasma. Motion of charged particles in constant and uniform electromagnetic fields, Diamagnetic behaviour of plasma, Magnetic mirror kinetic theory of plasmas,Propagation of e.m. waves in plasma under uniform electromapnetic fields, brief introduction to magneto hydrodynamic Waves and instabilities.
2. Fluid picture of plasma, Electron plasma wave, Electromagnetic waves and Ion-acoustic wave, idealMHD equations, Concept of frozen-in magnetic field lines.
3. Vacuum System: Rotary and diffusion pumps, Mcleod gauge, Pirani Gauge and other gauges.
4. Production of plasma: d.c. discharge and a.c. discharge, high power a.c. oscillators, Laser plasma production,
5. Plasma diagnostics: Electrodes for plasma diagnostics, Single and double probes, R. F.measurements, Microwave interferometric method, Collision frequency, ionization time and deionization time, Doppler shift method.

5. Applications of plasma:Brief discussion on magnetic and inertial confinements of fusion plasma, Tokamaks, Idea of plasma heating, laser fusion technology.

Reference Books:

1. Classical Electrodynamics: J. D. Jackson

2. Introduction to Electrodynamics: D. J. Griffiths

3. Telecommunications: W. Fraser

4. Principles of optics: M. Born and E. Wolf

5. Introduction to Plasma Physics: F.F. Chen

6. Plasma Diagnostics with Microwaves: M. A. Heald and C. B. Wharton

7. Plasma Physics : J.E. Drummond

8. Electronic Communication System: G. Kennedy and B. Davis

9. Networks, Lines and Fields. : J. Ryder.

10. Microwave devices & Ckts : S. Y Liao

Syllabus of Elective Papers
Practical (Any One)
ELSC/EL/01

Wireless and Smart Phone Based Instrumentation Lab

Syllabus will be available in the laboratory

Web design

Syllabus will be available in the laboratory

Industrial control

Syllabus will be available in the laboratory

Fault Diagnosis and Maintenance Lab

1. Tracing defective power supply, amplifier, oscillator, filter, digital circuits
2. Identification of the defects.
3. Repair of the defects.
4. Testing the repaired circuit.
5. Making a detailed report of the whole work performed.
6. Tracing the circuits of a defective instrument
7. Identification of the defects.
8. Repair of the defects.
9. Testing the repaired instrument.
10. Making a detailed report of the whole work performed.

CO1: Learning the methodology of fault diagnosis in the electronic circuit.
CO2: Learning to trace the fault and identify faulty elements circuits of defective instruments.
CO3: Develop the skill of repairing faulty instrument.
CO4: Not to discard any costly instrument if it is malfunctioning
CO4: Promote the culture of at least try to repair faulty/defective instruments and make them functional.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

ELSC/EL/01 Fault Diagnosis		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
	CO1	**1**	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**2**	**2**	**3**

and Maintenance Lab	**CO2**	**1**	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**2**	**2**	**3**
	CO3	**1**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**
	CO4	**1**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**