CBCS SYLLABUS

FOR

THREE YEARS UNDER-GRADUATE

COURSE

IN

ELECTRONIC SCIENCE (HONOURS)

(*w.e.f. 2017*)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

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

Course	*Credits	
	Theory+ Practical	Theory + Tutorial
I. Core Course		
(14 Papers)	14X4= 56	
Core Course Practical / Tutorial*		
(14 Papers)	14X2=28	
II. Elective Course		
(8 Papers)		
A.1. Discipline Specific Elective	4X4=16	
(4 Papers)		
A.2. Discipline Specific Elective Practical/ Tutorial*	4 X 2=8	
(4 Papers)		
B.1. Generic Elective/ Interdisciplinary	4X4=16	4X5=20
(4 Papers)		
B.2. Generic Elective Practical/ Tutorial*	4 X 2=8	4X1=4
(4 Papers)		
III. Ability Enhancement Courses		
1. **Ability Enhancement Compulsory Courses (AECC)**		
(2 Papers of 2 credit each)	2 X 2=4	2 X 2=4
Environmental Science		
English/MIL Communication		
2. **Skill Enhancement Courses (SEC)**		
(Minimum 2)	2 X 2=4	2 X 2=4
(2 Papers of 2 credit each)		
Total credit	**140**	**140**

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

	CORE COURSE (14)	**Ability Enhancement Compulsory Course (AECC) (2)**	**Skill Enhancement Course (SEC) (2)**	**Elective: Discipline Specific DSE (4)**	**Elective: Generic (GE) (4)**
I	Basic Circuit Theory and Network Analysis Mathematics Foundation for Electronics	(English/ MIL Communication)/ Environmental Science			GE-1
II	Semiconductor Devices Applied Physics	Environmental Science/(English/ MIL Communication)			GE-2
III	Electronic Circuits Digital Electronics and Verilog C Programming and Data Structures		SEC -1		GE-3
IV	Operational Amplifiers and Applications Signals and Systems Electronic Instrumentation		SEC -2		GE-4
V	Microprocessors and Microcontrollers Electromagnetics			DSE-1 DSE -2	
VI	Communication Electronics Photonics			DSE -3 DSE -4	

SEMESTER-WISE SCHEDULE FOR B.Sc. (HONOURS) ELECTRONIC SCIENCE

Semester	Course Opted	Course Name	Credits
I	Ability Enhancement Compulsory Course-I	English/MIL communications/ Environmental Science	2
	Core course-I	Basic Circuit Theory and Network Analysis	4
	Core Course-I Practical/Tutorial	Basic Circuit Theory and Network Analysis Lab	2
	Core course-II	Mathematics Foundation for Electronics	4
	Core Course-II Practical/Tutorial	Mathematics Foundation for Electronics Lab	2
	Generic Elective -1	GE-1	4/5
	Generic Elective -1 Practical/Tutorial		2/1
II	Ability Enhancement Compulsory Course-II	English/MIL communications/ Environmental Science	2
	Core course-III	Semiconductor Devices	4
	Core Course-III Practical/Tutorial	Semiconductor Devices Lab	2
	Core course-IV	Applied Physics	4
	Core Course-IV Practical/Tutorial	Applied Physics Lab	2
	Generic Elective -2	GE-2	4/5
	Generic Elective -2 Practical/Tutorial		2/1
III	Core course-V	Electronic Circuits	4
	Core Course-V Practical/Tutorial	Electronic Circuits Lab	2
	Core course-VI	Digital Electronics and VHDL	4
	Core Course-VI Practical/Tutorial	Digital Electronics and VHDL Lab	2
	Core course-VII	C Programming and Data Structures	4
	Core Course-VII Practical/Tutorial	C Programming and Data Structures Lab	2
	Skill Enhancement Course-1	SEC-1	2
	Generic Elective -3	GE-3	4/5
	Generic Elective -3 Practical/Tutorial		2/1
IV	Core course-VIII	Operational Amplifiers and Applications	4
	Core Course-VIII Practical/Tutorial	Operational Amplifiers and Applications Lab	2
	Core course-IX	Signals and Systems	4
	Core Course-IX Practical/Tutorial	Signals and Systems Lab	2

	Core course-X	Electronic Instrumentation	4
	Core Course-X Practical/Tutorial	Electronic Instrumentation Lab	2
	Skill Enhancement Course-2	SEC-2	2
	Generic Elective -4	GE-4	4/5
	Generic Elective -4 Practical/Tutorial		2/1
V	Core course-XI	Microprocessors and Microcontrollers	4
	Core Course-XI Practical/Tutorial	Microprocessors and Microcontrollers Lab	2
	Core course-XII	Electromagnetics	4
	Core Course-XII Practical/Tutorial	Electromagnetics Lab	2
	Discipline Specific Elective-1	DSE-1	4
	Discipline Specific Elective-1 Practical/Tutorial	DSE-1 Lab	2
	Discipline Specific Elective-2	DSE-2	4
	Discipline Specific Elective-2 Practical/Tutorial	DSE-2 Lab	2
VI	Core course-XIII	Communication Electronics	4
	Core Course-XIII Practical/Tutorial	Communication Electronics Lab	2
	Core course-XIV	Photonics	4
	Core Course-XIV Practical/Tutorial	Photonics Lab	2
	Discipline Specific Elective-3	DSE-3	4
	Discipline Specific Elective-3 Practical/Tutorial	DSE-3 Lab	2
	Discipline Specific Elective-4	DSE-4	4
	Discipline Specific Elective-4 Practical/Tutorial	DSE-4 Lab	2
		Total Credits	140

1 Credit = 1 Hour/week for Theory; 2 Hours/week for Practical

CORE COURSE(C): (Credit: 06 each) (1 period/week fortutorials or 4 periods/week for practical)

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

13. Communication Electronics
14. Photonics

Discipline Specific Electives (DSE): (Credit: 06 each): 4 papers to be selected, 2 papers for Semester-V (DSE-1 to 3) and 2 papers for Semester-VI (DSE-4 to 6)

1. Power Electronics
2. Transmission Lines, Antenna and Wave Propagation
3. Modern Communication Systems
4. Control Systems
5. Numerical Techniques
6. Digital Signal Processing

Skill Enhancement Course (SEC) (02 papers) (Credit: 02 each) - SEC1 to SEC2

1. Programming with MATLAB**Semester-III: SEC-1**
2. Design and Fabrication of Printed Circuit Boards **Semester-IV: SEC-2**

Other Discipline - GE 1 to GE 4

1. Mathematics
2. Computer Science
3. Physics
4. Biomedical Science
5. Chemistry
6. Commerce

Any other discipline of Choice

Generic Elective Papers (GE) (any four) for Honours candidates of other Departments/Disciplines: (Credit: 06 each)

1. Electronic Circuits and PCB Designing
2. Digital System Design
3. Communication Systems
4. Instrumentation

Full Marks: 25 Time 1 Hour 30 minutes

Total 8 questions each of 2 marks are to be set; any 5 to be answered.
Total 4 questions each of 5 marks are to be set; any 1 to be answered.
Total 4 questions each of 10 marks are to be set; any 1 to be answered.

SEMESTER I

C-I (Theory): Basic Circuit Theory and Network Analysis (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory **Lectures 60**

Unit- 1 (10 Lectures)

Basic Circuit Concepts:
Resistors: Fixed and Variable resistors, Color coding of resistors, resistors in series and parallel and its applications.
Inductors:Self and mutual inductance, Energy stored in an inductor, Inductance in series and parallel and its applications.
Capacitors: Various types of capacitors, Fixed and Variable capacitor, Energy stored in a capacitor, capacitors in series and parallel and its applications.
Voltage and Current Sources-Ideal and Practical, Dependent Sources

Unit- 2 (14 Lectures)

Circuit Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, MeshAnalysis, Linear Circuits, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Principle of Duality, Star-Delta Conversion (Concept only)

DC Transient Analysis: RC Circuit- Charging and discharging, RL Circuit-Growth and Decay of current, Time Constant in RL and RC Circuits, DC Response of Series RLC Circuits.

Unit-3 (20 Lectures)

AC Circuit Analysis: Sinusoidal Voltage and Current source, Definition of Instantaneous, Peak, Peak to Peak, RootMean Square and Average Values, Voltage-Current relationship in Resistor, Inductor and Capacitor, Complex Impedance, Phasor, Phase relationship between current and voltage in RL and RC circuit.
Power in AC Circuits: True and apparent power, wattles current, Power factor.
Sinusoidal Circuit Analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth.
Wave shaping RC circuit-Low Pass, High Pass, Integrator, Differentiator.

Unit-4 (16 Lectures)

Network Theorems:Superposition Theorem, Thevenin's Theorem, Norton's Theorem,Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem using ac source,
Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD)

Parameters.

Suggested books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.(2005)
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005)
5. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)

C-I (Practical): 60 Lectures

Basic Circuit Theory and Network Analysis Lab (Hardware and Circuit Simulation Software)

1. Familiarization with
   - Resistance in series, parallel and series – Parallel.
   - Capacitors & Inductors in series & Parallel.
   - Multimeter – Checking of components.
   - Voltage sources in series, parallel and series – Parallel
   - Voltage and Current dividers
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchhoff'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.

C-II (Theory): Mathematics Foundation for Electronics (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit – 1 (12 Lectures)

Ordinary Differential Equations, Series solution of differential equations, special functions: Basic concepts, different types of DifferentialEquations, First Order ordinary Differential Equations,Second Order homogeneous and non-homogeneous Differential Equations, Different solution techniques as applied to physical problems- like thermal, hydraulic, electrical systems, Solution by Power series method, Error functions, gamma function and Beta function.

Unit-2 (12 Lectures)

Matrices: Introduction to Matrices, Different techniques for solution of a System of Linear Algebraic Equations. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Diagonalization, Powers of a Matrix, Classification of different types of Real and Complex Matrices.

Unit-3 (12 Lectures)

Sequences and series: Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series- conditions and methods.

Unit-4 (14 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 Functions, Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivative of Analytic Functions, Taylor's Series, Laurent Series, Zeroes and Poles, Residue integration method, Residue integration of real Integrals.

Unit-5 (10 Lectures)

Laplace Transform: Laplace Transform properties, Transform of different signals, Inverse Laplace Transform, Application in circuit analysis, Equivalent circuit of Inductor, Capacitor in S-domain.

Suggested Books

1. E. Kreyszig, advanced engineering mathematics, Wiley India (2008)
2. Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series, Tata McGraw Hill (2007)
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
5. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)

C- II (Practical): 60 Lectures

Mathematics Foundation for Electronics Lab (Using C language/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. Numerical integration of a given function in a specified interval.

SEMESTER II

C-III (Theory): Semiconductor Devices (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory **Lectures 60**

Unit- 1 (14 Lectures)

Semiconductor Basics: Introduction to Semiconductor Materials, Crystal Structure, Planes and MillerIndices, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations.

Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes, Continuity Equation.

Unit 2 (14 Lectures)

P-N Junction Diode: Formation of Depletion Layer, Space Charge at a Junction, Derivation of ElectrostaticPotential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism.

Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications

Unit 3 (14 Lectures)

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Current Gain, 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.

Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.

Unit 4 (18 Lectures)

Field Effect Transistors:

JFET- Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage,Current-Voltage Output Characteristics.

MOSFET - Types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P

channel), Complimentary MOS (CMOS).

Power Devices:

UJT - Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio,Characteristics and relaxation oscillator-expression.

SCR - Construction,Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.

Suggested Books:

1) S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
2) Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3) Dennis Le Croissette, Transistors, Pearson Education (1989)
4) Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
5) Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
6) Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

C-III (Practical): 60 Lectures

Semiconductor Devices Lab (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 CE 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, ri, 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.

C-IV (Theory): Applied Physics (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit-1 (20 Lectures)

Quantum Physics: Inadequacies of Classical physics,Electron diffraction experiment, Compton's effect, Photo-electric Effect, Plank's law, Wave-particleduality, Heisenberg's Uncertainty Principle, de Broglie waves, Basic postulates and formalism of quantum mechanics: probabilistic interpretation of waves, conditions for physical acceptability of wave functions, Schrodinger wave equation for a free particle and in a force field (1 Dimension), Boundary and continuity conditions,Operators in Quantum Mechanics, Conservation of probability, Time-dependent form, Linearity and superposition, Operators, Time-independent one dimensional Schrodinger wave equation, Stationary states, Eigen-values and Eigen functions, Particle in a one-dimensional box, Extension to a three dimensional box, Potential barrier problems, phenomenon of tunneling, Kronig Penney Model and development of band structure, E-k diagram in solids, classification of conductors, insulators and semi-conductors on the basis of E-K diagram.
Quantum statistics: Quantization of phase space, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein probability distribution functions and their importance.

Unit-2 (10 Lectures)

Crystalline materials and Bonding in solids: Crystal Structure in solids, Concept of Lattice, Basis, Crystal axes and planes, Reciprocal lattice, Primitive cells, Metallic bonds, Ionic bonds, Covalent bonds.

Unit-3 (15 Lectures)

Thermal Properties: Brief Introduction to Laws of Thermodynamics, Concept of Entropy, Enthalpy function, Concept ofPhonons, Heat Capacity, Debye's Law (concept only), Lattice Specific Heat, Electronic Specific Heat (concept only), Thermal Conductivity, Thermoelectricity, Seebeck Effect, Peltier Effect, Thomson Effect.

Unit-4 (15 Lectures)

Electric and Magnetic Properties: Conductivity of metals, Ohm's Law, relaxation time, collision time andmean free path, electron scattering and resistivity of metals, heat developed in current carrying conductor, Superconductivity.
Classification of Magnetic Materials, Origin of Magnetic moment, Origin of dia, para, ferro and antiferro magnetism and their comparison, Ferrimagnetic materials, Saturation Magnetization and Curie temperature, Magnetic domains, Concepts of Giant Magnetic Resistance (GMR).

Suggested Books:

1. S. Vijaya and G. Rangarajan, Material Science, Tata McGraw Hill (2003)
2. W. E. Callister, Material Science and Engineering: An Introduction, Wiley India (2006)
3. A. Beiser, Concepts of Modern Physics , McGraw-Hill Book Company (1987)
4. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, Macmillan India (2004)

C-IV (Practical):60 Lectures

Applied Physics Lab

1. To measure the resistivity of a Ge crystal with temperature by four–probe method from room temperature to 200 ^{0}C).
2. To determine the value of Boltzmann Constant by studying forward characteristics of diode.
3. To determine the value of Planck's constant by using LEDs of at least 4 different wavelengths.
4. To measure the bandgap of a Thermistor.

SEMESTER III

C-V (Theory): Electronics Circuits (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit- 1 (14 Lectures)

Diode Circuits: Ideal diode, piece-wise linear equivalent circuit, dc load line analysis, Quiescent (Q) point.Clipping and clamping circuits, Rectifiers: HWR, FWR (center tapped and bridge), Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison.
Filters: Types, circuit diagram and explanation of shunt capacitor filter with waveforms.
Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

Unit- 2 (15 Lectures)

Bipolar Junction Transistor: Review of CE, CB Characteristics and regions of operation, Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with R_E, collector to base bias, voltage divider bias and emitter bias ($+V_{CC}$ and $-V_{EE}$ bias), circuit diagrams and their working.
Transistor as a switch, circuit and working**,** Darlington pair and its applications.
BJT amplifier (CE), dc and ac load line analysis, Hybridparameters, Hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).

Unit- 3 (13 Lectures)

Feedback Amplifiers: Concept of feedback, negative and positive feedback, advantages and disadvantages ofnegative feedback, voltage and current feedback amplifiers, gain, input and output impedances. Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.

Unit- 4 (18 Lectures)

MOSFET Circuits: Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small SignalParameters, Common Source amplifier circuit analysis, CMOS circuits.
Power Amplifiers: Difference between voltage and power amplifier, classification of power amplifiers, ClassA, Class B, Class C, Class AB and their comparisons.
Operation of a Class A single ended power amplifier, Operation of Transformer coupled Class A power amplifier, overall efficiency, Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion.

Single tuned amplifiers: Circuit diagram, Working and Frequency Response for each, Limitations of singletuned amplifier, Applications of tuned amplifiers in communication circuits.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronic devices, David A Bell, Reston Publishing Company
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
8. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation

C-V (Practical):60 Lectures

Electronics Circuits Lab (Hardware and Circuit Simulation Software)

1. Study of the Half wave rectifier and Full wave rectifier.
2. Study of power supply using C filter and Zener diode.
3. Designing and testing of 5V/9 V 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.

C-VI (Theory):Digital Electronics and Verilog/VHDL(Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit-1 (11 Lectures)

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions,Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code.
Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Truth Tables ofOR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates.
Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed powerproduct, TTL and CMOS families and their comparison.

Unit-2 (13 Lectures)

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS),Karnaugh map minimization, Encoder and Decoder, Multiplexers and De-multiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor, Comparator, Parity generator and Checker.

Unit-3 (18 Lectures)

Sequential logic design: Latches and Flip flops , S-R Flip flop, D type Flip flop, J-K Flip flop, T Flip flop,Clocked and edge triggered Flip flops, master slave flip flop, Registers, Counters (synchronous and asynchronous and modulo-N), State Table, State Diagrams, counter design using excitation table and equations, Ring counter and Johnson counter,
Memory technology, types of memory-volatile &non-volatile, ROM, PROM, EPROM,EEPROM, Flash memory, SRAM, DRAM, SDRAM, Concept of Primary, Secondary and Cache memory, Concept of CCD.
Programmable Logic Devices: Basic concepts- ROM, PLA, PAL, CPLD, FPGA

Unit-4 (18 Lectures)

Introduction to Verilog: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL andVerilog, Introduction to Simulation and Synthesis Tools, Test Benches, Verilog 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, Integers, reals and strings, Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Expressions, Operands, Operators, types of Expressions
Data flow Modeling and Behavioral Modeling: Data flow Modeling: Continuous assignment,

netdeclaration assignments, delays, net delays.
Behavioral Modeling: Procedural constructs, timing controls, block statement, procedural assignments, conditional statement, loop statement, procedural continuous assignment.
Gate level modeling - Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates,MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

OR

Introduction to VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL andVerilog, 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, describing 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 configurations.
Behavioral Modeling: Introduction to behavioral modeling, inertial delay, transport delay , inertial delaymodel, transport delay model, transport vs inertial 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, incompletetypes, File Type caveats, subtypes, Subprograms and functions.

Suggested Books:

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A Verilog HDL Primer – J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

C-VI (Practical):60 lectures

Digital Electronics and Verilog/VHDL Lab (Hardware and Circuit Simulation Software)

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 a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.

9. Design a shift register and study Serial and parallel shifting of data.

Experiments in Verlog/VHDL

1. Write code to realize basic and derived logic gates.
2. Half adder, 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 (4x1, 8x1) and De-multiplexer using logic gates.
6. Decoder, Encoders, Parity encoders
7. Design and simulation of 4-bit adder.
8. Code converters (Binary to Gray and vice-versa).
9. 2-bitMagnitude comparator.
10. 3-bit Ripple counter.

C-VII (Theory):C Programming and Data Structures(Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit- 1 (12 Lectures)

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).

Unit-2 (19 Lectures)

Decision making, branching & looping: Decision making, branching and looping: if, if-else, else-if, switchstatement, 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.

Unit-3 (15 Lectures)

Data Structures: Definition of stack, array implementation of stack, conversion of infix expression to prefix,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.

Unit-4 (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 andinorder traversal (recursive).

Suggested Books:

1. Yashavant Kanetkar, Let Us C , BPB Publications
2. Programming in ANSI C, Balagurusamy, 2nd edition, TMH.
3. Byron S Gottfried, Programming with C , Schaum Series

4. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
5. Yashavant Kanetkar, Pointers in C, BPB Publications
6. S. Sahni and E. Horowitz, "Data Structures", Galgotia Publications
7. Tanenbaum: "Data Structures using C", Pearson/PHI.
8. Ellis Horowitz and Sartaz Sahani "Fundamentals of Computer Algorithms", Computer Science Press.

C-VII (PRACTICAL): 60 Lectures

C Programming and Data Structures Lab

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 & difference of two matrices of order MxN and PxQ.
10. Find the product of two matrices of order MxN and PxQ.
11. Find the transpose of given MxN matrix.
12. Find the sum of principle and secondary diagonal elements of the given MxN 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.

SEC-I: Programming with MATLAB (Credits: 02)

F.M. = 50 (Theory - 40, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Total Lectures60

MATLAB Basics

The MATLAB environment - Basic computer programming - Variables and constants, operatorsand simple calculations - Formulas and functions - MATLAB toolboxes.

Matrices and vectors

Matrix and linear algebra review - Vectors and matrices in MATLAB - Matrix operations andfunctions in MATLAB

Computer programming

Algorithms and structures - MATLAB scripts and functions (m-files) - Simple sequentialalgorithms - Control structures

MATLAB programming and Numerical Simulations

Matlab Programming: Reading and writing data, file handling - Personalized functions - Toolbox structure – MATLABgraphic functions

Numerical simulations: Numerical methods and simulations - Random number generation - Montecarlo methods

Suggested Books:

- Hanselman Mastering Matlab. Pearson
- Rudrapratap Matlab Oxford
- Bansal Matlab Pearson
- Navas Lab Primer through Matlab PHI

SEMESTER-IV

Core Course-VIII: Operational Amplifiers and Applications (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit-1 (18 Lectures)

Basic Operational Amplifier: Concept of differential amplifiers (Dual input balanced and unbalancedoutput), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741)

Op-Amp parameters: input offset voltage, input offset current, input bias current, differential inputresistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Unit-2 (18 Lectures)

Op-Amp Circuits: Open and closed loop configuration, Frequency response of an op-amp in open loop andclosed loop configurations, Inverting, Non-inverting, Summing and Difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter.
Comparators: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger.
Signal generators: Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wavegenerator, saw tooth wave generator and Voltage controlled oscillator(IC 566).

Unit-3 (12 Lectures)

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications ofMonostable and Astable multivibrators, Phase locked loops (PLL): Block diagram, phase detectors, IC565.
Fixed and variable IC regulators: IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation

Unit-4 (12 Lectures)

Signal Conditioning circuits: Sample and hold systems, Active filters: First order low pass and high passbutterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.

Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson

Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
4. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
5. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)

Core Course-VIII (Practical): 60 Lectures

Operational Amplifiers and Application Lab (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 subtractor 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. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.
11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series

Core Course-IX: Signals & Systems (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit-1(17 Lectures)

Signals and Systems: Continuous and discrete time signals, Transformation of the independent variable,Exponential and sinusoidal signals, Impulse and unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

Unit-2(13 Lectures)

Linear Time -Invariant Systems (LTI): Discrete time LTI systems, the Convolution Sum, Continuous timeLTI systems, the Convolution integral, Properties of LTI systems, 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.

Unit-3(18 Lectures)

Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of theFourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Simple RC highpass and lowpass 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.

Unit-4(12 Lectures)

Laplace Transform: Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform for signals, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

Suggested Books:

1. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007)
2. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004)
3. C. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)
4. H. P. Hsu, Signals and Systems, Tata McGraw Hill (2007)
5. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling,

Orchard Publications (2008)
6. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)
7. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2007)

Core Course-IX: Practical **60 Lectures**

Signals & Systems Lab (Scilab/MATLAB/ Other Mathematical Simulation software)

1. Generation of Signals: continuous time
2. Generation of Signals: discrete time
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

Core Course-X: Electronic Instrumentation (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit-1(15 Lectures)

Qualities of Measurement: Specifications of instruments, 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, **o**hm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter).

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronicconnectors – audio and video, RF/Coaxial, USB etc.

Unit-2(15 Lectures)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, MediumResistance by Voltmeter Ammeter method, 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: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuitof R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Unit-3(16 Lectures)

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization,measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).

Signal Generators: Audio oscillator, Pulse Generator, Function generators.

Unit -4(14 Lectures)

Transducers and sensors: Classification of transducers, Basicrequirement/characteristics of transducers,active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types,

temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type – Variable Permittivity type), 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).

Suggested Books:

1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall (2005).
3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
4. E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).
5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
7. Oliver and Cage, “Electronic Measurements and Instrumentation”, TMH (2009).
8. Alan S. Morris, “Measurement and Instrumentation Principles”, Elsevier (Buterworth Heinmann-2008).
9. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpatRai and Sons (2007).
10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).

Core Course X: Practical **60 Lectures**

Electronic Instrumentation Lab

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. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
6. To determine the Characteristics of LVDT.
7. To determine the Characteristics of Thermistors and RTD.
8. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
9. To study the Characteristics of LDR, Photodiode, and Phototransistor:
   (i) Variable Illumination.
   (ii) Linear Displacement.
10. Characteristics of one Solid State sensor/ Fiber optic sensor

SEC-2: Design and Fabrication of Printed Circuit Boards (Credits: 02)

F.M. = 50 (Theory - 40, Internal Assessment – 10)

Internal Assessment [Class Attendance (Theory) – 05, Theory (Class Test/ Assignment/ Tutorial) – 05]

Total Lectures 60

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.

Schematic & 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.

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 & 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.

PCB Technology: Trends, Environmental concerns in PCB industry.

Suggested Books:

1. Printed circuit Board – Design & Technology by Walter C. Bosshart, Tata McGraw Hill.
2. Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, TATA McGrawHill Publisher

SEMESTER-V

Core Course-XI: Microprocessor and Microcontrollers (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit-1 (18 Lectures)

Introduction to Microprocessor: 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, stack pointer, program counter, types of buses. Multiplexed address 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.
8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Assembly language programming examples.

Unit-2 (10 Lectures)

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 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts
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.

Unit-3 (18 Lectures)

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 module, EUSART, master synchronous serial port (MSSP) module, special features of the CPU, interrupts, addressing modes, instruction set.

Unit-4 (14 Lectures)

Interfacing to PIC16F887: LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor. Interfacing program examples using C language.

Suggested Books:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram—Danpat Rai Publications.
3. Microchip PIC16F87X datasheet
4. PIC Microcontrollers, Milan Verle, , mikro Elektronika, 1st edition (2008)
5. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006

Core Course-XI: Practical60 Lectures

Microprocessor and Microcontrollers Lab 8085 Assembly language programs:

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

Note: Programs to be written using C programming language

1. LED blinking with a delay of 1 second.
2. Solid State Relay Interface
2. Interfacing of LCD (2X16).
3. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control.
4. To test all the gates of a given IC74XX is good or bad.
5. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface.
6. Display of 4- digit decimal number using the multiplexed 7-segment display interface.
7. Analog to digital conversion using internal ADC and display the result on LCD.
8. Implementation of DC-Volt meter (0-5V) using internal ADC and LCD
9. Digital to analog conversion using PWM (pulse delay to be implemented using timers).
10. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
11. Interfacing of matrix keyboard (4X4).
12. Serial communication between microcontroller and PC.

Core Course-XII: Electromagnetics (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1(16Lectures)

Vector Analysis: Scalars and Vectors, Vector Algebra, Rectangular (Cartesian) Coordinate System, Vector Components and Unit Vector, Vector Field, Products, Cylindrical Coordinates, Spherical Coordinates, Differential Length, Area and Volume, Line, Surface and Volume integrals, Del Operator, Gradient of a Scalar, Divergence and Curl of a Vector, the Laplacian.
Electrostatic Fields: Coulomb's Law and Electric Field, Field due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss's Law and Applications, Divergence Theorem and Maxwell's First Equation. Electric Potential, Potential due to a Charge and Charge distribution, Electric dipole. Electric Fields in Conductors, Current and Current Density, Continuity of Current, Metallic Conductor Properties and Boundary Conditions, Method of Images. Dielectric materials, Polarization, Dielectric Constant, Isotropic and Anisotropic dielectrics, Boundary conditions, Capacitance and Capacitors. Electrostatic Energy and Forces.

Unit-2(14 Lectures)

Poisson's Equation and Laplace's Equation: Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation: Cartesian, Cylindrical and Spherical Coordinates.
Magneto statics: Biot Savert's law and Applications, Magnetic dipole, Ampere's Circuital Law, Curl of a magnetic field, Stoke's Theorem, Maxwell's Equation, Magnetic Flux and Magnetic Flux Density, Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits. Inductances and Inductors, Magnetic Energy, Forces and Torques.

Unit-3(13 Lectures)

Time-Varying Fields and Maxwell's Equations: Faraday's Law of Electromagnetic Induction, 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 the Wave Equation for Potentials, Concept of Retarded Potentials. Electromagnetic Boundary Conditions. Time-Harmonic Electromagnetic Fields and use of Phasors.

Unit-4(17 Lectures)

Electromagnetic Wave Propagation: Time- Harmonic Electromagnetic Fields and use of Phasors, the Electromagnetic Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Phase and Group velocity, Flow of Electromagnetic Power and Poynting Vector. Uniform Plane wave incident on a Plane conductor boundary, concept of reflection and standing wave.

Guided Electromagnetic Wave Propagation: Waves along Uniform Guiding Structures, TEM, TE and TMwaves, Electromagnetic Wave Propagation in Parallel Plate and Rectangular Metallic Waveguides.

Suggested Books:

1. Murray. R. Spiegel, Vector Analysis, Schaum series, Tata McGraw Hill (2006)
2. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press (2001)
3. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
4. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
5. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
6. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)
7. Introduction to Electrodynamics, D.J. Griffiths, Pearson Education (2012)
8. Electromagnetic Wave and Radiating System, Jordan and Balmain, Prentice Hall (1979)

Core Course-XII: Practical **60 Lectures**

Electromagnetics Lab (using 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.

DISCIPLINE SPECIFIC ELECTIVE PAPERS (Credit 06 for each paper)
(2 papers to be selected)

DSE-1: Power Electronics (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures 60

Unit- 1 (15 Lectures)

Power Devices and SCR

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.

Unit- 2 (15 Lectures)

Diac&Triac, IGBT, Application of SCR and Power MOSFETs

Diac and Triac: Basic structure, working and V-I characteristic of, application of a Diac as a triggering device for a 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 a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR and Triac as a switch.
Power MOSFETs: Operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

Unit- 3 (15 Lectures)

Power Inverters and Choppers

Power Inverters: Need for commutating circuits and their various types, d.c. link invertors, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, bridge invertors.
Choppers: Basic chopper circuit, types of choppers(Type A-D), step-down chopper, step-up chopper, operation of d.c. chopper circuits using self-commutation (A & 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.

Unit- 4 (15 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& speed of induction motor, Thyristor control of ac motors(block diagrams only).

DSE 1- Power Electronics Lab **60 Lectures**

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. AC voltage controller using TRIAC with UJT triggering.
6. Study of parallel and bridge inverter.
7. Design of snubber circuit
8. VI Characteristic of MOSFET and IGBT (Both)
9. Study of chopper circuits

Reference Books

- Power Electronics, P.C. Sen, TMH
- Power Electronics & Controls, S.K. Dutta
- Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
- Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, PearsonEducation
- Power Electronics, Applications and Design, Ned Mohan, Tore.
- Power Electronics, K. HariBabu, Scitech Publication.
- Power Electronics, M.S. Jamil Asghar, PHI.
- A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand

DSE-2: Transmission Lines, Antenna and Wave Propagation (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (15 Lectures)

Electromagnetic Wave Propagation: Propagation in Good Conductors, Skin Effect,Reflection of uniform Plane Waves at normal incidence, Plane Wave reflection at Oblique Incidence, Wave propagation in dispersive media, concept of phase velocity and group velocity, modes of propagation, ionospheric refractive index, MUF, Skip distance, critical frequency, Plasma frequency, virtual height, ducting.

Unit-2 (17 Lectures)

Transmission Lines: Typical Transmission lines- Co-axial, Two Wire, Microstrip, Coplanarand Slot Lines, Transmission Line Parameters, Transmission Line Equations, Electrical transmission/low frequency transmission, Wave propagation in Transmission lines, lowloss, lossless line, Distortionless line, Input Impedance, Standing Wave Ratio, Power and lossy lines, Shorted Line, Open-Circuited Line, Matched Line, Smith Chart, Transmission Line Applications.

Unit-3 (13 Lectures)

Waveguides and Waveguide Devices: Wave propagation in waveguides, Parallel platewaveguides, TEM, TM and TE modes of propagation, Rectangular waveguides, Power transmission and attenuation, Rectangular cavity resonators, directional couplers, isolator, circulator.

Unit-4 (15 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, Beam width, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance Antenna Radiation Efficiency, Effective Length and Equivalent Areas, Maximum Directivity and Maximum Effective Area, Friis Transmission Equation and Radar Range Equation.

Types of Antenna: Hertzian dipole, Half wave dipole, Quarter-wave dipole, Yagi-Uda,microstrip, Parabolic antenna, Helical antenna, Antenna array.

Suggested books:

1. M. N. O. Sadiku, Principles of Electromagnetics, Oxford University Press (2001)
2. Karl E. Longren, Sava V. Savov, Randy J. Jost., Fundamentals of Electromagnetics with MATLAB,PHI
3. W. H. Hayt and J.A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
4. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
5. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
6. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)
7. G. S. N. Raju, Antennas and Propagation, Pearson Education (2001)

DSE 2- Transmission Lines, Antenna and Wave Propagation Lab 60 Lectures

(Use Scilab/MATLAB/Other Mathematical Simulation Software)

1. Program to determine the phasor of forward propagating field
2. Program to determine the instantaneous field of a 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 a function of time and position in a loss less transmission line
6. Program to find the characteristic impedance, the phase constant an the phase velocity
7. Program to find the output power and attenuation coefficient
8. Program to find the power dissipated in the lossless transmission line
9. Program to find the total loss in lossy lines
10. Program to find the load impedance of a slotted line
11. Program to find the input impedance for a line terminated with pure capacitive impedance
12. Program to determine the operating range of frequency for TE10 mode of air filled rectangular waveguide
13. Program to determine Directivity, Bandwidth, Beamwidth of an antenna
14. Program to determine diameter of parabolic reflector
15. Program to find out minimum distance between primary and secondary antenna

DSE-3: Modern Communication Systems (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (16 Lectures)

Advanced Digital Modulation Technique: DPCM, DM, ADM. Binary Line Coding Technique, Multi-level coding, QAM (Modulation and Demodulation)

Unit-2 (10 Lectures)

Optical Communication: Introduction of Optical Fiber, Types of Fiber, Guidance in Optical Fiber, Attenuation and Dispersion in Fiber, Optical Sources and Detectors, Block Diagram of optical communication system, optical power budgeting

Unit-3 (17 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.

Unit-4 (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 & PPS.

Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, Wi-Fi and WiMAX.

Suggested Books:

1. W. Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 3rd Edition
2. Martin S. Roden, Analog & Digital Communication Systems, Prentice Hall, Englewood Cliffs, 3rd Edition
3. Modern digital and analog Communication systems- B. P. Lathi, 4rd Edition 2009 Oxford University press.
4. ThiagarajanVishwanathan, Telecommunication Switching Systems and Networks, Prentice Hall of India.
5. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2nd Edition, Pearson Education Asia.

DSE-3: Modern Communication Systems **60 Lectures**

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.
7. Study of Satellite Communication System.
8. Study of Optical Fiber Communication System

SEMESTER-VI

Core Course-XIII: Communication Electronics (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1(10 Lectures)

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, Friss formula.

Unit-2(20 Lectures)

Amplitude Modulation: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM, Amplitude Demodulation (diode detector), Concept of Double side band suppressed carrier, Single side band suppressed carrier, other forms of AM (Pilot Carrier Modulation, Vestigial Side Band modulation, Independent Side Band Modulation). Block diagram of AM Transmitter and Receiver

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.

Unit -3(14 Lectures)

Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, Modulation and detection techniques, Multiplexing, TDM and FDM.
Pulse Code Modulation: Need for digital transmission, Quantizing, Uniform and Non-Uniform Quantization, Quantization Noise, Commanding, Coding, Decoding, Regeneration.

Unit -4(16 Lectures)

Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK).

Suggested Books:

1. Electronic communication systems- Kennedy, 3rd edition, McGraw international publications
2. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
3. Communication Systems, S. Haykin, Wiley India (2006)
4. Advanced electronic communications systems – Tomasi, 6th edition, PHI.
5. Communication Systems, S. Haykin, Wiley India (2006)

Core Course-XIII: Practical **60 Lectures**

Communication Electronics Lab (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.

Core Course-XIV: Photonics(Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (22 Lectures)

Light as an Electromagnetic Wave: Plane waves in homogeneous media, concept ofspherical waves. Reflection and transmission at an interface, total internal reflection, Brewster's Law. Interaction of electromagnetic waves with dielectrics: origin of refractive index, dispersion.

Interference: Superposition of waves of same frequency, Concept of coherence,Interference by division of wavefront, Young's double slit, Division of Amplitude, thin film interference, anti-reflecting films, Newton's rings; Michelson interferometer. Holography.

Diffraction: Huygen Fresnel Principle, Diffraction Integral, Fresnel and Fraunhofferapproximations. Fraunhoffer Diffraction by a single slit, rectangular aperture, double slit,Resolving power of microscopes and telescopes; Diffraction grating: Resolving power and Dispersive power

Unit-2 (13 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.

Unit-3 (13 Lectures)

Light Emitting Diodes: Construction, materials and operation.

Lasers: Interaction of radiation and matter, Einstein coefficients, Condition foramplification,laser cavity, threshold for laser oscillation, line shape function. Examples of common lasers. The semiconductor injection laser diode.

Photodetectors: Bolometer, Photomultiplier tube, Charge Coupled Device. Photo transistorsand 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.

Unit-4 (12 Lectures)

Guided Waves and the Optical Fiber: TE and TM modes in symmetric slab waveguides,effective index, field distributions, Dispersion relation and Group Velocity. Step index optical fiber, total internal reflection, concept of linearly polarized waves in

the step index circular dielectric waveguides, single mode and multimode fibers, attenuation and dispersion in optical fiber.

Suggested Books:

1. Ajoy Ghatak, Optics, Tata McGraw Hill, New Delhi (2005)
2. E. Hecht, Optics, Pearson Education Ltd. (2002)
3. J. Wilson and J. F. B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996)
4. S. O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education (2009)
5. Ghatak A.K. and Thyagarajan K., "Introduction to fiber optics," Cambridge Univ. Press. (1998)

Core Course-XIV: Practical **60 Lectures**

Photonics Lab

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.

DISCIPLINE SPECIFIC ELECTIVE PAPERS (Credit 06 for each paper)

(2 papers to be selected)

DSE-4: Control Systems (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit 1 (16 Lectures)

Introduction to Control Systems: Open loop and Closed loop control systems,Mathematical modeling of physical systems (Electrical, Mechanical and Thermal), Derivation of transfer function, Armature controlled and field controlled DC servomotors, AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula. Effect of feedback on control systems.

Unit 2 (14 Lectures)

Time Domain Analysis: Time domain performance criteria, transient response of first,second & higher order systems, steady state errors and static error constants, Performance indices.

Concept of Stability: Asymptotic stability and conditional stability, Routh – Hurwitzcriterion, relative stability analysis, Root Locus plots and their applications.

Unit 3 (14 Lectures)

Frequency Domain Analysis: Correlation between time and frequency response, Polar andinverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.

Unit 4 (16 Lectures)

State Space Analysis: Definitions of state, state variables, state space, representation ofsystems, 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

Suggested Books:

1. J. Nagrath& M. Gopal, Control System Engineering, New Age International, 2000
2. K. Ogata, Modern Control Engineering, PHI 2002
3. B. C. Kuo , "Automatic control system", Prentice Hall of India, 2000

DSE-4: Control Systems Practical **60 Lectures**

(Hardware and Scilab/MATLAB/Other Mathematical Simulationsoftware)

1. To study characteristics of: a. Synchro transmitter receiver, b. Synchro as an 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 a 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-5: Numerical Techniques (Credits: Theory-04, Practicals-02) F.M. = 50
(Theory - 25, Practical – 15, Internal Assessment – 10)
[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (16 Lectures)

Numerical Methods: Floating point, Round-off error, Error propagation, Stability, Programming errors.
Solution of Transcendental and Polynomial Equations f(x)=0: Bisection method, Secantand 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.

Unit-2 (14 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.

Unit-3 (16 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'sMethod, Classical Runge Kutta method of fourth order. Methods for system and higher order equations.

Unit- 4 (14 Lectures)

Numerical Methods in Linear Algebra: Linear systems Ax=B, Gauss Elimination, PartialPivoting, LU factorization, Doolittle's, Crout's and Cholesky's method. Matrix

Inversion, Gauss-Jordon, Iterative Methods: Gauss-Seidel Iteration, Jacobian Iteration.
Matrix Eigenvalue: Power Method.

Suggested Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons (1999).
2. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall India, Third Edition.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India (2008).
4. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, New Age International (2007).
5. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C and C++, Khanna Publishers (2012).

DSE-5: Numerical Techniques Lab 60 Lectures

(C language/ Scilab/MATLAB/Other Mathematical Simulationsoftware)

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

DSE-6: Digital Signal Processing (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit- 1 (15 Lectures)

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.

Unit- 2 (15 Lectures)

Z-Transform: Definition and properties, Inverse Z Transform and stability. ParsevalsTheorem and applications.
System Function: signal flow graph, its use in representation and analysis of Discrete Time Systems. Techniques of representations. Matrix generation and solution for DTS evaluations.

Unit- 3 (15 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.

Unit- 4 (15 Lectures)

Digital Filters: Analog filter review. System function for IIR and FIR filters, networkrepresentation. Canonical and decomposition networks. IIR filter realization methods and their limitations. FIR filter realization techniques. Discrete correlation and convolution; Properties and limitations.

Suggested Books:

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.

DSE-6: Digital Signal Processing Lab 60 Lectures
Scilab/MATLAB/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.

Generic Elective Papers (GE)

(Any four for other Departments/Disciplines: (Credit: 06 each)

Semester-I

GE-1: Electronic Circuits and PCB Designing (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (12 Lectures)

Network theorems (DC analysis only): Review of Ohms law, Kirchhoff's laws, voltagedivider and current divider theorems, open and short circuits.
Thevenin's theorem, Norton's theorem and interconversion, superposition theorem, maximum power transfer theorem.

Unit 2 (13 Lectures)

Semiconductor Diode and its applications: PN junction diode and characteristics, idealdiode and diode approximations. Block diagram of a Regulated Power Supply, Rectifiers: HWR, FWR - center tapped and bridge FWRs. Circuit diagrams, working and waveforms, ripple factor & efficiency (no derivations).Filters: circuit diagram and explanation of shunt capacitor filter with waveforms.
Zener diode regulator: circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

Unit-3 (17 Lectures)

BJT and Small Signal amplifier: Bipolar Junction Transistor: Construction, principle &working of NPN transistor, terminology. Configuration: CE, CB, CC. Definition of α, β and γ and their interrelations, leakage currents. Study of CE Characteristics, Hybrid parameters.
Transistor biasing: need for biasing, DC load line, operating point, thermal runaway, stability and stability factor.
Voltage divider bias: circuit diagrams and their working, Q point expressions for voltage divider biasing.
Small signal CE amplifier: circuit, working, frequency response, re model for CE configuration, derivation for Av, Zin and Zout.

Unit-4 (18 Lectures)

Types of PCB: Single sided board, double sided, Multilayer boards, Plated through holes technology, Benefits of Surface Mount Technology (SMT), Limitation of SMT, Surface mount components: Resistors, Capacitor, Inductor, Diode and IC's.

Layout and Artwork: Layout Planning: General rules of Layout, Resistance, Capacitanceand Inductance, Conductor Spacing, Supply and Ground Conductors, Component Placing and mounting, Cooling requirement and package density, Layout check.
Basic artwork approaches, Artwork taping guidelines, General artwork rules: Artwork check and Inspection.
Laminates and Photoprinting: Properties of laminates, Types of Laminates, Manualcleaning process, Basic printing process for double sided PCB's, Photo resists, wet film resists, Coating process for wet film resists, Exposure and further process for wet film resists, Dry film resists
Etching and Soldering: Introduction, Etching machine, Etchant system. Principles of Solderconnection, Solder joints, Solder alloys, Soldering fluxes. Soldering, Desoldering tools and Techniques.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronics text lab manual, Paul B. Zbar.
3. Electric circuits, Joeseph Edminister, Schaum series.
4. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta -TMH.
5. Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
6. Walter C.Bosshart "PCB DESIGN AND TECHNOLOGY" Tata McGraw Hill Publications, Delhi. 1983
7. Clyde F.Coombs "Printed circuits Handbook" III Edition, McGraw Hill.

GE-1: Electronic Circuits and PCB Designing Lab **60 Lectures**

(Hardware and Circuit SimulationSoftware)

1. Verification of Thevenin's theorem
2. Verification of Super position theorem
3. Verification of Maximum power transfer theorem.
4. Half wave Rectifier – without and with shunt capacitance filter.
5. Centre tapped full wave rectifier – without and with shunt capacitance filter.
6. Zener diode as voltage regulator – load regulation.
7. Transistor characteristics in CE mode – determination of ri, ro and β.
8. Design and study of voltage divider biasing.
9. Designing of an CE based amplifier of given gain
10. Designing of PCB using artwork, its fabrication and testing.
11. Design, fabrication and testing of a 9 V power supply with zener regulator

Semester-II

GE-2: Digital System Design (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (15 lectures)

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions,Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes

Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Booleanlaws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates-basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families.

Unit-2 (11 lectures)

Combinational logic analysis and design: Multiplexers and De-multiplexers, Adder (halfand full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa)

Unit-3 (16 lectures)

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs,registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

Unit-4 (18 Lectures)

VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL andVerilog, Introduction to Simulation and Synthesis Tools, Test Benches.

VHDL: Module, Delays, brief description - data flow style, behavioral style, structural style, mixed design style, simulating design.

Language Elements, Introduction, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Operands, Operators, types of Expressions

Gate level modeling, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

Suggested books:

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A Verilog HDL Primer – J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

GE-2: Digital System Design Lab60 Lectures

(Hardware and Circuit Simulation Software)

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 a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.
9. Design a shift register and study Serial and parallel shifting of data.

VHDL

1. Write code to realize basic and derived logic gates.
2. Half adder, 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 (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4 bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 2 bit Magnitude comparator.
10. 3 bit Ripple counter.

Semester-III

GE-3: Communication Systems (Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (16 Lectures)

Noise and Transmission lines: Noise-Introduction, internal and external noises, signal tonoise ratio and noise figure

Amplitude Modulation/demodulation techniques: Block diagram of electroniccommunication system. Modulation-need and types of modulation-AM, FM & PM. Amplitude modulation – representation, modulation index, expression for instantaneous voltage, power relations, frequency spectrum, DSBFC, DSBSC and SSBSC (mention only). Limitations of AM.
Demodulation- AM detection: principles of detection, linear diode, principle of working and waveforms.
Block diagram of AM transmitter and Receiver.

Unit-2 (12 Lectures)

Frequency Modulation/demodulation techniques: Frequency Modulation: definition,modulation index, FM frequency spectrum diagram, bandwidth requirements, frequency deviation and carrier swing, FM generator-varactor diode modulator.
FM detector – principle, slope detector-circuit, principle of working and waveforms.
Block diagram of FM transmitter and Receiver. Comparison of AM and FM.

Unit- 3 (16 Lectures)

Digital communication: Introduction to pulse and digital communications, digital radio,sampling theorem, types- PAM, PWM, PPM, PCM – quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits – Shannon limit for information capacity, bandwidth requirements, data transmission speed, noise, cross talk, echo suppressors, distortion and equalizer, MODEM– modes, classification, interfacing (RS232). TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA

Unit- 4 (16 Lectures)

Cellular Communication: Concept of cellular mobile communication – cell and

cellsplitting, 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.

Satellite communication: Introduction, to Orbit, types of orbits, Block diagram of satellitetransponder.

Suggested Books:

1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.
4. Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition- Pearson education

GE-3: Communication Systems Lab60 Lectures

1. Amplitude modulator and Amplitude demodulator
2. Study of FM modulator using IC8038
3. Study of VCO using IC 566
4. Study of Time Division Multiplexing and de multiplexing
5. Study of AM Transmitter/Receiver
6. Study of FM Transmitter/Receiver
7. ASK modulator and demodulator
8. Study of FSK modulation
9. Study of PWM and PPM
10. Study of PAM modulator and demodulator

Semester-IV

GE-4: Instrumentation(Credits: Theory-04, Practicals-02)

F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]

Theory Lectures **60**

Unit-1 (10 Lectures)

DC and AC indicating Instruments: Accuracy and precision, Types of errors, PMMC galvanometer, sensitivity, Loading effect , Conversion of Galvanometer into ammeter, Voltmeter and Shunt type ohmmeter, Multimeter.

Unit- 2(18 Lectures)

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronisation, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).
Signal Generators: Audio oscillator, Pulse Generator, Function generators.

Unit - 3 (12 Lectures)

Transducers: Basic requirements of transducers, Transducers for measurement of nonelectrical quantities: Types and their principle of working , measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature.

Unit - 4 (20 Lectures)

Data acquisition systems: Block diagram, brief description of preamplifier, signalconditioner, instrumentation amplifier, waveform generator, A/D and D/A converter blocks,computer controlled test and measurement system.
Bio-medical instrumentation: Bio-Amplifiers: Bio potentials - Bio-electricity – Necessityfor 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.

Suggested Books:

1. Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies
2. Electrical and Electronics Measurement and Instrumentation Sahwany A.K.
3. Instrumentation devices and systems: Rangan, Sarma, Mani, TMH
4. Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH
5. Handbook of biomedical instrumentation: Khandpur R S, TMH
6. Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.
7. Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
8. Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell, Erich A Pfieffer, PHI, 1994.
9. Mechatronics – principles and applications, Godfrey C Onwubolu, Elsevier, 2006

Instrumentation Lab: 60 Lectures

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 and RTD.
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.