UNIVERSITY OF CALCUTTA

GURUPADA SAREN
SECRETARY
COUNCILS FOR UNDERGRADUATE STUDIES,
UNIVERSITY OF CALCUTTA.

SENATE HOUSE
Kolkata – 700 073.
Phone : 2241-0071-74,
2241-0077-78,2241-4989-90,
2241-2850-51,2241-2859
Fax : 91-033-2241-3222
E-mail :u.g.councilsc.u@gmail.com
Website :www.caluniv.ac.in

Ref.No : CUS/ 77 /18
Dated the 13th February, 2018

To
The Principals/T.I.C.
of all the Undergraduate Colleges
offering B.Sc. (Honours) in Electronics
affiliated to the University of Calcutta

Sir/Madam,

The undersigned is to inform you that the proposed **revised semesterised draft Syllabus for Electronics (Honours)** Courses of Studies under **CBCS has been uploaded in the Calcutta University website (www.caluniv.ac.in).**

The said syllabus has been prepared by the **U.G. Board of Studies in Electronics, C.U.**, suppose to be implemented from the academic session 2018-2019

You are requested kindly to go through it and send your feedback within 28th February, 2018.

In this regard you may send your observation/ suggestion to the **Department of U.G. Councils, C.U**. or through email (u.g.councilsc.u@gmail.com), and you also may contact **Prof. Anupam Karmakar,** Department of Electronics, C.U. through e-mail **(akelc@caluniv.ac.in / akarmakar@gmail.com).**

Your cooperation in this regard will be highly appreciated. Kindly treat the matter as urgent.

Thanking you,

Yours faithfully,

13/02/18

Secretary

UNIVERSITY OF CALCUTTA

DRAFT

CBCS SYLLABUS

F
O
R

THREE-YEAR B.Sc.
HONOURS
DEGREE COURSE OF STUDIES

ELECTRONICS

2018

Draft

CBCS Syllabus

for

Electronics (UG-Honours)

Course Structure
Details of Course under B.Sc. (Honours)

Course	*Credits Theory+Practical	Theory+Tutorial
I. Core Course Theory (14 Papers)	**14×4= 56**	
Core Course Practical/Tutorial* (14 Papers)	**14×2=28**	
II. Elective Course (8 Papers)		
A. Discipline Specific Elective Theory (4 Papers)	**4×4=16**	
Discipline Specific Elective Practical/Tutorial* (4 Papers)	**4×2=8**	
B. Generic Elective Theory (4 Papers)	**4×4=16**	**4×5=20**
Generic Elective Practical/Tutorial* (4 Papers)	**4×2=8**	**4×1=4**
III. Ability Enhancement Courses		
1. Ability Enhancement Compulsory Courses (AECC) (2 Papers of 2 credits each)	**2×2=4**	**2×2=4**
2. Skill Enhancement Courses (SEC) (2 Papers of 2 credits each)	**2×2=4**	**2×2=4**
Total Credit	**140**	**140**

*** Wherever there is a practical there will be no tutorial and vice-versa.**
**** Generic Elective Courses are Interdisciplinary (to be selected from any other Department/Discipline).**

Scheme for Choice Based Credit System in B.Sc. (Honours) Electronics

Year	Semester	Core Course (CC) (14)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective (DSE) (4)	Generic Elective (GE) (4)
1st Year	I	CC-1: Basic Circuit Theory and Network Analysis	AECC-1 Communicative English			GE-1
		CC-2: Mathematics Foundation for Electronics				
	II	CC-3: Applied Physics	AECC-2 Environmental Science			GE-2
		CC-4: C Programming and Data Structure				
2nd Year	III	CC-5: Semiconductor Device		SEC-1		GE-3
		CC-6: Electronic Circuits				
		CC-7: Electromagnetics				
	IV	CC-8: Operational Amplifiers and Applications		SEC-2		GE-4
		CC-9: Digital Electronics and VHDL				
		CC-10: Signals and Systems				
3rd Year	V	CC-11: Electronic Instrumentation			DSE-1	
		CC-12: Microprocessors and Microcontrollers			DSE-2	
	VI	CC-13: Communication Electronics			DSE-3	
		CC-14: Photonics			DSE-4	

SEMERTER WISE SCHEDULE FOR B.Sc. (HONOURS) ELECTRONICS					
Year	**Semester**	**Course Opted**	**Code**	**Course Name**	**Credits**
1st Year	I	Ability Enhancement Compulsory Course-1	AECC-1	Communicative English	2
		Core Course-1 Theory	ELSCCHT-1	Basic Circuit Theory and Network Analysis	4
		Core Course-1 Practical	ELSCCHP-1	Basic Circuit Theory and Network Analysis Lab	2
		Core Course-2 Theory	ELSCCHT-2	Mathematics Foundation for Electronics	4
		Core Course-2 Practical	ELSCCHP-2	Mathematics Foundation for Electronics Lab	2
		Generic Elective-1 Theory		GE-1	4/5
		Generic Elective-1 Practical/Tutorial		GE-1 Lab/Tutorial	2/1
	II	Ability Enhancement Compulsory Course-2	AECC-2	Environmental Science	2
		Core Course-3 Theory	ELSCCHT-3	Applied Physics	4
		Core Course-3 Practical	ELSCCHP-3	Applied Physics Lab	2
		Core Course-4 Theory	ELSCCHT-4	C Programming and Data Structure	4
		Core Course-4 Practical	ELSCCHP-4	C Programming and Data Structure Lab	2
		Generic Elective-2 Theory		GE-2	4/5
		Generic Elective-2 Practical/Tutorial		GE-2 Lab/Tutorial	2/1
2nd Year	III	Core Course-5 Theory	ELSCCHT-5	Semiconductor Device	4
		Core Course-5 Practical	ELSCCHP-5	Semiconductor Device Lab	2
		Core Course-6 Theory	ELSCCHT-6	Electronic Circuits	4
		Core Course-6 Practical	ELSCCHP-6	Electronic Circuits Lab	2
		Core Course-7 Theory	ELSCCHT-7	Electromagnetics	4
		Core Course-7 Practical	ELSCCHP-7	Electromagnetics Lab	2
		Skill Enhancement Course-1	ELSSECH-	SEC-1	2
		Generic Elective-3 Theory		GE-3	4/5
		Generic Elective-3 Practical/Tutorial		GE-3 Lab/Tutorial	2/1
	IV	Core Course-8 Theory	ELSCCHT-8	Operational Amplifiers and Applications	4
		Core Course-8 Practical	ELSCCHP-8	Operational Amplifiers and Applications Lab	2
		Core Course-9 Theory	ELSCCHT-9	Digital Electronics and VHDL	4
		Core Course-9 Practical	ELSCCHP-9	Digital Electronics and VHDL Lab	2
		Core Course-10 Theory	ELSCCHT-10	Signals and Systems	4
		Core Course-10 Practical	ELSCCHP-10	Signals and Systems Lab	2
		Skill Enhancement Course-2	ELSSECH-	SEC-2	2
		Generic Elective-4 Theory		GE-4	4/5
		Generic Elective-4 Practical/Tutorial		GE-4 Lab/Tutorial	2/1
3rd Year	V	Core Course-11 Theory	ELSCCHT-11	Electronic Instrumentation	4
		Core Course-11 Practical	ELSCCHP-11	Electronic Instrumentation	2
		Core Course-12 Theory	ELSCCHT-12	Microprocessors and Microcontrollers	4
		Core Course-12 Practical	ELSCCHP-12	Microprocessors and Microcontrollers Lab	2
		Discipline Specific Elective-1 Theory	ELSDSEHT-1	DSE-1	4
		Discipline Specific Elective-1 Practical	ELSDSEHP-1	DSE-1 Lab	2
		Discipline Specific Elective -2 Theory	ELSDSEHT-2	DSE-2	4
		Discipline Specific Elective-2 Practical	ELSDSEHP-2	DSE-2 Lab	2
	VI	Core Course-13 Theory	ELSCCHT-13	Communication Electronics	4
		Core Course-13 Practical	ELSCCHP-13	Communication Electronics Lab	2
		Core Course-14 Theory	ELSCCHT-14	Photonics	4
		Core Course -14 Practical	ELSCCHP-14	Photonics lab	2
		Discipline Specific Elective-3 Theory	ELSDSEHT-3	DSE-3	4
		Discipline Specific Elective-3 Practical	ELSDSEHP-3	DSE-3 Lab	2
		Discipline Specific Elective-4 Theory	ELSDSEHT-4	DSE-4	4
		Discipline Specific Elective-4 Practical	ELSDSEHP-4	DSE-4 Lab	2
				Total Credits	**140**

Core Course (CC): (Credits: 6 each) – CC 1-14

1. ELSCCH-1: Basic Circuit Theory and Network Analysis
2. ELSCCH-2: Mathematics Foundation for Electronics
3. ELSCCH-3: Applied Physics
4. ELSCCH-4: C Programming and Data Structures
5. ELSCCH-5: Semiconductor Devices
6. ELSCCH-6: Electronic Circuits
7. ELSCCH-7: Electromagnetics
8. ELSCCH-8: Operational Amplifiers and Applications
9. ELSCCH-9: Digital Electronics and VHDL
10. ELSCCH-10: Signals and Systems
11. ELSCCH-11: Electronic Instrumentation
12. ELSCCH-12: Microprocessors and Microcontrollers
13. ELSCCH-13: Communication Electronics
14. ELSCCH-14: Photonics

Discipline Specific Electives (DSE): (Credits: 6 each) – DSE 1-4
(4 papers to be selected)

1. ELSDSEH-1: Power Electronics
2. ELSDSEH-2: Numerical Techniqes
3. ELSDSEH-3: Modern Communication Systems
4. ELSDSEH-4: Semiconductor Fabrication and Characterization
5. ELSDSEH-5: Electrical Machines
6. ELSDSEH-6: Basic VLSI Design
7. ELSDSEH-7: Digital Signal Processing
8. ELSDSEH-8: Control Systems
9. ELSDSEH-9: Computer Networks
10. ELSDSEH-10: Nanoelectronics
11. ELSDSEH-11: Embedded Systems
12. ELSDSEH-12: Biomedical Instrumentation
13. ELSDSEH-13: Transmission Lines, Antenna and Microwave Devices

Ability Enhancement Compulsory Course (AECC) (Credits: 2 each) – AECC 1-2
1. AECC-1: Communicative English
2. AECC-2: Environmental Science

Skill Enhancement Course (SEC) (Credits: 2 each) – SEC 1-2
(2 papers to be selected)
1. ELSSECH-1: Design and Fabrication of Printed Circuit Boards
2. ELSSECH-2: Robotics
3. ELSSECH-3: Mobile Application Programming
4. ELSSECH-4: Internet and Java Programming
5. ELSSECH-5: Programming with Matlab/SciLab
6. ELSSECH-6: Networking and Mobile Communications
7. ELSSECH-7: Circuit Modeling using PSPICE

Generic Elective (GE) (Credits: 6 each) from other Department/Discipline – GE 1-4
(4 papers to be selected)
Any other discipline of Choice

Generic Elective (GE) (Credits: 6 each) for other Departments/Disciplines: (Credits: 6 each)

1. ELSGEH-1: Network Analysis and Analog Electronics
2. ELSGEH-2: Linear and Digital Integrated Circuits
3. ELSGEH-3: Instrumentation
4. ELSGEH-4: Photonic Devices and Power Electronics
5. ELSGEH-5: Communication Systems
6. ELSGEH-6: Microprocessor and Microcontroller Systems

Core Course Syllabus

CC-1

ELSCCHT-1: Basic Circuit Theory and Network Analysis
[Credits: 4; Lecture Hours: 56]

Basic Circuit Concepts: Classification of circuit elements, Resistors- Fixed and variable resistors, Construction and characteristics, Color coding of resistors, resistors in series and parallel, Testing of resistance using multimeter. Inductors- Fixed and variable inductors, Self and mutual inductance, Energy stored in an inductor, Inductance in series and parallel, Testing of inductance using multimeter. Capacitors- Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, Capacitors in series and parallel, factors governing the value of capacitors, Testing of capacitors using multimeter.
Ideal and practical voltage and current sources, Dependent sources, Laws of conservation flux linkage and charge. [**10 Lectures]**

Circuit Analysis: Kirchhoff's current law (KCL), Kirchhoff's voltage law (KVL), Node analysis, Mesh analysis, Linear circuits, Principle of duality, Star-Delta conversion.
DC transient Analysis: Transient response of series RL, RC and RLC circuits under DC excitation.
[**14 Lectures]**

AC Circuit Analysis: Sinusoidal voltage and current, Definition of instantaneous, Peak, Peak to peak, Root mean square and Average values, Voltage-current relationship in resistor, inductor and capacitor, Phasor, Complex impedance, Sinusoidal circuit analysis for RL, RC, series and parallel RLC circuits, Power in AC circuits- Instantaneous power, average power, reactive power, power factor.
Resonance in series and parallel RLC circuits, Quality (Q) factor and Bandwidth, Passive filters- Low pass, High pass, Band pass and Band stop, Integrator and differentiator. [**16 Lectures]**

Network Theorems: Superposition theorem, Millman's theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Compensation theorem, Tellegen's theorem, Bisection theorem, Maximum power transfer theorem, AC circuit analysis using network theorems.
Two Port Networks: Impedance (Z), Admittance (Y) and Transmission (ABCD) parameters.
Network Graph Theory: Equivalent graph, incidence matrix, fundamental Tie-Set/cut-set. [**16 Lectures]**

ELSCCHP-1: Basic Circuit Theory and Network Analysis Lab
[Credits: 2]

Hardware and Circuit Simulation Software

1. Familiarization with:
   a) Resistance in series, parallel and series – Parallel.
   b) Capacitors and Inductors in series and Parallel.
   c) Multimeter – Checking of components.
   d) Voltage sources in series, parallel and series – parallel.
   e) Voltage and Current dividers.
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Law.
4. Verification of Norton's theorem.
5. Verification of Thevenin's Theorem.
6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. RC Circuits: Time Constant, Differentiator, Integrator.
9. Designing of a Low Pass RC Filter and study of its Frequency Response.
10. Designing of a High Pass RC Filter and study of its Frequency Response.
11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

CC-2

ELSCCHT-2: Mathematics Foundation for Electronics
[Credits: 4; Lecture Hours: 56]

Ordinary Differential Equation: First order ordinary differential equations, Basic concepts, Separable ordinary differential equations, Exact ordinary differential equations, Linear ordinary differential equations, Second order homogeneous and non-homogeneous differential equations.
Series Solution of Differential Equations and Special Functions: Power series method, Legendre polynomials, Frobenius method, Bessel's equations and Bessel's functions of first and second kind, Error functions and gamma function. [**14 Lectures]**

Matrices: Introduction to Matrices, System of linear algebraic equations, Gaussian elimination method, Gauss-Seidel method, LU decomposition, Solution of linear system by LU decomposition, Eigenvalues and eigenvectors, Linear transformation, Properties of eigenvalues and eigenvectors, Cayley-Hamilton theorem, Diagonalization, Powers of a matrix, Real and complex matrices, Symmetric, Skew Symmetric, Orthogonal quadratic form, Hermitian, Skew Hermitian, Unitary matrices. [**10 Lectures]**

Sequences and Series: Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for convergence, Cauchy's integral test, D'Alembert's ratio test, Cauchy's nth root test, Alternating series, Leibnitz's theorem, Absolute convergence and conditional convergence, Power series. **[10 Lectures]**

Complex Variables and Functions: Complex Variable, Complex Function, Continuity, Differentiability, Analyticity, Cauchy-Riemann (C-R) equations, Harmonic and Conjugate harmonic functions, Exponential function, Trigonometric function, Hyperbolic function, Line integral in complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivative of analytic functions, Sequences, Series and Power series, Taylor's Series, Laurent Series, Zeroes and Poles, Residue integration method, Residue integration of real integrals. **[12 Lectures]**

Laplace Ttransform: Properties of Laplace transform, Laplace transform of different signals, inverse Laplace transform, application in circuit analysis - Equivalent circuit of inductor, capacitor in s-domain.
[10 Lectures]

ELSCCHP-2: Mathematics Foundation for Electronic Lab
[Credits: 02]

Scilab/MATLAB/Any Other Mathematical Simulation Software

1. Solution of First Order Differential Equations.
2. Solution of Second Order homogeneous Differential Equations.
3. Solution of Second Order non-homogeneous Differential Equations.
4. Convergence of a given series.
5. Divergence of a given series.
6. Solution of linear system of equations using Gauss Elimination method.
7. Solution of linear system of equations using Gauss – Seidel method.
8. Solution of linear system of equations using L-U decomposition method.

CC-3

ELSCCHT-3: Applied Physics
[Credits: 04; Lecture Hours: 56]

Physics of Crystalline Solids: Crystalline Materials- Crystal structure in solids, Concept of lattice and basis, Crystal axes and planes, Primitive and unit cells, Packing fraction for simple, body-centered and face-centered cubic lattices, Calculation of interplaner spacing for cubic lattice, Miller indices, Concept of reciprocal lattice, Bragg's equation in direct and reciprocal lattice (no derivation). Bonding in Solids- Basic ideas of Metallic bonds, Ionic bonds, Covalent bonds, Vander Waal's bonds. **[8 Lectures]**

Quantum Mechanics: Inadequacies of classical physics (in relevance to electron diffraction experiment), Compton's effect, Photo-electric effect, Blackbody radiation, Wien's law, Raleigh Jeans law, Plank's law, Introduction to wave particle duality, de Broglie's hypothesis, Heisenberg's uncertainty principle, Probability density and Born interpretation, Basic postulates and formalism of quantum mechanics, Wavefunctions, Operators in quantum mechanics, Eigenstates, Eigenvalues and Eigenfunctions, Schrodinger wave equation, Qualitative discussion of phenomenon of tunnelling, Particle in a one-dimensional box, Extension to a three-dimensional box, Potential barrier problems (free electron, electron in an infinite well), Kronig-Penney model and development of band structure, E-k diagram in solids, Classification of conductors, insulators and semi-conductors. **[16 Lectures]**

Mechanical Properties of Materials: Concept of elastic and plastic deformations, Hooke's law, Elastic Moduli, Brittle and Ductile materials, Tensile strength.
Thermal Properties: Specific heat in solids, Phonons, Heat capacity, Debye's law, Basic concept of thermoelectricity, Laws of Thermodynamics, Concept of entropy, Thermodynamic potentials, Helmholtz free energy, Enthalpy function, Gibb's free energy, Chemical potential, Relation of chemical potential with Fermi level. **[10 Lectures]**

Statistical Mechanics: Macroscopic and Microscopic States, Concept of phase space and density of states, Statistical interpretation of entropy, Quantization of phase space, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution functions and their importance. **[10 Lectures]**

Electric Properties: Metals (Conductors)- Basic concept of free electron theory, Conductivity of metals, Ohm's law, Relaxation time, Collision time and mean free path, Electron scattering and Resistivity of metals, Heat developed in current carrying conductor, Concept of Superconductivity.
Insulators- Dielectric properties, Concepts of Polarization, Permittivity and Dielectric constant.
Semiconductors- Bonding in elemental and compound semiconductors, Intrinsic and Extrinsic semiconductor, Concept of holes, Computation of carrier concentrations, Fermi level in semiconductors, E-k diagrams to explain direct and indirect bandgap semiconductors.
Magnetic Properties: Classification of Magnetic materials, Magnetic moment, Dia, Para, Ferro and Antiferro magnetism, Ferrimagnetic materials, Saturation magnetisation, Curie temperature. **[12 Lectures]**

ELSCCHP-3: Applied Physics Lab
[Credits: 02]

1. To determine Young's modulus of a wire/beam.
2. To determine modulus of rigidity of a wire by Maxwell's needle.
3. To determine elastic constants of a wire by Searle's method.
4. To measure the resistivity of a Si crystal with temperature by four- probe method from room temperature to 200 ^{O}C).
5. To determine the value of Boltzmann Constant by studying forward characteristics of diode.
6. To determine the value of Planck's constant by using LEDs of different wavelengths.
7. Simulation Studies.
    a) Find lowest Energy Eigen values for1-D Schrodinger equation.
    b) Plotting tunneling probability as a function of barrier width.
    c) Plot Energy Band-diagram corresponding to different potential profile.

CC-4

ELSCCHT-4: C Programming and Data Structures
[Credits: 04; Lecture Hours: 56]

C Programming Language: Introduction, Importance of C, Character set, Tokens, keywords, identifier,constants, basic data types, variables: declaration & assigning values. Structure of C program, Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays- Concepts, Declaration, Accessing elements, Storing elements, Two-dimensional and Multi-dimensional arrays, Input output statement and library functions (math and string related functions). **[12 Lectures]**

Decision Making, Branching and Looping: Decision making, branching & looping: Decision making, branching and looping- if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions- Defining functions, Function arguments and passing, Returning values from functions.
Structures: Defining and declaring a structure variables, Accessing structure members, Initializing a structure, Copying and comparing structure variables, Array of structures, Arrays within structures, Structures within structures, Structures and functions, Pointers.
Introduction to C++: Object oriented programming, Characteristics of an object oriented language.
[16 Lectures]

Data Structures: Definition of stack, Array implementation of stack, Conversion of infix expression to prefix and postfix expressions, Evaluation of postfix expression, Definition of Queue, Circular queues, Array implementation of queues, Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list. **[14 Lectures]**

Searching and Sorting: Insertion sort, Selection sort, Bubble sort, Merge sort, Linear Search, Binary search. Trees- Introduction to trees, Binary search tree, Insertion and searching in a BST, Preorder, Postorder and Inorder traversal (recursive). **[14 Lectures]**

ELSCCHP-4: C Programming and Data Structures Lab
[Credits: 02]

The list of programs given below is indicative only. Students should do programs which make use of the different programming techniques and data structures.

1. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series.
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.
4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non -zero coefficients A, B and C. Else report error.
6. Calculate the value of sin(x) and cos(x) using the series. Also print sin(x) and cos(x) value using library function.
7. Generate and print prime numbers up to an integer N.
8. Sort given N numbers in ascending order.
9. Find the sum and difference of two matrices of order M×N and P×Q.
10. Find the product of two matrices of order M×N and P×Q.
11. Find the transpose of given M×N matrix.
12. Find the sum of principle and secondary diagonal elements of the given M×N matrix.
13. Calculate the subject wise and student wise totals and store them as a part of the structure.
14. Maintain an account of a customer using classes.
15. Implement linear and circular linked lists using single and double pointers.
16. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list
17. Create circular linked list having information about a college and perform Insertion at front, Deletion at end.
18. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
19. Implement polynomial addition and subtraction using linked lists.
20. Implement sparse matrices using arrays and linked lists.
21. Create a Binary Tree to perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
22. Implement binary search tree using linked lists. Compare its time complexity over that of linear search.
23. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

CC-5

ELSCCHT-5: Semiconductor Devices
[Credits: 04; Lecture Hours: 56]

Semiconductor Basics: Introduction to semiconductor material, Elemental and Compound semiconductors, Direct and Indirect bandgap semiconductors, Intrinsic and Extrinsic semiconductors, Carriers in semiconductors. Concept of effective mass, Density of states, Carrier concentration at normal equilibrium in intrinsic semiconductors, Dependence of Fermi level on temperature and doping concentration, Temperature dependence of carrier concentrations, Charge neutrality condition, Degenerate and non-degenerate semiconductors.
Carrier Transport Phenomena: Carrier drift, Mobility, Resistivity, Hall effect, Diffusion process, Einstein relation, Current density equation, Carrier injection, Generation and Recombination processes, Continuity equation. **[13 Lectures]**

Physics of Junctions: Homojunction and Heterojunction- Metal-metal contact, Metal-semiconductor contact (both ohmic and Schottky junction).
Semiconductor-Semiconductor Homojunction- Formation of depletion layer / space charge region at the junction, Variation of depletion width in presence and absence of field, Built-in electric field and potential, Derivation of electrostatic potential difference at thermal equilibrium, Junction capacitance (depletion and diffusion), Junction breakdown mechanism, Concept of abrupt and linearly graded junctions.
PN Junction Diode: Current-voltage characteristics, DC and AC equivalent circuit (Eber's-Moll equation and Charge balance equation).
Application of Junction Properties: Varactor diode, Solar cell, Zener diode. **[13 Lectures]**

Bipolar Junction Transistors (BJT): Basic transistor action, BJT as a current control device, Energy band diagram of transistor in thermal equilibrium, Quantitative analysis of static characteristics (minority carrier distribution and terminal currents), Base-width modulation, Modes of operation, Input and Output characteristics of CB, CE and CC configurations. **[12 Lectures]**

Field Effect Transistors: Transverse field effect and channel isolation, Categories of FETs.
JFET: Construction, Channel formation, Pinch-off and Saturation voltage, Current-voltage output characteristics.
MOSFET: MOS capacitor, Channel formation, Threshold voltage (ideal and real), Current-voltage relation, Depletion and Enhancement type MOSFET, Complimentary MOS (CMOS). [**12 Lectures]**

Power Devices:
UJT, Construction, Working principle, Equivalent circuit, Intrinsic standoff ratio, Characteristics, Relaxation oscillator, Basic working principle and characteristics of SCR, Diac and Triac. **[6 Lectures]**

ELSCCHP-5: Semiconductor Devices Lab
[Credits: 02]

Hardware and Circuit Simulation Software

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the Common Emitter Configuration of BJT and obtain r_i, r_o, β.
3. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o, α.
4. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, r_i, r_o.
5. Study of the I-V Characteristics of the UJT.
6. Study of the I-V Characteristics of the SCR.
7. Study of the I-V Characteristics of JFET.
8. Study of the I-V Characteristics of MOSFET.
9. Study of Characteristics of Solar Cell.
10. Study of Hall effect/measurement of temperature sensitivity of carrier concentration.

CC-6

ELSCCHT-6: Electronic Circuits
[Credits: 04; Lecture Hours: 56]

Diode Circuits: Piece-wise linear characteristics of diode, DC load line analysis, Quiescent (Q) point, Clipping and clamping circuits. Rectifiers- Half-wave rectifier, Full-wave rectifier (center tapped and bridge), PIV, Ripple factor, Efficiency, Filters- Types, Circuit diagram and explanation of shunt capacitor filter with waveforms, Zener diode regulator- Circuit diagram, Explanation for load and line regulation. [**14 Lectures]**

Bipolar Junction Transistor Circuits: Review of CE, CB Characteristics and regions of operation. Hybrid parameters, r_e model, Transistor biasing, DC load line, Operating point, Thermal runaway, Stability and stability factor, Fixed bias with and without emitter resistor, Collector to base bias, Voltage divider bias and Emitter bias, Transistor as a switch- circuit and working, Darlington pair and its applications. BJT amplifier- Voltage and Power amplifier, DC and AC load line analysis, Hybrid model of CE configuration, Quantitative study of frequency response of CE amplifier, Effect on gain and bandwidth for cascaded RC coupled CE amplifier.
[**14 Lectures]**

Feedback Amplifiers: Concept of feedback, Negative and positive feedback, Types of feedback circuits, advantages and disadvantages of negative feedback, Voltage (series and shunt) and Current (series and shunt) feedback amplifiers, Effect of negative feedback on Gain, Input and Output impedances, Bandwidth and Distortion, Barkhausen criteria, Phase shift oscillator, Colpitts oscillator, Hartley oscillator.
Regulated power supply- Series and shunt (using BJT). [**14 Lectures**]

MOSFET Circuits: Review of depletion and enhancement MOSFET, Biasing of MOSFETs, Small signal parameters, Common source amplifier circuit analysis, CMOS circuits.
Power Amplifiers: Difference between voltage and power amplifier, Classification of power amplifiers, Class A, Class B, Class C, Class AB and their comparisons, Operation of Class A single ended power amplifier, Operation of transformer coupled Class A power amplifier, Efficiency, Operation of complementary symmetry Class B push pull power amplifier, Crossover distortion, Heat sinks.
Single Tuned Amplifiers: Circuit diagram, Working and frequency response, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits. [**14 Lectures]**

ELSCCHP-6: Electronic Circuits Lab
[Credits: 02]

Hardware and Circuit Simulation Software

1. Study of the Half-wave rectifier and Full-wave (Center-tap and Bridge) rectifier.
2. Study of power supply using C filter and Zener diode.
3. Designing and testing of 5V/9V DC regulated power supply and find its load regulation.
4. Study of clipping and clamping circuits.
5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
6. Designing of a Single Stage CE amplifier.
7. Study of Class A, B and C Power Amplifier.
8. Study of the Colpitt's Oscillator.
9. Study of the Hartley's Oscillator.
10. Study of the Phase Shift Oscillator
11. Study of the frequency response of Common Source FET amplifier.

CC-7

ELSCCHT-7: Electromagnetics
[Credits: 04; Lecture Hours: 56]

Vector Analysis, Poisson's Equation and Laplace Equation: Vector Analysis: Scalars and Vectors, Unit vector and vector components, Vector field, Vector Algebra, Rectangular (Cartesian) coordinate, Curvilinear coordinates: Unit vectors and scalar factors, Cylindrical coordinate and Spherical coordinate, Differential length, area and volume, Line, Surface and Volume integrals, Del operator, Gradient of a scalar, Divergence of a vector and Divergence theorem, Curl of a vector and Stokes's theorem, Green's theorem, Laplacian of a scalar. **[8 Lectures]**

Electrostatics: Coulomb's law, Electric field and Electric potential due to discrete and continuous charge distributions, Electric flux density, Gauss's law – Maxwell's equation and applications, Electric dipole, Electric Fields in different materials, Current and Current density, Polarization, Dielectric Constant, Linear and Nonlinear, Homogeneous and Inhomogeneous, Isotropic and Anisotropic Dielectrics, Boundary conditions, Poisson's and Laplace's equations and their derivations and examples of solutions, Uniqueness Theorem, Capacitance and Capacitors, Method of images, Electrostatic energy and Forces, Energy density. **[12 Lectures]**

Magnetostatics: Biot Savart's law and applications, Magnetic dipole, Ampere's Circuital law – Maxwell's equation and applications, Magnetic flux and Magnetic flux density – Maxwell's equation, Scalar and Vector magnetic potentials. Magnetization in materials and permeability, Anisotropic materials, Magnetic boundary conditions, Inductors and Inductances, Mutual and Self inductance, Magnetic circuits, Magnetic Energy, Forces, Torque and Moment. **[11 Lectures]**

Time-Varying Fields and Maxwell's Equations: Faraday's law of electromagnetic induction – Maxwell's equation, Stationary circuit in time-varying magnetic field, Transformer and Motional EMF, Displacement current, Maxwell's Equations in differential and integral form and constitutive relations, Potential functions, Lorentz gauge and wave equation for potentials, Concept of Retarded potentials, Electromagnetic boundary conditions. **[11 Lectures]**

Electromagnetic Wave Propagation: Time-Harmonic electromagnetic fields, Electromagnetic spectrum, Wave equation in a source free isotropic homogeneous media, Uniform plane waves in lossless and lossy unbounded homogeneous media, Uniform plane waves in good dielectrics and conductor, Skin effect, Wave polarization, Reflection and transmission of plane waves at normal and oblique incidence, Snell's law, Fresnel's equation, Brewster's angle, Wave propagation in dispersive media, Normal and Anomalous dispersion, Concept of phase and group velocity, Electromagnetic power and Poynting vector and Poynting theorem.
Radio Wave Propagation- Modes of propagation, ionosphere refractive index, MUF, critical frequency, virtual height, Skip distance, ducting. **[14 Lectures]**

ELSCCHP-7: Electromagnetics Lab
[Credits: 02]

Scilab/Any Other Similar Freeware

1. Understanding and Plotting Vectors.
2. Transformation of vectors into various coordinate systems.
3. 2D and 3D Graphical plotting with change of view and rotation.
4. Representation of the Gradient of a scalar field, Divergence and Curl of Vector Fields.
5. Plots of Electric field and Electric Potential due to charge distributions.
6. Plots of Magnetic Flux Density due to current carrying wire.
7. Programs and Contour Plots to illustrate Method of Images.
8. Solutions of Poisson and Laplace Equations - Contour plots of charge and potential distributions
9. Introduction to Computational Electromagnetics - Simple Boundary Value Problems by Finite Difference/Finite Element Methods.

CC-8

ELSCCHT-8: Operational Amplifiers and Applications
[Credits: 04; Lecture Hours: 56]

Basic Operational Amplifier: Concept of differential amplifiers (Dual input and balanced and unbalanced output), Constant current bias, Current mirror, Cascaded differential amplifier stages with concept of level transistor, Ideal Op-Amp and its characteristics, Block diagram of Op-Amp (IC 741), Deviations for a real Op-Amp from ideal behavior.
Op-Amp Parameters: Input offset voltage, Input offset current, Input bias current, Differential input resistance, Input capacitance, Offset voltage adjustment range, Input voltage range, Common mode rejection ratio, Slew rate, Supply voltage rejection ratio. **[12 Lectures]**

Op-Amp Circuits and Applications: Open and closed loop configuration, Frequency response, Inverting, Non-inverting, Summing and Difference amplifiers, Integrator, Differentiator, Multiplier and Divider, Voltage to current and Current to voltage convertor, Instrumentation amplifier.
Comparators: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger.
Signal Generators: Concept of sinusoidal and relaxation type, Phase shift oscillator, Wien bridge oscillator, Square wave generator, Triangle wave generator, Saw tooth wave generator, Voltage controlled oscillator (IC 566). **[18 Lectures]**

Timers Circuits Multivibrators (IC 555)- Functional block diagram, Astable and monostable multivibrator circuits and applications, Phase locked loops (PLL)- Block diagram, Phase detectors, IC565, Voltage controlled oscillator (IC 566).
Fixed and Variable IC Regulators: IC 78xx and IC 79xx (concepts only), IC LM317- output voltage equation, SMPS- Principle of DC-to-DC conversion, Block diagram representation of SMPS module. **[12 Lectures]**

Signal Conditioning Circuits: Sample and hold systems, Active filters- Butterworth filter, First and second order low pass and high pass filters, Band pass filter, Band reject filter, All pass filter, Log and Antilog amplifiers. **[14 Lectures]**

ELSCCHP-8: Operational Amplifiers and Applications Lab
[Credits: 02]

Hardware and Circuit Simulation Software

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op- amp.
3. Designing of analog adder and sub-tractor circuit.
4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Designing of a Wien Bridge Oscillator using op-amp.
10. Study of IC 555 as Astable Multivibrator.
11. Study of IC 555 as Monostable Multivibrator.
12. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series.

CC-9

ELSCCHT-9: Digital Electronics and VHDL
[Credits: 04; Lecture Hours: 56]

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, Base conversions and arithmetic (addition, subtraction by complement method, multiplication), Representation of signed and unsigned numbers, Binary Coded Decimal (BCD) code.
Logic Gates and Boolean Algebra: Basic postulates and fundamental theorems of Boolean algebra, Switching equivalent circuits of Basic gates, Truth tables and symbolic representation of OR, AND, NOT, NAND, NOR XOR, XNOR gates, Universal logic gates, Circuit representation using Universal logic gates.
Digital Logic Families: Fan-in, Fan-out, Noise immunity, Noise margin, Power dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison. [**14 Lectures]**

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Multiplexers and Demultiplexers, Encoder and Decoder, Implementation of logic functions with multiplexer, Binary adder and subtractor, parallel adder/subtractor, Comparator, Parity checker. [**14 Lectures]**
Sequential Logic Design: Latches and Flip flops, Registers, Counters (Ripples, Ring, Johnson, Synchronous, Asynchronous and Modulo-N), State table, State diagrams, Counter design using excitation table and equations.
Programmable Logic Devices: Basic concepts- ROM, PLA, PAL, CPLD, FPGA.
Memory: Memory technology, Types of memory, Volatile and Non-volatile, ROM, PROM, EPROM, EEPROM, Flash memory, SRAM, DRAM, SDRAM, Concept of Primary, Secondary and Cache memory [**14 Lectures]**

VHDL Programming:
Introduction to VHDL: Brief history of HDL, Structure of HDL module, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL Modules, Delays, Data flow style, Behavioral style, Structural style, Mixed design style, Simulating design. Introduction to Language elements, Keywords, Identifiers, White space characters, Comments, Format, VHDL terms, Hardware in VHDL, Entity, Architectures, Concurrent signal assignment, Event scheduling, Statement concurrency, Structural designs, Sequential behavior, Process statements, Process declarative region, Process statement region, Process execution, Sequential statements, Architecture selection, Configuration statements, Power of configuration.
Behavioral Modeling: Introduction to behavioral modeling, Inertial delay and model, Transport delay and model, Inertial vs transport delay, Simulation delta drivers, Driver creation, Generics, Block statements, Guarded blocks.
Sequential Processing: Process statement, sensitivity list, Signal assignment vs Variable assignment, Sequential statements, IF, CASE, LOOP, NEXT, EXIT and ASSERT statements, Assertion BNF, WAIT ON signal, WAIT UNTIL expression, WAIT FOR time expression, Multiple wait conditions, WAIT time-Out, Sensitivity List vs WAIT statement concurrent assignment, Passive processes.
Data Types: Object types-signal, Variable, Constant, Data types - Scalar types, Composite types, Incomplete types, File type caveats, Subtypes, Subprograms and functions. [**14 Lectures]**

ELSCCHP-9: Digital Electronics and VHDL Lab
[Credits: 02]

Hardware

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design Half and Full Adder.
4. Design Half and Full Sub-tractor.
5. Design seven segment display driver.
6. Design 4 × 1 Multiplexer using gates.
7. To build Flip- Flop Circuits (RS, Clocked RS, D-type) using elementary gates.
8. Design counters (Ring, Ripple, Johnson and Mod-N) using D/T/JK Flip-Flop.
9. Design shift register and study serial and parallel shifting of data.

Experiments in VHDL

1. Write code to realize basic and derived logic gates.
2. Half Adder and Full Adder using basic and derived gates.
3. Half Subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4×1, 8×1) and Demultiplexer using logic gates.
6. Decoder (2×4, 3×8), Encoders and Priority Encoders.
7. Design and simulation of 4-bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 2-bit Magnitude comparator.
10. 3-bit Ripple counter.

CC-10

ELSCCHT-10: Signals and Systems
[Credits: 04; Lecture Hours: 56]

Signals and Systems: Continuous and discrete time signals, Digital signal, Types of signals (Deterministic and Nondeterministic, Periodic and Aperiodic, Symmetric and Antisymmetric, Energ and Power, Causal, Noncausal and Anticausal, Single and Multiple valued signals), Signals in time, spatial and frequency domain, Transformation of the independent variable, Exponential and Sinusoidal signals, Impulse and Unit step functions, Continuous and Discrete time systems and their classifications, Basic system properties.
[12 Lectures]

Linear Time Invariant Systems (LTI): Discrete and Continuous time LTI systems, Properties of LTI systems, Convolution, Commutative, Distributive, Associative, LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response, Differential and Difference equation formulation, Block diagram representation of first order systems. **[14 Lectures]**

Fourier Series: Fourier series representation of periodic signals, Continuous time periodic signals, Convergence of the Fourier series, Properties of continuous time Fourier series, Discrete time periodic signals, Properties of discrete time Fourier series, Frequency-Selective filters.
Fourier Transform: Aperiodic signals, Periodic signals, Properties of continuous time Fourier transform, Convolution and Multiplication properties, Properties of Fourier transform and basic Fourier transform Pairs.
[16 Lectures]

Z-Transform: Introduction to Z-Transform, Region of Convergence, Properties of Z-Transforms, Inverse Z-Transforms, Relation with Laplace and Fourier transforms, Condition of stability, Application of Z-Transforms.
[14 Lectures]

ELSCCHP-10: Signals and Systems Lab
[Credits: 02]

Scilab/MATLAB/Any Other Mathematical Simulation Software

1. Generation of continuous time signals.
2. Generation of discrete time signals.
3. Time shifting and time scaling of signals.
4. Convolution of Signals.
5. Solution of Difference equations.
6. Fourier series representation of continuous time signals.
7. Fourier transform of continuous time signals.
8. Laplace transform of continuous time signals.
9. Introduction to Xcos/similar function and calculation of output of systems represented by block diagrams.

CC-11

ELSCCHT-11: Electronic Instrumentation
[Credits: 04; Lecture Hours: 56]

Qualities of Measurement: Specifications of instruments and their static and dynamic characteristics, Error (Gross error, Systematic error, Absolute error and Relative error) and uncertainty analysis, Statistical analysis of data and curve fitting.
Basic Measurement Instruments: PMMC instrument, Galvanometer, DC measurement- Ammeter, Voltmeter, Ohm meter, AC measurement, Digital voltmeter (integrating and nonintegrating types) system, Digital multimeter, Digital frequency meter system.
Connectors and Probes: Low capacitance probes, High voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc. **[14 Lectures]**

Measurement of Resistance and Impedance: Low resistance by Kelvin's double bridge method, Medium resistance by voltmeter ammeter method and Wheatstone bridge method, High resistance by Megger A.C. bridges, Measurement of self inductance, Maxwell's bridge, Hay's bridge and Anderson's bridge, Measurement of capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge.
A-D and D-A Conversion: Circuit and working of 4 bit binary weighted resistor type and R-2R ladder type D-A conversion, Circuit of A-D conversion characteristics, Successive approximation ADC. (Mention of relevant ICs for all). **[14 Lectures]**

Oscilloscope: CRT, Waveform display and electrostatic focusing, Time base and sweep synchronization, Measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Block diagram, working principle, advantages and applications of Dual trace oscilloscope, Sampling oscilloscope, Digital storage oscilloscope and Powerscope, CRO specifications (bandwidth, sensitivity, rise time).
Signal Generators: Audio oscillator, Pulse generator, Function generators. **[14 Lectures]**

Transducers and Sensors: Classification of transducers, Basic requirement/characteristics of transducers, Active and Passive transducers, Resistive (Potentiometer, Strain gauge- Theory, types, temperature compensation and applications), Capacitive (Variable area, Variable air gap and Permittivity types), Inductive (LVDT) and Piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational), Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, Thermistor, Thermocouple, Semiconductor IC sensors), Light transducers (Photoresistors, Photovoltaic cells, Photodiodes). **[14 Lectures]**

ELSCCHP-11: Electronic Instrumentation Lab
[Credits: 02]

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de'Sautys.
4. Measure of low resistance by Kelvin's double bridge.
5. Design and implementation of Instrumentation Amplifier using 741 op-amp.
6. To determine the Characteristics of resistance transducer- Strain Gauge (Measurement of Strain using half and full bridge).
7. To determine the Characteristics of LVDT.
8. To determine the Characteristics of Thermistors and RTD.
9. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
10. To study the Characteristics of LDR, Photodiode, and Phototransistor:
    a) Variable Illumination.
    b) Linear Displacement.
11. Design and Implementation of Temperature Controller.

CC-12

ELSCCHT-12: Microprocessors and Microcontrollers

[Credits: 04; Lecture Hours: 56]

Introduction to Microprocessors: Introduction, Applications, Basic block diagram, Speed, Word size, Memory capacity, Classification of microprocessors (mention of different microprocessors being used)

Microprocessor 8085: Features, Architecture- Block diagram, General purpose registers, Register pairs, Flags, Special purpose resisters- Stack pointer, Program counter, Types of buses, Multiplexed address bus and data bus, Generation of control signals, Pin description of microprocessor 8085, Basic interfacing concepts, Memory mapped I/O and I/O mapped I/O, Partial/Full memory decoding, DMA.

8085 Instructions: Operation code, Operand and Mnemonics, Instruction set of 8085, Instruction classification, Addressing modes, Instruction format, Instruction classifications- Data transfer instructions, Arithmetic instructions, Increment and Decrement instructions, Logical instructions, Branch instructions and Machine control instructions, Assembly language programming examples, Stack operations, Subroutine, Call and return instructions, Delay loops, Use of counters, Timing diagrams-Instruction cycle, Machine cycle, T-states, Time delay, Interrupt structure of 8085 microprocessor, Processing of vectored and non-vectored interrupts, Latency time and response time, Handling multiple interrupts, Interfacing with Programmable Peripheral Interface (PPI) chip 8255, Interfacing with Analog to Digital converter (ADC) chip 0808. **[28 Lectures]**

Introduction to Microcontrollers: Introduction, Different types of microcontrollers, Embedded microcontrollers, Processor architectures, Harvard vs. Princeton, CISC vs. RISC architectures, Microcontroller memory types, Microcontroller features, Clocking, I/O pins, Interrupts, Timers, Peripherals.

PIC16F887 Microcontroller: Core features, Architecture, Pin diagram, Memory organization- Program and Data memory organization, I/O Ports, Oscillator module, Timer modules (Timer 0, Timer 1 and Timer 2), Comparator module, Analog-to-Digital converter (ADC) module, Data EEPROM, Enhanced Capture/Compare/PWM (CCP) module, EUSART, Master synchronous serial port (MSSP) module, Special features of CPU, Interrupts, Addressing modes, Instruction set.

Interfacing to PIC16F887: Interfacing of LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 16×2 LCD display, 4×4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor, Corresponding interfacing programs using C language. **[28 Lectures]**

ELSCCHP-12: Microprocessors and Microcontrollers Lab
[Credits: 02]

Assembly Language Programming

1. Program to transfer a block of data.
2. Program for multibyte addition.
3. Program for multibyte subtraction.
4. Program to multiply two 8 bit numbers.
5. Program to divide a 16 bit number by 8 bit number.
6. Program to search a given number in a given list.
7. Program to generate terms of Fibonacci series.
8. Program to find minimum and maximum among N numbers.
9. Program to find the square root of an integer.
10. Program to find GCD of two numbers.
11. Program to sort numbers in ascending/descending order.
12. Program to verify the truth table of logic gates.

PIC Microcontroller Programming

1. LED blinking with a delay of 1 second.
2. Solid State Relay Interface.
3. Interfacing of LCD (2×16).
4. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control.
5. To test all the gates of a given IC74XX is good or bad.
6. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface.
7. Display of 4-digit decimal number using the multiplexed 7-segment display interface.
8. Analog to digital conversion using internal ADC and display the result on LCD.
9. Implementation of DC Voltmeter (0-5V) using internal ADC and LCD.
10. Digital to analog conversion using PWM (pulse delay to be implemented using timers).
11. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
12. Interfacing of matrix keyboard (4×4).
13. Serial communication between microcontroller and PC.

CC-13

ELSCCHT-13: Communication Electronics
[Credits: 04; Lecture Hours: 56]

Electronic Communication: Block diagram of an electronic communication system, Electromagnetic spectrum-band designations and applications, Need for modulation, Concept of channels and base-band signals, Concept of Noise, Types of Noise, Signal to noise ratio, Noise figure, Noise temperature, Friis transmission equation. **[14 Lectures]**

Amplitude Modulation: Amplitude modulation, Modulation index and frequency spectrum, Generation of AM (Linear and Non Linear Methods), Amplitude demodulation (diode detector), Concept of double side band suppressed carrier (DSBC), Single side band suppressed carrier (SSBC) (Chopper, Balanced modulation), Pilot carrier amplitude modulation, Vestigial side band (VSB) modulation, Independent side band modulation, Block diagram of AM Transmitter and Receiver (Super heterodyne receiver- advantages over TRF, utility of heterodyning, different stages). **[14 Lectures]**

Angle Modulation: Frequency and Phase modulation, Modulation index and frequency spectrum, Equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (PLL), Block diagram of FM Transmitter and Receiver, Comparison between AM, FM and PM. **[10 Lectures]**

Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, PPM modulation and detection techniques, Multiplexing, TDM and FDM. **[5 Lectures]**

Pulse Code Modulation: Need for digital transmission, Quantizing, Uniform and non-uniform quantization, Quantization noise, Companding, Coding, Decoding, Regeneration. **[5 Lectures]**

Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit rate, Baud rate and M-array coding, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK). **[8 Lectures]**

ELSCCHP-13: Communication Electronics Lab
[Credits: 02]

Hardware and Circuit Simulation Software

1. Study of Amplitude Modulation.
2. Study of Amplitude Demodulation.
3. Study of Frequency Modulation.
4. Study of Frequency Demodulation.
5. Study of Pulse Amplitude Modulation.
6. AM Transmitter/Receiver.
7. FM Transmitter/Receiver.
8. Study of TDM, FDM.
9. Study of Pulse Width Modulation.
10. Study of Pulse Position Modulation.
11. Study of Pulse Code Modulation.
12. Study of Amplitude Shift Keying.
13. Study of Phase Shift Keying.
14. Study of Frequency Shift Keying.

CC-14

ELSCCHT-14: Photonics
[Credits: 04; Lecture Hours: 56]

Light as Electromagnetic Wave: Plane waves in homogeneous media, Concept of spherical waves, Reflection and transmission at an interface, total internal reflection, Brewster's law, Stoke's law, Interaction of electromagnetic waves with dielectrics, Origin of refractive index, Dispersion.
Interference: Superposition of waves of same frequency, Concept of coherence, Interference using division of wavefront and division of amplitude, Young's double slit, Thin film interference, Anti-reflecting films, Newton's rings, Michelson interferometer, Holography.
Diffraction: Huygen's principle, Diffraction integral, Fresnel and Fraunhoffer approximations. Fraunhoffer diffraction by single slit, Rectangular aperture, Double slit, Rayleigh criterion of limit of resolution, Resolving power of microscopes and telescopes, Diffraction grating, Resolving power and Dispersive power.
[14 Lectures]

Polarization: Linear, Circular and Elliptical polarization, Polarizer-analyzer and Malus' law, Double refraction by crystals, Interference of polarized light, Wave propagation in uniaxial media, Half wave and quarter wave plates, Faraday rotation and electro-optic effect. **[12 Lectures]**

Light Emitting Diodes: Construction, Materials, Operation, Concept of quantum efficiency.
Lasers: Interaction of radiation and matter, Einstein coefficients, Condition for amplification, Laser cavity, Threshold for laser oscillation, Line shape function, Examples of common lasers, Semiconductor injection laser diode. **[8 Lectures]**

Photodetectors: Bolometer, Photomultiplier tube, Charge coupled device, Photo transistors and Photodiodes (p-i-n, avalanche), Quantum efficiency and responsivity.
LCD Displays: Types of liquid crystals, Principle of Liquid Crystal Displays, Applications, Advantages over LED displays. **[10 Lectures]**

Guided Waves and Optical Fiber: TE and TM modes in symmetric slab waveguides, Effective refractive index, Field distributions, Dispersion relation and Group velocity, Step index optical fiber, Total internal reflection, Concept of linearly polarized waves in step index circular dielectric waveguides, Single mode and Multimode fibers, Attenuation and Dispersion in optical fiber, Basic idea of OEIC (Optoelectronic Communication system). **[12 Lectures]**

ELSCCHP-14: Photonics Lab
[Credits: 02]

1. To verify the law of Malus for plane polarized light.
2. To determine wavelength of sodium light using Michelson's Interferometer.
3. To determine wavelength of sodium light using Newton's Rings.
4. To determine the resolving power and Dispersive power of Diffraction Grating.
5. Diffraction experiments using a laser.
6. Study of Faraday rotation.
7. Study of Electro-optic Effect.
8. To determine the specific rotation of scan sugar using polarimeter.
9. To determine characteristics of LEDs and Photo- detector.
10. To measure the numerical aperture of an optical fiber.

Department Specific Elective (DSE) Syllabus

DSE-1

ELSDSEHT-1: Power Electronics
[Credits: 04; Lecture Hours: 56]

Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors.
Silicon Controlled Rectifier (SCR): Structure, Two transistor analogy, I-V characteristics, Turn-on and Turn-off characteristics, Ratings, Factors affecting the characteristics/ratings of SCR, Gate-triggering circuits, dv/dt triggering circuits, Control circuits design and Protection circuits, Snubber circuit. **[12 Lectures]**

Diac and Triac: Basic structure, Working and V-I characteristics, Application of Diac as triggering device for Triac.
Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V characteristics, Switching characteristics, Device limitations and safe operating area (SOA) etc.
Application of SCR: SCR as static switch, Phase controlled rectification, Single phase half wave, full wave and bridge rectifiers with inductive and non-inductive loads, AC voltage control using SCR and Triac as switch.
Power MOSFETs: Operation modes, Switching characteristics, Power BJT, Second breakdown, Saturation and quasi-saturation state. **[12 Lectures]**

Power Inverters: Need for commutating circuits and their various types, DC link inverters, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series inverter, Limitations and its improved versions, Bridge inverters.
Choppers: Basic chopper circuit, Types of choppers (Type A-D), Step-down and Step-up choppesr, Operation of DC chopper circuits using self-commutation (A and B-type commutating circuit), Cathode pulse turn-off chopper (using class D commutation), Load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper.
Regulators and Converters: Basics, Series, Shunt, Buck, Boost, Buck-boost, Cuk. **[18 Lectures]**

Electromechanical Machines: DC Motors, Basic understanding of field and armature, Principle of operation, EMF equation, Back EMF, Factors controlling motor speed, Thyristor based speed control of DC motors, AC motor (Induction Motor only), Rotor and Stator, Torque and speed of induction motor, Thyristor control of AC motors(block diagrams only). **[14 Lectures]**

ELSDSEHP-1: Power Electronics Lab
[Credits: 02]

1. Study of I-V characteristics of DIAC.
2. Study of I-V characteristics of a TRIAC.
3. Study of I-V characteristics of a SCR.
4. SCR as a half wave and full wave rectifiers with R and RL loads.
5. DC motor control using SCR**.**
6. DC motor control using TRIAC**.**
7. AC voltage controller using TRIAC with UJT triggering.
8. Study of parallel and bridge inverter.
9. Design of snubber circuit.
10. VI Characteristic of MOSFET and IGBT (Both).
11. Study of chopper circuits.

DSE-2

ELSDSEHT-2: Numerical Techniques
[Credits: 04; Lecture Hours: 56]

Numerical Methods: Floating point, Round-off error, Error propagation, Stability, Programming errors.
Solution of Transcendental and Polynomial Equations: Bisection method, Secant and Regula Falsi Methods, Newton Raphson method, Rate of convergence, General Iteration Methods, Newton's Method for Systems, Method for Complex Roots, Roots of Polynomial Equations. **[16 Lectures]**

Interpolation and Polynomial Approximations: Taylor Series and Calculation of Functions, Langrange interpolation, Newton divided difference interpolation (forward and backward difference formulae), Truncation errors.
Curve Fitting: Least square fitting, Curve fitting, Interpolation by Spline functions. **[12 Lectures]**

Numerical Integration: Trapezoidal Rule, Error bounds and estimate for the Trapezoidal rule, Simpson's Rule, Error of Simpson's rule.
Numerical Differentiation: Finite difference method and applications to electrostatic boundary value problems.
Numerical methods for first order differential equations: Euler-Cauchy method, Heun's method, Classical Runge Kutta method of fourth order, Methods for system and higher order equations. **[16 Lectures]**

Numerical Methods in Linear Algebra: Linear systems Ax=B, Gauss Elimination, Partial Pivoting, LU factorization, Doolittle's, Crout's and Cholesky's methods, Matrix Inversion, Gauss-Jordon, Iterative methods-Gauss-Seidel iteration, Jacobian iteration.
Matrix Eigenvalue: Power Method. **[12 Lectures]**

ELSDSEHP-2: Numerical Techniques Lab
[Credits: 02]

C Language/Scilab/MatLab/Any Other Mathematical Simulation Software

1. Program to implement Bisection Method.
2. Program to implement Secant Method.
3. Program to implement Regula falsi method.
4. Program to implement Newton Raphson Method.
5. Program to implement Trapezoidal rule.
6. Program to implement Simpson's rule.
7. Program to implement Runge Kutta Method.
8. Program to implement Euler-Cauchy Method.
9. Program to implement Gauss-Jordon Method.
10. Program to implement Gauss-Seidel Iteration.
11. Program to implement Newton forward/backward interpolation.
12. Program to implement Lagrange's interpolation.

DSE-3

ELSDSEHT-3: Modern Communication Systems
[Credits: 04; Lecture Hours: 56]

Advanced Digital Modulation Technique: DPCM, DM, ADM, Binary line coding technique, Multilevel coding, QAM (Modulation and Demodulation). **[12 Lectures]**

Optical Communication: Block diagram of optical communication system, Optical power budgeting. **[2 Lectures]**

Switching Systems: Basic overview of different electro-mechanical switching system,Digital Switching system (time and space division).

Traffic Engineering: Blocking network, Blocking probability, Grade of service, Traffic load, Erlang formula, Congestion control strategies. **[10 Lectures]**

Cellular Communication: Concept of cellular mobile communication- Cell and cell splitting, Frequency bands used in cellular communication, Absolute RF channel numbers (ARFCN), Frequency reuse, Roaming and Hand off, Authentication of the SIM card of the subscribers, IMEI number, Concept of data encryption, Architecture (Block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, Simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts. Concept of WLL. **[17 Lectures]**

Satellite Communication: Introduction, Need, Satellite orbits, Advantages and disadvantages of geostationary satellites, Satellite visibility, Satellite system- Space segment, Block diagrams of satellite sub systems, Up link, Down link, Cross link, Transponders (C-Band), Effect of solar eclipse, Path loss, Ground station, Simplified block diagram of earth station, Satellite access, TDMA, FDMA, CDMA concepts, Comparison of TDMA and FDMA, Satellite antenna (Parabolic dish antenna), GPS services like SPS and PPS.

Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, OSI model, Wireless LAN requirements, Concept of Bluetooth, Wi-Fi and WiMAX, Concept of optical wireless communication and Li-Fi. **[15 Lectures]**

ELSDSEHP-3: Modern Communication Systems Lab
[Credits: 02]

1. Modulation of LED and detection through Photo detector.
2. Calculation of the transmission losses in an optical communication system.
3. Study of 16 QAM modulation and Detection with generation of Constellation Diagram.
4. Study of DPCM and demodulation.
5. Study of DM, ADM.
6. Study of architecture of Mobile phone- Real Time study of GSM 07.05 and 07.07 commands in various categories.
7. Study of Satellite Communication System.
8. Study of Optical Fiber Communication System.
9. Studies on satellite communication system – to set up active and passive satellite communication link, to set up an FM/FDM satellite link to measure the path loss and propagation delay in a satellite link, to communicate voice signal through satellite link.
10. Use different combinations of uplink and downlink frequencies to check the communication link, to transmit and receive various waveforms from a function generator through a satellite link.
11. Studies on Blue tooth system- to understand concept of Blue tooth technology, to study RF module, RS-232C serial communication, Blue tooth protocol, different types of Blue tooth network.
12. Studies on wireless LAN.

DSE-4

ELSDSEHT-4: Semiconductor Fabrication and Characterization
[Credits: 04; Lecture Hours: 56]

Introduction of Semiconductor Process Technology (Line width – 10 nm technology), Semiconductor materials, Single crystal, Polycrystalline and Amorphous, Crystal growth techniques- Czochralski technique, Distribution of dopants, Effective segregation eoefficient, Float Zone Process, Bridgman technique, Wafer preparation.
Epitaxy Deposition: Epitaxial growth by vapor phase epitaxy (VPE) and molecular beam epitaxy (MBE).
Characterization: Various characterization methods for structural, electrical and optical properties, Basic idea of X-ray diffractometer (XRD), Scanning electron microscope, (SEM) Transmission electron microscope (TEM) and UV-VIS-NIR spectrophotometer (Atomic force microscopy). **[18 Lectures]**

Oxidation: Thermal oxidation process- Kinetics of growth for thick and thin oxide, Dry and Wet oxidation. Effects of high pressure and impurities, Impurity redistribution during oxidation, Masking property of silicon oxide, Chemical vapour deposition of silicon oxide, Properties of silicon oxide, Step coverage, P-glass flow.
Diffusion: Basic diffusion process- Diffusion equation, Diffusion profiles, Extrinsic diffusion concentration dependent diffusivity, Lateral diffusion, Doping through Ion implantation and its comparison with diffusion.
[14 Lectures]

Lithographic Processes: Clean room, Optical lithography, Exposure tools, Masks, Photoresist, Pattern Transfer, Resolution Enhancement Techniques- Electron beam lithography, X-ray lithography and Ion beam lithography, Comparison between various lithographic techniques.
Etching: Wet chemical etching- Basic process and few examples of etchants for semiconductors, insulators and conductors, Dry etching using plasma etching technique, Lambda rule, Scaling rules.
Metallization: Uses of Physical Vapor Deposition and Chemical Vapor Deposition technique for Aluminum and Copper metallization. **[14 Lectures]**

Process Integration: Passive components- Integrated circuit resistor, Integrated circuit inductor, Integrated circuit capacitor, Bipolar technology- Basic fabrication process, Isolation techniques, MOSFET technology- Basic fabrication process of NMOS, PMOS and CMOS technology. **[10 Lectures]**

ELSDSEHP-4: Semiconductor Fabrication and Characterization Lab
[Credits: 02]

1. To measure the resistivity of semiconductor crystal with temperature by four-probe method.
2. To determine the type (n or p) and mobility of semiconductor material using Hall-effect.
3. Oxidation process Simulation.
4. Diffusion Process Simulation.
5. To design a pattern using photolithographic process and its simulation.
6. Process integration simulation.
7. Fabrication of thin film using Spin Coating/Thermal Coating System.
8. Determination of Optical Bandgap through transmission spectra.

*** In case of non-availability of equipment simulation studies may be done in lieu of the last two experiments.**

DSE-5

ELSDSEHT-5: Electrical Machines
[Credits: 04; Lecture Hours: 56]

DC Machines: Basic constructional features and physical principles involved in electrical machines, armature winding (AC and DC), Lap and wave connections, Different types of pitches.
DC Generators: Construction and principles of operation, Brief idea about armature reaction and commutation, EMF equation, Methods of excitation, Characteristics of Self excited and separately (Shunt, Compound and Series) excited generators, Losses and Efficiency, Applications.
DC Motors: Comparison of generator and motor action & interchangeability, principle of operation, significance of back EMF, maximum power, Torque and speed relation, Characteristics of series, shunt and compound excited motors and applications, Losses and Efficiency, Necessity of motor starters, Three point starter, Speed control of DC motors, Electronic speed control of DC motors, Electric braking.
Single Phase transformer: Principle, Construction, EMF equation, No load operation, Operation under load, Phasor diagrams, Equivalent circuit, Transformer losses, Voltage regulation, Condition for maximum efficiency, All day efficiency, short circuit and open circuit tests, Auto transformer. **[22 Lectures]**

Poly Phase Induction Motors: General constructional features, Types of rotors, Rotating magnetic field (Ferrari's principle), Induction motor as a generalized transformer, Equivalent circuit, Production of torque, Slip, Torque equation, Torque-slip characteristics, Comparison with DC motor.
Single Phase Induction Motors: Construction, Principle of operation based on starting methods, Double revolving field theory, Split phase motors, Capacitor start motors, Capacitor start and run motors, Stepper Motor, Single phase AC series motor, Universal motor, Brush less DC motor and PMDC motor. **[20 Lectures]**

Synchronous Machines: Brief construction details of three phase synchronous generators, EMF equation, Excitation system for synchronous generator, Principle of operation of synchronous motor, Method of starting, factors for failure to star, Applications, Comparison of synchronous and induction motors. **[14 Lectures]**

ELSDSEHP-5: Electrical Machines Lab
[Credits: 02]

1. Study of characteristics of DC Series motor.
2. Speed Control of DC Shunt motor.
3. Study of Load characteristics of single phase induction motor.
4. Study of Load characteristics of three phase induction motor.
5. Study of speed control of shunt DC motor using SCR.
6. Study of Open Circuit Test on single phase transformer.
7. Study of Short Circuit Test on single phase transformer.

DSE-6

ELSDSEHT-6: Basic VLSI Design
[Credits: 04; Lecture Hours: 56]

Metal Oxide Semiconductor (MOS): Introduction to basic principle of MOS transistor, Large signal MOS models (long channel) for digital design, MOS SPICE model, MOS device layout- Transistor layout, Inverter layout, CMOS digital circuit layout, Effects of scaling on MOS behavior. **[16 Lectures]**

MOS Inverter: Inverter principle, Depletion and enhancement load inverters, Basic CMOS inverter, Transfer characteristics, Logic threshold, Noise margins, Dynamic behavior, Propagation Delay and Power consumption. **[14 Lectures]**

Combinational MOS Logic Design: Static MOS design, Pass transistor logic, Complex logic circuits, Sequential MOS logic design- Static latches, Flip flops and Registers, Dynamic Latches and Registers, CMOS Schmitt trigger, Monostable sequential circuits, Astable circuits, Concept of BICMOS. **[14 Lectures]**

Memory Design: ROM and RAM cells design, Dynamic MOS design- Dynamic logic families and performances, Interconnect and clock distribution- Interconnect delays, Cross talks, Clock distribution. **[12 Lectures]**

ELSDSEHP-6: Basic VLSI Design Lab
[Credits: 02]

Implementation using Hardware and/or any Circuit Simulation Software

1. To plot the output characteristics and transfer characteristics of n-channel and p- channel MOSFET.
2. To design and plot the static (VTC) and dynamic characteristics of digital CMOS inverter.
3. To design and plot the output characteristics of 3-inverter ring oscillator.
4. To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology.
5. To design and plot the characteristics of a 4×1 digital multiplexer using pass transistor logic.
6. To design and plot the characteristics of a positive and negative latch based on multiplexers.
7. To design and plot the characteristics of a master-slave positive and negative edge triggered registers based on multiplexers.

DSE-7

ELSDSEHT-7: Digital Signal Processing
[Credits: 04; Lecture Hours: 56]

Discrete Time Systems: Discrete sequences, Linear coefficient difference equation, Representation of DTS, LSI systems. Stability and Causality, Frequency domain representations and Fourier transform of DT sequences. **[12 Lectures]**

Network Synthesis: Concept of pole-zero, Properties of pole-zeroes, Synthesis of two terminal reactive networks, Foster's reactance theorem, Network realization of reactance function, Canonic networks, Continued fraction networks (Cauer networks), Synthesis of two terminal R-C and R-L networks, Positive real functions, numericals. **[12 Lectures]**

Discrete Fourier Transform: DFT assumptions and Inverse DFT, Matrix relations, Relationship with FT and its inverse, Circular convolution, DFT theorems, DCT, Computation of DFT, FFT algorithms and processing gain, Discrimination, Interpolation and Extrapolation, Gibbs phenomena, FFT of real functions interleaving and resolution improvement, Word length effects. **[16 Lectures]**

Digital Filters: Analog filter review, Concept of filters in signal processing, Filter parameters, Concept of LP, HP, BP, Notch filters, Types of filters- Butterworth and Chebyshev, System function for IIR and FIR filters, Network representation, Canonical and decomposition networks, IIR filter realization methods and their limitations, FIR filter realization techniques, Discrete correlation and convolution, Properties and limitations. **[16 Lectures]**

ELSDSEHP-7: Digital Signal Processing Lab
[Credits: 02]

Implementation using Scilab/MATLAB/Any Other Mathematical Simulation Software

1. Generation of unit sample sequence, unit step, ramp function, discrete time sequence, real sinusoidal sequence.
2. Generate and plot sequences over an interval.
3. Given x[n], write program to find X[z].
4. Fourier Transform, Discrete Fourier Transform and Fast Fourier Transform.
5. Design of a Butterworth analog filter for low pass and high pass.
6. Design of digital filters.

DSE-8

ELSDSEHT-8: Control Systems
[Credits: 04; Lecture Hours: 56]

Introduction to Control Systems: Open loop and Closed loop control systems, Mathematical modeling of physical systems (Electrical, Mechanical and Thermal), Derivation of transfer function, Block diagram representation and Signal flow graph, Reduction Technique, Mason's gain formula, Effect of feedback on control systems. **[12 Lectures]**

Time Domain Analysis: Time domain performance criteria, Transient response of first, second and higher order systems, Steady state errors and static error constants, Performance indices.
Concept of Stability: Asymptotic stability and conditional stability, Routh-Hurwitz criterion, Relative stability analysis, Root locus plots and their applications. **[14 Lectures]**

Frequency Domain Analysis: Correlation between time and frequency response, Polar and inverse polar plots, Frequency domain specifications, Logarithmic plots (Bode plots), Gain and Phase margins, Nyquist stability criterion, Relative stability using Nyquist criterion, constant M and N circles. **[16 Lectures]**

State Space Analysis: Definitions of state, State variables, State space, Representation of systems, Solution of time invariant, Homogeneous state equation, State transition matrix and its properties.
Controllers and Compensation Techniques: Response with P, PI and PID controllers, Concept of compensation, Lag, Lead and Lag-Lead networks. **[14 Lectures]**

ELSDSEHP-8: Control Systems Lab
[Credits: 02]

Implementation using Hardware and Scilab/MATLAB/Any Other Circuit Simulation Software

1. To study characteristics of:
   a) Synchro transmitter receiver.
   b) Synchro as error detector.
2. To study position control of DC motor.
3. To study speed control of DC motor.
4. To find characteristics of AC servo motor.
5. To study time response of type 0, 1 and 2 systems.
6. To study frequency response of first and second order systems.
7. To study time response characteristics of second order system.
8. To study effect of damping factor on performance of second order system.
9. To study frequency response of Lead and Lag networks.
10. Study of P, PI and PID controller.

DSE-9

ELSDSEHT-9: Computer Networks
[Credits: 04; Lecture Hours: 56]

Data Communications: Components, Protocols and Standards, Network and protocol architecture, Reference model ISO-OSI, TCP/IP- Overview, Topology, Transmission mode, Digital signals, Digital to digital encoding, Digital data transmission, DTE-DCE interface, Interface standards, Modems, Cable modem, Transmission media- Guided and unguided, Transmission impairment, Performance, Wavelength and Shannon capacity.
Switching: Circuit switching (space division, time division and space-time division), Packet switching (Virtual circuit and Datagram approach), Message switching. [**14 Lectures]**

Data Link Layer: Design issues, Data link control and protocols- Flow and Error control, Stop and Wait ARQ, Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to-Point Access- PPP Point-to-Point Protocol, PPP stack, Error detection and correction codes (Parity, Checksum, CRC and Hamming).
Medium Access Sub Layer: Channel allocation problem, Controlled access, Channelization, Multiple access protocols, IEEE standard 802.3 and 802.11 for Ethernet, LAN and WLAN, Introduction to high-speed LANs (Gigabit Ethernet, Jumbo Frames), Token ring, Token Bus, FDDI based LAN, Network devices-repeaters, Hubs, Switches, Bridges. [**14 Lectures]**

Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host delivery- Internetworking, Addressing and Routing, IP addressing (class full and classless), Subnet, Network layer protocols- ARP, IPV4, ICMP, IPV6, ICMPV6. **[14 Lectures]**

Transport Layer: Process to Process delivery- UDP; TCP, Congestion control, Quality service.
Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.
Introductory Concepts of Security: Authentication and Encryption. **[14 Lectures]**

ELSDSEHP-9: Computer Networks Lab
[Credits: 02]

Scilab/MATLAB/Any Other Mathematical Simulation Software

1. Setting up off LAN
   (i) Identification of networking components:
      (a) Newtork Cables (CAT 5,6)
      (b) Network Jack and Crimping Process
      (c) Understading the NIC
   (ii) Setting up of Local LAN (in windows and LINUX) using switch in a client server mode.
   (iii) Creating workgroups in the same LAN
   (iv) Setting up a system as a Gateway (this should have at least two NIC interfaces) and making two LANs with the Gateway machine as the router (this should be done in LINUX).
2. Introduction to Discrete Event Simulation- Discrete Event Simulation Tools- ns2/ns3, Omnet++.
3. Using Free Open Source Software tools for network simulation of telnet and ftp between N sources- N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion.
4. Using Free Open Source Software tools for network simulation to study effect of queuing disciplines on network performance- Random Early Detection/Weighted RED/Adaptive RED.
5. Using Free Open Source Software tools for network simulation for http, ftp and DBMS access in networks.
6. Using Free Open Source Software tools for network simulation to study effect of VLAN on network performance- multiple VLANs and single router.
7. Using Free Open Source Software tools for network simulation to study effect of VLAN on network performance- multiple VLANs with separate multiple router.
8. Using Free Open Source Software tools for network simulation to study the performance of wireless networks

DSE-10

ELSDSEHT-10: Nanoelectronics
[Credits: 04; Lecture Hours: 56]

Introduction to Nano Electronics: Introduction, Definition of Nanoscience and Nanotechnology, Applications of Nanotechnology.
Introduction to Physics of Solid State: Size dependence of properties, bonding in atoms and giant molecular solids, Electronic conduction, Systems confined to one, two or three dimension and their effect on property.
Quantum Theory for Nanoscience: Time dependent and time independent Schrodinger wave equations, Particle in a box, Potential step- Reflection and tunneling (Quantum leak), Penetration of barrier, Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials.
Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure, Size and dimensionality effect, Fermi gas, Potential wells, Partial confinement, Excitons, Single electron tunneling, Coulomb Blockade, Density of states for confinement in one, two and three dimensions, Infrared detectors, Quantum dot laser, Superconductivity, Balliistic transport. **[18 Lectures]**

Growth Techniques of Nanomaterials: Synthetic aspects- Bottom up and top down approaches, Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO2 deposition), Thermal evaporation technique, E-beam evaporation, Chemical vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed laser deposition, Molecular beam epitaxy, Sol-Gel technique (No chemistry required), Synthesis of nanowires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid-Solid (VLS) method of nanowire. **[16 Lectures]**

Methods of Measuring Properties and Characterization techniques:
Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) including energy dispersive X-ray (EDX) analysis, Low Energy Electron Diffraction (LEED), Reflection High Energy Electron Diffraction (RHEED).
Spectroscopy: Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic Resonance, Optical and Vibrational Spectroscopy. **[12 Lectures]**

Application of Nano Electronics: Carbon nanotubes, Nano cuboids, Graphene, Carbon quantum dots-Fabrication, Structure, Electrical, Mechanical, and vibrational properties and applications, Concept of silicone, Use of nano particles for biological application, Drug delivery and bio-imaging, Impact of nanotechnology on environment. **[10 Lectures]**

ELSDSEHP-10: Nanoelectronics Lab
[Credits: 02]

1. Synthesis of at least two different sizes of Nickel Oxide/ Copper Oxide/ Zinc Oxide Nano Particles Using Sol-Gel Method.
2. Polymer synthesis by suspension method/emulsion method.
3. Electrical Characterization of nanomaterials.
4. Magnetoresistance of thin films and nanocomposite, I-V characteristics and transient response.
5. Particle size determination by X-ray diffraction (XRD) and XRD analysis of the given XRD spectra.
6. Determination of the particle size of the given materials using He-Ne LASER.
7. Selective area electron diffraction: Software based structural analysis based on TEM based experimental data from published literature. (Note: Later experiment may be performed in the lab based on availability of TEM facility).
8. Surface area and pore volume measurements of nanoparticles (standard sample and new sample, if available).
9. UV-VIS Spectroscopic characterization of metallic, semiconducting and insulating nanoparticles.

DSE-11

ELSDSEHT-11: Embedded Systems
[Credits: 04; Lecture Hours: 56]

Introduction to Embedded Systems: Overview of embedded systems, Features, Requirements and applications, Range of embedded systems- CPU size and complexity, Memory size, I/O handling variations, Use of OS-es with single or multitasking, Recent Trends in the embedded system design, Common architectures for the embedded system design, Embedded software design issues, Introduction to microcontrollers, Overview of Harvard architecture and Von Neumann architecture, RISC and CISC microcontrollers. **[12 Lectures]**

AVR RISC Microcontrollers: Introduction to AVR RISC Microcontrollers, Architecture overview, Status register, General purpose register, Memories, Instruction set, Data transfer instructions, Arithmetic and Logic instructions, Branch instructions, Bit and Bit-test instructions, MCU control instructions, Simple programs in assembly language / C language, Use of Cross-compiler. **[18 Lectures]**

Interrupts and Timer: Introduction to system clock, Reset sources, Introduction to interrupts, External interrupts, IO Ports, 8-bit and 16-bit timers, Introduction to different modes, Input capture and compare match. **[12 Lectures]**

Peripherals: Analog comparator, Analog-to-Digital converter, Serial Peripheral Interface (SPI), Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART), Two Wire Interface (TWI) / I^2C bus, USB concepts. **[14 Lectures]**

ELSDSEHP-11: Embedded Systems Lab
[Credits: 02]

Implementation with AVR Kit/Arduino Kit/ Any other 16/32 bit Microcontroller

1. Display custom characters on LCD using AVR Microcontroller.
2. Interfacing AVR microcontroller with PC using USART.
3. Interfacing SD Card with AVR Microcontroller.
4. Phase Correct PWM (Pulse Width Modulation) Mode of AVR microcontroller Timer.
5. Waveform Generation using AVR Microcontroller (Atmega16) Timers.
6. Interfacing Servo Motor with AVR Microcontroller.
7. Using I2C/TWI (Two Wire Interface) in AVR ATmega32.
8. Designing Audio Tone Generator using AVR Microcontroller.
9. Speed and Direction Control of Stepper Motor using AVR Microcontroller.
10. Designing Watchdog System Monitor.

DSE-12

ELSDSEHT-12: Biomedical Instrumentation
[Credits: 04; Lecture Hours: 56]

Biomedical Signals and Physiological Transducers: Source of biomedical signal, Origin of bioelectric signals, Recording electrodes, Electrodes for ECG, EMG and EEG, Physiological transducers- Pressure, Temperature, Photoelectric and Ultrasound transducers, Measurement in respiratory system- Physiology of respiratory system, Measurement of breathing mechanics Spiro meter, Respiratory therapy equipments- Inhalators, Ventilators, Respirators, Humidifiers, Nebulizers, Aspirators, Biomedical recorders- ECG, EEG and EMG, MEMS based biosensors. **[16 Lectures]**

Patient Monitoring Systems and Audiometers: Cardiac monitor, Bedside patient monitor, Measurement of heart rate, Blood pressure, Temperature, Respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity, Audiometers, Blood cell counters, Oximeter, Blood flow meter, Cardiac output measurement, Blood gas analyzers. **[14 Lectures]**

Modern Imaging Systems: Introduction, Basic principle and block diagram of X-ray machine, X-ray Computed Tomography (CT), Magnetic resonance imaging (MRI) system, Ultrasonic imaging system, Eco-Cardiograph, Eco Encephalography, Ophthalmic scans, Therapeutic Equipments- Cardiac pacemakers, Cardiac defibrillators, Hemodialysis machine, Surgical diathermy machine. **[16 Lectures]**

Patients Safety and Computer Applications in Biomedical Field: Electric shock hazards and precautions to minimize them, Effects of electric current on human body, Leakage current shocks and precautions to minimize them, Safety codes for electro medical equipment, Electric safety analyzer, Testing of biomedical equipment, Use of microprocessors in medical instruments, Microcontrollers, PC based medical instruments, Computerized Critical care units, Planning and designing a computerized critical care unit.
Physiotherapy: Software diathermy, Microwave diathermy, Ultrasound therapy unit, Electrotherapy equipments, Ventilators. **[10 Lectures]**

ELSDSEHP-12: Biomedical Instrumentation Lab
[Credits: 02]

1. Characterization of bio potential amplifier for ECG signals.
2. Study on ECG simulator.
3. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor/simulator.
4. Study of pulse rate monitor with alarm system.
5. Determination pulmonary function using spirometer (using mechanical system).
6. Measurement of respiration rate using thermistor/other electrodes.
7. Study of Respiration Rate monitor/Apnea monitor.
8. Study on ultrasound transducers based on medical system.
9. Study of Pacemaker.
10. Measurement of pulse rate using photoelectric transducer and pulse counting for known period.

DSE-13

ELSDSEHT-13: Transmission Lines, Antenna and Microwave Devices
[Credits: 04; Lecture Hours: 56]

Transmission Lines: Typical Transmission lines- Co-axial, Two wire, Microstrip, Coplanar and Slot lines, Transmission line parameters, Transmission line equations, Wave propagation in transmission lines, Characteristics impedance, Propagation constant, Lowloss and lossless and distortionless line, Input impedance, Reflection coefficient, Standing wave and standing wave ratio, Power and lossy lines, Short-circuited and Open-circuited line, Matched line, Smith chart, Transmission line applications. **[12 Lectures]**

Guided Waves and Waveguides: Wave propagation between parallel conducting planes, TEM, TE and TM modes, Rectangular waveguides, Circular waveguides, Power transmission and attenuation, Rectangular cavity resonators, Directional couplers, Isolator, Circulator. **[12 Lectures]**

Radiation of Electromagnetic Waves: Concept of retarded potentials, Antenna parameters: Radiation mechanism, Current distribution on a thin wire antenna, Radiation pattern, Radiation power density, Radiation intensity, Beamwidth, Directivity, Antenna efficiency, Gain, Beam efficiency, Bandwidth, Polarization, Input impedance, Antenna radiation efficiency, Effective length and Equivalent areas, Maximum directivity and Maximum effective area, Radiation resistance, Friis transmission equation and Radar range equation. **[10 Lectures]**

Types of Antenna: Hertzian dipole, half-wave dipole, Quarter-wave dipole, Yagi-Uda, Microstrip, Parabolic antenna, Helical antenna, Antenna array. **[10 Lectures]**

Microwave Devices (Qualitative): Microwave domains, Two-cavity klystron, Reflex klystron, Travelling Wave Tube (TWT), Magnetron, Transferred electron mechanism and Gunn diode, Avalanche transit time mechanism and IMPATT diode, Tunnel diode. **[12 Lectures]**

ELSDSEHP-13: Transmission Lines, Antenna and Microwave Devices Lab
[Credits: 02]

Implementation with Hardware and/or SciLab/MATLAB/Any Other Mathematical Simulation Software

1. Program to determine the phasor of forward propagating field.
2. Program to determine the instantaneous field of plane wave.
3. Program to find the Phase constant, Phase velocity, Electric Field Intensity and Intrinsic ratio.
4. Program to find skin depth, loss tangent and phase velocity.
5. Program to determine the total voltage as function of time and position in loss less transmission line.
6. Program to find the characteristic impedance, phase constant and phase velocity.
7. Program to find the output power and attenuation coefficient.
8. Program to find the power dissipated in lossless transmission line.
9. Program to find the total loss in lossy lines.
10. Program to find the load impedance of slotted line.
11. Program to find the input impedance of transmission line terminated with pure capacitive impedance.
12. Program to determine the operating range of frequency for TE_{10} mode of air filled rectangular waveguide.
13. Program to determine Directivity, Bandwidth, Beamwidth of antenna.
14. Program to determine diameter of parabolic reflector.
15. Program to find out minimum distance between primary and secondary antenna.
16. Simple problems using Smith Chart.

Skill Enhancement Course (SEC) Syllabus

SEC-1

ELSSECHT-1: Design and Fabrication of Printed Circuit Boards
[Credits: 02; Lecture Hours: 28]

PCB Fundamentals: PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD), Classification of PCB- single, double, multilayer and flexible boards, Manufacturing of PCB, PCB standards. **[4 Lectures]**

Schematic and Layout Design: Schematic diagram, General, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding. **[10 Lectures]**

Technology OF PCB: Design automation, Design Rule Checking, Exporting Drill and Gerber Files, Drills, Footprints and Libraries, Adding and Editing Pins, copper clad laminates, materials of copper clad laminates, properties of laminates (electrical and physical), types of laminates, soldering techniques, Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing and quality controls. **[12 Lectures]**

PCB Technology: Trends, Environmental concerns in PCB industry. [**2 Lectures]**

SEC-2

ELSSECHT-2: Robotics
[Credits: 02; Lecture Hours: 28]

Programming Environments: Integrated Development Environment (IDE) for AVR microcontrollers, free IDEs like AVR Studio, WIN AVR. Installing and configuring for Robot programming, In System Programmer (ISP), loading programmes on Robot. [**6 Lectures]**

Actuators: DC Motors, Gearing and Efficiency, Servo Motors, Stepper motors, Motor Control and its implementations. **[6 Lectures]**

Sensors: White line sensors, IR range sensor of different range, Analog IR proximity sensors , Analog directional light intensity sensors, Position encoders , Servo mounted sensor pod/ Camera Pod, Wireless colour camera , Ultrasound scanner, Gyroscope and Accelerometer, Magnetometer, GPS receiver, Battery voltage sensing, Current Sensing. [**6 Lectures]**

LCD interfacing and other operations of robotics: LCD interfacing with the robot (2 x 16 Characters LCD) Other indicators: Indicator LEDs, Buzzer Timer / Counter operations: PWM generation, Motor velocity control, Servo control, velocity calculation and motor position Control, event scheduling Communication: Wired RS232 (serial) Communication, Wireless ZigBee Communication, USB Communication, Simplex infrared Communication (IR remote to robot). **[10 Lectures]**

SEC-3

ELSSECHT-3: Mobile Application Programming
[Credits: 02; Lecture Hours: 28]

Introduction to Mobile Application Programming : Introduction: What is mobile Application Programming, Different Platforms, Architecture and working of Android, iOS and Windows phone 8operating system, Comparison of Android, iOS and Windows phone 8 functions) **[6 Lectures]**

Android Development Environment: What is Android, Advantages and Future of Android, Tools and about Android SDK, Installing Java, Eclipse, and Android, Android Software Development Kit for Eclipse, Android Development Tool: Android Tools for Eclipse, AVDs: Smartphone Emulators, Image Editing,
Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine, Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: The AndroidManifest.xml File, Creating Your First Android Application.
Android Framework Overview: The Foundation of OOP, The APK File, Android Application Components, Android Activities: Defining the User Interface, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications, Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components.
Views and Layouts, Buttons, Menus, and Dialogs, Graphics Resources in Android: Introducing the Drawables, Implementing Images, Core Drawable Subclasses, Using Bitmap, PNG, JPEG and GIF Images in Android, Creating Animation in Android
Handling User Interface(UI) Events: An Overview of UI Events in Android, Listening for and Handling Events , Handling UI Events via the View Class, Event Callback Methods, Handling Click Events, Touchscreen Events, Keyboard Events, Context Menus, Controlling the Focus.
Content Providers: An Overview of Android Content Providers, Defining a Content Provider, working with a Database.
Intents and Intent Filters: Intent, Implicit Intents and Explicit Intents, Intents with Activities, Intents with Broadcast Receivers
Advanced Android: New Features in Android 4.4. **[18 Lectures]**

iOS Development Environment: Overview of iOS, iOS Layers, Introduction to iOS application development.
Windows phone Environment: Overview of windows phone and its platform, Building windows phone application. **[4 Lectures]**

SEC-4

ELSSECHT-4: Internet and Java Programming
[Credits: 02; Lecture Hours: 28]

Internet: Introduction, Understanding the Internet, Internet Addressing, Hardware Requirements to Connect to the Internet. **[2 Lectures]**

Data types, Arrays, Operators, Flow Control: Branching, Looping. Classes, New Operator, Dot Operator, Method Declaration and Calling, Constructors, Inheritance, Super, Method Overriding Final, Finalize, Static, Package and Import Statement, Interface and Implements. **[6 Lectures]**

Exception Handling: Exception Types, Uncaught and Calling, Nested Try Statements, Java Thread Model, and Thread, Runnable, Thread Priorities, Synchronization, Deadlock. **[8 Lectures]**

File Handling: Input Stream, Output Stream, and File Stream, Applets-Tag, Order of Applet Initialization, Repainting, Sizing Graphics- Abstract Window Tool Kit Components. **[12 Lectures]**

SEC-5

ELSSECHT-5: Programming with Matlab/SciLab
[Credits: 02; Lecture Hours: 28]

MATLAB Basics: MATLAB environment, Basic computer programming, Variables and constants, operators and simple calculations, Formulas and functions, MATLAB toolboxes. **[4 Lectures]**

Matrices and Vectors: Matrix and linear algebra review, Vectors and matrices in MATLAB, Matrix operations and functions in MATLAB. **[6 Lectures]**

Computer Programming: Algorithms and structures, MATLAB scripts and functions (m-files), Simple sequential algorithms, Control structures. **[6 Lectures]**

MATLAB Programming: Reading and writing data, file handling, Personalized functions, Toolbox structure, MATLAB graphic functions.
Numerical Simulations: Numerical methods and simulations, Random number generation, Montecarlo methods. **[12 Lectures]**

SEC-6

ELSSECHT-6: Networking and Mobile Communications
[Credits: 02; Lecture Hours: 28]

Networking: Concepts of networking, network layers, network hardware components, Layered protocol architecture- OSI : TCP, Physical media- topology, switching mechanism (circuit and packet switched systems), Comparison of various transmission media, Transport layer- Connection less and connection oriented protocols, Policies on flow control, error control, MAC-Ethernet, CSMA. CD, ALOHA, FDDI, Network layer- IPV4, ICMP, IGMP, introduction to routing and sub netting. **[6 Lectures]**

Mobile Communication: Evolution from PSTN, Cellular concept, frequency reuse, channel assignment strategies, system capacity, trucking and grade of service.
GSM- architecture, protocols, handover, security.
Physical layer- Wireless media-characteristics, modes of propagation, various loss mechanisms.
Multiplexing and multiple access techniques- FDM, TDM, FDMA,TDMA,CDMA,WCDMA.
Mobile IP, dynamic host configuration protocol , wireless LAN technology standards, **[10 Lectures]**

Studies on Bluetooth System: To understand concept of Blue tooth technology, to study RF module, RS- 232C serial communication, Blue tooth protocol, different types of Blue tooth network. **[2 Lectures]**

Hands On: Realtime Remote Monitoring System of Mobile Base Station using Quad-band GSM/GPRS modem. Understanding of GSM technology, its network, GSM capability & data services.Understanding RF environment & study of GSM network by actually connecting to the GSM environment by any service provider.
Command Level Study: Real Time study of GSM 07.05 & 07.07 commands in various categories : Command concerning modem and SIM card hardware, Network registration, Call control, Call setting, Call information, Phone Book, Serial link control, Message setting, Storing/restoring, Error message handling and survey.
[10 Lectures]

SEC-7

ELSSECHT-7: Circuit Modeling using PSPICE
[Credits: 02; Lecture Hours: 28]

Introduction: Introduction to PSpice software, file types, netlist commands. **[4 Lectures]**

Basic Analysis: DC, AC, Transient. Analog behavioral models (ABM): equations setup, IF statement, voltage/current/ frequency dependent sources. Advanced analyses: noise, Monte-Carlo. **[10 Lectures]**

Circuit Modeling: I-V characteristic, Temperature Effects, Iterative solution of simple series circuit, Solution of simple series circuit using an equation solver, PSpice solution of simple series circuit, PSpice I-V Characteristic, PSpice I-V Characteristic with temperature dependence, Thevenin solution, Diode Models, Diode Circuits, Rectifier, Clipping, Zener Circuits, Clipping , MOSFETS , PSpice AC, DC, transient, and bias point simulations, MOSFET as switch, Resistive pull-up, Active pull-up, Drive an LED, Basic NMOS gate, Ohmic and SAT regions, Bias with Current Source, MOSFET Small-Signal Analysis, Small-signal model, Common-source amplifier, Source-follower, Input and output impedance, Bipolar Junction Transistors, PSpice AC, DC, transient, and bias point simulations, BJT as switch, Drive an LED, Drive a relay, Biasing with Current Sources, BJT Small-Signal Analysis, Hybrid-pi model, Common-emitter amplifier, Emitter-follower, Input and output impedance, OPAMPS – analysis using subcircuits. **[14 Lectures]**

Generic Elective (GE) Syllabus

GE-1

ELSGEHT-1: Network Analysis and Analog Electronics
[Credits: 04; Lecture Hours: 56]

Circuit Analysis: Concept of Voltage and Current Sources, Kirchhoff's Current Law, Kirchhoff's Voltage Law, Mesh Analysis, Node Analysis, Star and Delta networks, Star-Delta Conversion, Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, Two Port Networks: h, y and z parameters and their conversion. **[10 Lectures]**

Junction Diode and Its Applications: PN junction diode (Ideal and practical)-constructions, Formation of Depletion Layer, Diode Equation and I-V characteristics, Idea of static and dynamic resistance, dc load line analysis, Quiescent (Q) point, Zener diode, Reverse saturation current, Zener and avalanche breakdown, Qualitative idea of Schottky diode, Rectifiers - Half wave rectifier, Full wave rectifiers (center tapped and bridge), circuit diagrams, working and waveforms, ripple factor and efficiency. Filter - Shunt capacitor filter, its role in power supply, output waveform, and working, Regulation - Line and load regulation, Zener diode as voltage regulator, and explanation for load and line regulation. **[12 Lectures]**

Bipolar Junction Transistor: Construction, Principle and Working of NPN Transistor, Terminology, CE, CB and CC Configurations and Characteristics, Regions of Operation (Active, Cut-off and Saturation), Current Gains α and β, Relations between α and β, Leakage Currents. **[5 Lectures]**

Transistor Biasing: Need for Biasing, Fixed Bias, Collector to Base Bias, Voltage Divider Bias and Emitter Bias- Circuits and Working, DC Load Line and Operating Point, Thermal Runaway, Stability and Stability Factor. **[5 Lectures]**

BJT Amplifiers: Small Signal Analysis of Single Stage CE Amplifier, r_e-Model and h-Parameter Equivalent Circuit, Frequency Response, Input and Output Impedance, Current and Voltage Gains, Class A, B and C Amplifiers. **[5 Lectures]**

Cascaded Amplifiers: Two stage RC Coupled Amplifier and its frequency response. **[2 Lectures]**

Feedback in Amplifiers: Concept of feedback, Negative and positive feedback, Advantages of negative feedback (Qualitative only). **[2 Lectures]**

Sinusoidal Oscillators: Barkhausen criterion for sustained oscillations, Phase shift and Colpitt's and Hartley oscillators, Determination of frequency and condition of oscillation. **[5 Lectures]**

Unipolar Devices: JFET- Construction, Working and I-V characteristics (output and transfer), Pinchoff voltage, MOSFET- MOS Capacitor, Channel formation, Threshold voltage (ideal and real), Current-Voltage relation, Depletion and Enhancement type MOSFET, Complementary MOS (CMOS), UJT- Basic construction, Working, Equivalent circuit and I-V characteristics. **[10 Lectures]**

ELSGEHP-1: Network Analysis and Analog Electronics Lab
[Credits: 02]

1. To familiarize with basic electronic components (R, C, L, diodes, transistors), Digital Multimeter, Function Generator and Oscilloscope.
2. Measurement of Amplitude, Frequency and Phase difference using Oscilloscope.
3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.
4. Verification of (a) Superposition theorem and (b) Maximum Power Transfer theorem.
5. Study of the I-V Characteristics of (a) p-n junction Diode and (b) Zener diode.
6. Study of (a) Half wave rectifier and (b) Full wave rectifier (FWR) without and with capacitor filter.
7. Study of Zener diode as voltage regulator and its load regulation.
8. Study of the I-V Characteristics of the Common Emitter Configuration of BJT and obtain r_i, r_o, β.
9. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o, α.
10. Study of Fixed Bias and Voltage divider bias configuration for CE transistor.
11. Design of a Single Stage CE amplifier of given gain and study its frequency response.
12. Study of the I-V Characteristics of JFET.
13. Study of the I-V Characteristics of MOSFET.
14. Study of the I-V Characteristics of UJT and design of relaxation oscillator.
15. Study of the RC Phase Shift Oscillator.
16. Study the Colpitt's Oscillator.
17. Study the Hartley Oscillator.

GE-2

ELSGEHT-2: Linear and Digital Integrated Circuits
[Credits: 04; Lecture Hours: 56]

Operational Amplifiers (Black Box Approach): Characteristics of an ideal and practical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency response, CMRR, PSRR, Slew rate and concept of virtual Ground. **[3 Lectures]**

Applications of Op-Amps: Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Voltage to current and current to voltage converters, Comparator and Zero-crossing detector, Schmitt trigger, Wien bridge oscillator, Active low pass and high pass Butterworth filter (1st order only). **[11 Lectures]**

Clock and Timer (IC 555): Functional block diagram of IC 555, Astable and Monostable multivibrator circuits. **[2 Lectures]**

Number System and Codes: Decimal, Binary, Octal and Hexadecimal number systems, Base conversions, 1's and 2's complements, Representation of signed and unsigned numbers, BCD code, Grey codes, Binary, Octal and Hexadecimal arithmetic, Addition, Subtraction by 2's complement method, Multiplication. **[8 Lectures]**

Boolean Algebra and Logic Gates: Positive and negative logic, Basic postulates and fundamental theorems of Boolean algebra, De Morgan's theorems, Logic symbol and truth tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates, Standard representation of logic functions (SOP and POS), Karnaugh map minimization (up to 4 variables), Characteristics of logic families- Fan-in and fan-out, Power dissipation and noise immunity, Propagation delay, Comparison of TTL and CMOS families. **[9 Lectures]**

Combinational Circuits: Half and full Adder, Half and full Subtractor, 4-bit binary adder and subtractor, Multiplexers, Demultiplexers, Encoder, Decoder, Code converter (Binary to BCD and vice versa). **[9 Lectures]**

Sequential Circuits: Latches, Flip flop, SR, JK, D and T flip flops, Truth Table, Excitation Table and Excitation Equation, Clocked (level and edge triggered) flip-flops, Preset and clear operations, Race-around conditions in JK flip flop, Master-slave JK flip-flop. **[6 Lectures]**

Shift Registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out shift registers (up to 4 bits). **[2 Lectures]**

Counters (4 bits): Ripple, Ring counter, Synchronous, Asynchronous, Decade and Modulo-N counters, State Table and State Diagram, Excitation Table and Excitation Equation. **[3 Lectures]**

D-A and A-D Conversion: 4 bit binary weighted and R-2R D-A converter- circuit and working, Accuracy and Resolution, A-D conversion characteristics, Successive approximation ADC. (Mention of relevant ICs for all). **[3 Lectures]**

ELSGEHP-2: Linear and Digital Integrated Circuits Lab
[Credits: 02]

Section-A: Op-Amp Circuits (Hardware)

1. To design an inverting and non-inverting amplifiers using Op-amp (741, 351) for dc voltage of given gain.
2. (a) To design inverting amplifier using Op-amp (741,351) and study its frequency response.
   (b) To design non-inverting amplifier using Op-amp (741,351) and study frequency response.
3. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode.
   (b) To study zero-crossing detector and comparator.
4. To design precision differential amplifier of given I/O specification using Op-amp.
5. To investigate use of op-amp as Integrator.
6. To investigate use of op-amp as Differentiator.
7. To design Wien bridge oscillator for given frequency using an op-amp.
8. To design a circuit to simulate the solution of simultaneous equation and $1^{st}/2^{nd}$ order differential equation.
9. To design Butterworth Low Pass active Filter (1^{st} order) and study Frequency Response.
10. To design Butterworth High Pass active Filter (1^{st} order) and study Frequency Response.
11. To design digital to analog converter (DAC) of given specifications.
12. To design Astable Multivibrator of given specification using IC 555 Timer.
13. To design Monostable Multivibrator of given specification using IC 555 Timer.

Section-B: Digital Circuits (Hardware)

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert Boolean expression into logic circuit and design it using logic gate ICs. .
3. To design Half Adder and Full Adder.
4. To design Half Subtractor and Full Subtractor.
5. To design 4 bit binary adder and adder-subtractor using Full adder IC.
6. To design a seven segment decoder driver.
7. To design 4×1 Multiplexer using gates.
8. To build Flip-Flop (RS, Clocked RS, D and JK) circuits using NAND gates.
9. To build JK Master-slave flip-flop using Flip-Flop ICs.
10. To design Counter using D/T/JK Flip-Flop ICs and study timing diagram.
11. To design Shift Register and study serial and parallel shifting of data using D/JK Flip-Flop ICs.

Section-C: SPICE/MULTISIM simulations for electronic circuits and devices

1. To verify the Thevenin and Norton Theorems.
2. Design and analyze the series and parallel LCR circuits
3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain
4. Design and Verification of op-amp as integrator and differentiator
5. Design the 1storder active low pass and high pass filters of given cutoff frequency
6. Design a Wein`s Bridge oscillator of given frequency.
7. Design clocked SR and JK Flip-Flop`s using NAND Gates
8. Design 4-bit asynchronous counter using Flip-Flop ICs
9. Design the CE amplifier of a given gain and its frequency response.

GE-3

ELSGEHT-3: Instrumentation
[Credits: 04; Lecture Hours: 56]

Measurements: Accuracy and Precision, Significant Figures, Error and Uncertainty Analysis, Sensitivity and Loading Effect, Shielding and Grounding, Electromagnetic Interference. **[4 Lectures]**

Basic Measurement Instruments: PMMC Galvanometer, DC Measurement- Ammeter, Voltmeter, Ohmmeter, AC Measurement, Digital Voltmeter Systems (Integrating and Non-integrating), Digital Multimeter, Measurement of- Low Resistance by Kelvin's Double Bridge Method, Medium Resistance by Voltmeter Ammeter Method and Wheatstone Bridge Method and High Resistance by Megger AC Bridges, Measurement of Self Inductance by Maxwell's Bridge, Hay's Bridge and Anderson's Bridge, Measurement of Capacitance by Schering's Bridge and DeSauty's Bridge, Measurement of frequency by Wien's Bridge Method. **[10 Lectures]**

Oscilloscope: Block Diagram, CRT, Waveform Display and Electrostatic Focusing, Time Base and Sweep Synchronisation, , Screens for CRT, Oscilloscope Probes, Measurement of Voltage, Frequency and Phase by CRO, Digital Storage Oscilloscopes- Principle and Working, Advantages and Applications, CRO Specifications (Bandwidth, Sensitivity, Rise-time), LCD Display for Instruments. **[10 Lectures]**

Signal Generators: Audio Oscillator, Pulse Generator, Function Generators. (Qualitative only) **[3 Lectures]**

Transducers: Classification, Basic Requirements and Characteristics, Active and Passive Transducers, Resistive (Potentiometer and Strain Gauge- Theory, Temperature Compensation and Applications), Capacitive (Variable Area and Variable Air Gap Types), Inductive (LVDT) and Piezoelectric Transducers, Measurement of Temperature (RTD, Semiconductor IC Sensors), Light Transducers (Photo Resistors and Photovoltaic Cells). **[10 Lectures]**

Data Acquisition using Arduino: Arduino- Birth, Open Source Community, Functional Block Diagram, Functions of each Pin, Arduino Development Boards- IDE, I/O Functions, Looping Techniques, Decision Making Techniques, Designing of 1st Sketch, Programming of Arduino (Arduino ISP), Serial Port Interfacing, Basic Interfacing and I/O Concept, Interfacing LED, Switch, 7seg LED. **[10 Lectures]**

Bio-Medical Instrumentation: Bio-Amplifiers, Bio-Potentials, Bio-Electricity, Necessity for Special Types of Amplifiers for Biological Signal Amplifications, Different Types of Bio-Op-Amps, Electrodes for ECG, EEG and EMG, Block Diagram of ECG and EEG Systems, Brief Analysis of Graphs. **[9 Lectures]**

ELSGEHP-3: Instrumentation Lab
[Credits: 02]

1. Design of multi range ammeter and voltmeter using galvanometer.
2. To determine the Characteristics of resistance transducer – Strain Gauge (Measurement of Strain using half and full bridge).
3. To determine the Characteristics of LVDT.
4. To determine the Characteristics of Thermistors.
5. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
6. Characterization of bio potential amplifier for ECG signals.
7. Study on ECG simulator.
8. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator.
9. Study of pulse rate monitor with alarm system.
10. Measurement of respiration rate using thermistor /other electrodes.
11. Test the different Arduino Boards, Open-Source and Arduino Shields.
12. Install Arduino IDE and its development tool.
13. Develop a program to Blink LED for 1second.
14. Develop a program to interface Input Switches and output LEDs with development board (Arduino).
15. Interface 7 segment display with development board (Arduino).
16. Interface LM35 temperature sensor with Arduino and monitor temperature on serial monitor.
17. Interface DC motor using L293D Motor Driver.

GE-4

ELSGEHT-4: Photonic Devices and Power Electronics
[Credits: 04; Lecture Hours: 56]

Optoelectronic Devices: Classification of Photonic Devices, Interaction of Radiation and Matter, Radiative Transition and Optical Absorption, Light Emitting Diodes- Construction, Materials and Operation, Semiconductor Laser- Condition for Amplification, Laser Cavity, Heterostructure and Quantum Well Devices, Charge Carrier and Photon Confinement, Line Shape Function, Threshold Current, Laser Diode. **[11 Lectures]**

Photodetectors: Photoconductor, Photodiodes (p-i-n, Avalanche) and Photo Transistors, Quantum Efficiency and Responsivity, Photomultiplier Tube. **[5 Lectures]**

Solar Cell: Construction, Working and Characteristics. **[2 Lectures]**

LCD Displays: Types of Liquid Crystals, Principle of Liquid Crystal Displays, Applications, Advantages over LED Displays. **[4 Lectures]**

Introduction to Fiber Optics: Evolution of Fiber Optic System, Element of Optical Fiber Transmission Link, Optical Fiber Modes and Configurations, Mode Theory of Circular Wave Guides, Overview of Modes-Key Modal Concepts, Linearly Polarized Modes, Single Mode Fibers and Graded Index Fiber Structure. **[12 Lectures]**

Power Electronics Devices: Need for Semiconductor Power Devices, Power MOSFET (Qualitative), Introduction to Family of Thyristors, Silicon Controlled Rectifier (SCR)- Structure, I-V Characteristics, Turn-On and Turn-Off Characteristics, Ratings, Gate-Triggering Circuits, Diac and Triac- Basic Structure, Working and I-V Characteristics, Application of Diac as Triggering Device for Triac. **[9 Lectures]**

Insulated Gate Bipolar Transistors (IGBT): Basic Structure, I-V Characteristics, Switching Characteristics, Device Limitations and Safe Operating Area (SOA). **[2 Lectures]**

Applications of SCR: Phase Controlled Rectification, AC Voltage Control using SCR and Triac, Power Invertors- Need for Commutating Circuits and their Various Types, DC Link Invertors, Parallel Capacitor Commutated Invertors, Series Invertors, Limitations and its Improved Versions, Bridge Invertors. **[11 Lectures]**

ELSGEHP-4: Photonic Devices and Power Electronics Lab
[Credits: 02]

1. To determine wavelength of sodium light using Michelson's Interferometer.
2. Diffraction experiments using a laser.
3. Study of Electro-optic Effect.
4. To determine characteristics of (a) LEDs, (b) Photo voltaic cell and (c) Photo diode.
5. To study the Characteristics of LDR and Photodiode with (i) Variable Illumination intensity and (ii) Linear Displacement of source.
6. To measure the numerical aperture of an optical fiber.
7. Output and transfer characteristics of a power MOSFET.
8. Study of I-V characteristics of SCR.
9. SCR as half wave and full wave rectifiers with R and RL loads.
10. AC voltage controller using TRIAC with UJT triggering.
11. Study of I-V characteristics of DIAC.
12. Study of I-V characteristics of TRIAC.

GE-5

ELSGEHT-5: Communication Systems
[Credits: 04; Lecture Hours: 56]

Electronic Communication: Introduction to communication – means and modes. Need for modulation, Block diagram of an electronic communication system, Brief idea of frequency allocation for radio communication system in India (TRAI), Electromagnetic communication spectrum, Band designations and usage, Channels and base-band signals, Noise - Introduction, Internal and external noises, Signal-to-noise (S/N) ratio and noise figure. **[7 Lectures]**

Amplitude Modulation: Definition, Representation, Modulation index, Expression for instantaneous voltage, Power relations, Frequency spectrum, Concept of DSBFC, DSBSC, SSBSC generation and detection, Limitations of AM, Demodulation - AM detection, Diode detector circuit, Principle of working and waveforms, Concept of VSB, Block diagram of AM transmitter and Receiver. **[9 Lectures]**

Frequency Modulation and Phase Modulation: Definition, Representation, Modulation index, Frequency spectrum, Bandwidth requirements, Frequency deviation and carrier swing, Equivalence between FM and PM, Generation of FM using VCO, Demodulation - FM detector, Slope detector circuit, Principle of working and waveforms, Block diagram of FM transmitter and receiver, Comparison of AM and FM, Qualitative idea of Super heterodyne receiver. **[9 Lectures]**

Analog Pulse Modulation: Channel capacity, Sampling theorem, Basic principles of PAM, PWM and PPM, Modulation and detection technique for PAM only, Multiplexing. **[7 Lectures]**

Digital Pulse Modulation: Need for digital transmission, Digital radio, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding, Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK), Advantages and disadvantages of digital communication, Characteristics of data transmission circuits – Shannon limit for information capacity, Bandwidth requirements, Data transmission speed, Noise, Cross talk, Echo suppressors, Distortion and equalizer, Concept of TDMA, FDMA and CDMA, comparison of TDMA and FDMA. **[8 Lectures]**

Cellular Communication: Concept of cellular mobile communication, Frequency bands used in cellular communication, Concept of cell sectoring and cell splitting, Absolute RF channel numbers (ARFCN), Frequency reuse, Roaming and hand off, Authentication of the SIM card of the subscribers, IMEI number, Need for data encryption, Architecture (block diagram) of cellular mobile communication network, Idea of GSM and CDMA technology, Simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts, Qualitative idea of GPS navigation system. **[8 Lectures]**

Satellite Communication– Introduction, Need, Geosynchronous satellite orbits, Geostationary satellite, Advantages of geostationary satellites, Satellite visibility, Transponders (C - Band), Path loss, Ground station, Simplified block diagram of earth station, Uplink and downlink. **[8 Lectures]**

ELSGEHP-5: Communication Systems Lab
[Credits: 02]

1. To design an Amplitude Modulator using Transistor.
2. To study envelope detector for demodulation of AM signal.
3. To study FM Generator and Detector circuit.
4. To study AM Transmitter and Receiver.
5. To study FM Transmitter and Receiver.
6. To study Time Division Multiplexing (TDM).
7. To study Pulse Amplitude Modulation (PAM).
8. To study Pulse Width Modulation (PWM).
9. To study Pulse Position Modulation (PPM).
10. To study ASK, PSK and FSK modulators.

GE-6

ELSGEHT-6: Microprocessor and Microcontroller Systems
[Credits: 04; Lecture Hours: 56]

Introduction to Microprocessor: Introduction, Applications, Basic Block Diagram, Speed, Word Size, Memory Capacity, Classification of Microprocessors (mention different microprocessors being used). **[2 Lectures]**

8085 Microprocessor: Main Features, Architecture- Block diagram, CPU, ALU, Registers, Flags, Stack Pointer, Program Counter, Data and Address Buses, Control Signals, Pin-Out Diagram and Pin Description. **[8 Lectures]**

8085 Instruction and Programming: Operation Code, Operand and Mnemonics, Instruction Classification, Addressing Modes, Instruction Format, Instructions Set- Data Transfer, Arithmetic, Increment, Decrement, Logical, Branch and Machine Control Instructions, Assembly Language Programming Examples, Stack Operations, Subroutines and Delay Loops Call and Return Operations, Use of Counters, Timing and Control Circuitry, Timing Diagram, Instruction Cycle, Machine Cycle, T (Timing)-States, Time Delay. **[8 Lectures]**

Interrupts: Structure, Hardware and Software Interrupts, Vectored and Non-Vectored Interrupts Latency Time and Response Time. **[2 Lectures]**

Interfacing: Basic Interfacing Concepts, Memory Mapped I/O and I/O Mapped I/O and Isolated I/O Structure, Partial/Full Memory Decoding, Interfacing of Programmable Peripheral Interface (PPI) Chip (8255), Address Allocation Technique and Decoding, Interfacing of I/O Devices (LEDs and Toggle-Switches as Examples). **[4 Lectures]**

Introduction to Microcontroller: Introduction, Types, Basic Block Diagram, Comparison of Microcontroller with Microprocessors, Comparison of 8 Bit, 16 Bit and 32 Bit Microcontrollers. **[2 Lectures]**

8051 Microcontroller: Architecture- Internal Block diagram, Key Features, Pin Diagram, Memory Organization, Internal RAM Memory, Internal ROM, General Purpose Data Memory, Special Purpose/Function Registers, External Memory, Program Counter and ROM Memory Map, Data Types and Directives, Flag Bits and Program Status Word (PSW) Register, Jump, Loop and Call Instructions. **[10 Lectures]**

8051 I/O Port Programming: Introduction of I/O Port Programming, Pin-Out Diagram of 8051 Microcontroller, I/O Port Pins Description and their Functions, I/O Port Programming in 8051 (using assembly language), I/O Programming: Bit manipulation. **[4 Lectures]**

8051 Programming: 8051 Addressing Modes and Accessing Memory Locations using Various Addressing Modes, Assembly Language Instructions using Addressing Mode, Arithmetic and Logic Instructions, 8051 Programming in C- for Time Delay and I/O Operations and Manipulation, for Arithmetic and Logic operations, for ASCII and BCD Conversions, 8051 Assembly Language Programming Examples. **[10 Lectures]**

Introduction to Embedded System: Embedded Systems and General Purpose Computer Systems, Architecture of Embedded System, Classifications, Applications and Purpose of Embedded Systems. **[4 Lectures]**

ELSGEHP-6: Microprocessor and Microcontroller Systems Lab
[Credits: 02]

Section-A: Programs using 8085 Microprocessor:

1. Transfer of block of data.
2. Addition and subtraction of numbers using direct addressing mode.
3. Addition and subtraction of numbers using indirect addressing mode.
4. Multiplication by repeated addition.
5. Division by repeated subtraction.
6. Handling of 16-bit Numbers.
7. Search a given number in a given list.
8. Generate Fibonacci series.
9. Sorting of numbers in ascending/descending order.
10. To find square root of an integer.
11. Use of CALL and RETURN Instruction.
12. To study interfacing of IC 8255.
13. Other programs (e.g. Parity Check, using interrupts, etc.).
14. Program to verify truth table of logic gates.

Section-B: Experiments using 8051 microcontroller:

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. To find (a) largest of N numbers and (b) smallest of N numbers.
4. To find whether the given data is palindrome.
5. To arrange the numbers in ascending/descending order.
6. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
7. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's .
8. Program to glow the first four LEDs then next four using TIMER application.
9. Program to rotate the contents of the accumulator first right and then left.
10. Program to run a countdown from 9-0 in the seven segment LED display.
11. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
12. To toggle '1234' as '1324' in the seven segment LED display.
13. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
14. Application of embedded systems: Temperature measurement and display on LCD.