CBCS SYLLABUS

FOR

THREE YEARS UNDER-GRADUATE COURSE

IN

ELECTRONICS (HONOURS)

(*w.e.f. 2022*)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

STRUCTURE IN ELECTRONICS (HONOURS)

SEMESTER–I

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/ELC/101/C-1	Basic Circuit Theory and Network Analysis (T1)	4	10	25	50			
	Basic Circuit Theory and Network Analysis Lab (P1)	2		15				
SH/ELC/102/C-2	Mathematics Foundation for Electronics (T2)	4	10	25	50			
	Mathematics Foundation for Electronics Lab (P2)	2		15				
SH/ELC/103/GE-1	***Any one of the following***:							
	1. Network Analysis and Analog Electronics (GE-T1)	4	10	25	50			
	Network Analysis and Analog Electronics Lab (GE-P1)	2		15				
	2. Digital System Design (GE-T1)	4		25				
	Digital System Design Lab (GE-P1)	2		15				
ACSHP/104/AECC-1	Environmental Studies	4	10	40	50			
Total in Semester – I		22	40	160	200			

SEMESTER–II

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/ELC/201/C-3	Semiconductor Devices (T3)	4	10	25	50			
	Semiconductor Devices Lab (P3)	2		15				
SH/ELC/202/C-4	Applied Physics (T4)	4	10	25	50			
	Applied Physics Lab (P4)	2		15				
SH/ELC/203/GE-2	***Any one of the following***: 1. Network Analysis and Analog Electronics (GE-T2)	4	10	25	50			
	Network Analysis and Analog Electronics Lab (GE-P2)	2		15				
	2. Digital System Design (GE-T2)	4		25				
	Digital System Design Lab (GE-P2)	2		15				
ACSHP/204/AECC-2	English/Hind/MIL	2	10	40	50			
Total in Semester – II		20	40	160	200			

SEMESTER–III

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/ELC/301/C-5	Electronic Circuits (T5)	4	10	25	50			
	Electronic Circuits Lab (P5)	2		15				
SH/ELC/302/C-6	Digital Electronics (T6)	4	10	25	50			
	Digital Electronics Lab (P6)	2		15				
SH/ELC/303/C-7	C Programming and Data Structures (T7)	4	10	25	50			
	C Programming and Data Structures Lab (P7)	2		15				
SH/ELC/304/GE-3	***Any one of the following***: 3.Communication Systems (GE-T3) Communication Systems Lab (GE-P3)	4 2	10	25 15	50			
	4. Instrumentation (GE- T3) Instrumentation Lab (GE-P3)	4 2		25 15				
SH/ELC/305/SEC-1	Programming with MATLAB (T)	2	10	40	50			
Total in Semester – III		26	50	200	250			

SEMESTER–IV

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/ELC/401/C-8	Operational Amplifiers and Applications (T8)	4	10	25	50			
	Operational Amplifiers and Applications Lab (P8)	2		15				
SH/ELC/402/C-9	Signals and Systems (T9)	4	10	25	50			
	Signals and Systems Lab (P9)	2		15				
SH/ELC/403/C-10	Electronic Instrumentation (T10)	4	10	25	50			
	Electronic Instrumentation Lab (P10)	2		15				
SH/ELC /404/GE-4	***Any one of the following***: 3.Communication Systems (GE-T4) Communication Systems Lab (GE-P4)	4 2	10	25 15	50			
	4. Instrumentation (GE-T4) Instrumentation Lab (GE-P4)	4 2		25 15				
SH/ELC/405/SEC-2	Design and Fabrication of Printed Circuit Boards (T)	2	10	40	50			
Total in Semester – IV		26	50	200	250			

SEMESTER–V

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/ELC/501/C-11	Microprocessors and Microcontrollers (T11)	4	10	25	50			
	Microprocessors and Microcontrollers Lab (P11)	2		15				
SH/ELC/502/C-12	Electromagnetics (T12)	4	10	25	50			
	Electromagnetics Lab (P12)	2		15				
SH/ELC/503/DSE-1	Power Electronics (DSE1-T1)	4	10	25	50			
	Power Electronics (DSE1-P1)	2		15				
SH/ELC/504/DSE-2	Transmission Lines, Antenna and Wave Propagation (DSE2-T2)	4	10	25	50			
	Transmission Lines, Antenna and Wave Propagation (DSE2-P2)	2		15				
Total in Semester – V		24	40	160	200			

SEMESTER–VI

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SH/ELC/601/C-13	Communication Electronics (T13)	4	10	25	50			
	Communication Electronics Lab (T13)	2		15				
SH/ELC/602/C-14	Photonics (T14)	4	10	25	50			
	Photonics Lab (P14)	2		15				
SH/ELC/603/DSE-3	Control Systems (DSE3-T3)	4	10	25	50			
	Control Systems Lab (DSE3-P3)	2		15				
SH/ELC/604/DSE-4	Numerical Techniques (DSE4-T4)	4	10	25	50			
	Numerical Techniques Lab (DSE4-P4)	2		15				
Total in Semester – VI		24	40	160	200			

SC = Subject Code, C= Core Course, AECC= Ability Enhancement Compulsory Course, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.=Lecture, Tu.= Tutorial, and Prc.=Practical

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

Course	*Credits Theory+ Practical	Theory + Tutorial
I. Core Course		
(14 Papers)	14×4= 56	
Core Course Practical / Tutorial*		
(14 Papers)	14×2=28	
II. Elective Course (8 Papers)		
Discipline Specific Elective	4×4=16	
(4 Papers)		
Discipline Specific Elective Practical/ Tutorial*	4 × 2=8	
(4 Papers)		
Generic Elective/ Interdisciplinary	4×4=16	4×5=20
(4 Papers)		
Generic Elective Practical/ Tutorial*	4 × 2=8	4×1=4
(4 Papers)		
III. Ability Enhancement Courses		
1. Ability Enhancement Compulsory Courses (AECC)		
(2 Papers of 2 credit each)	2 × 2=4	2 × 2=4
Environmental Science		
English/MIL Communication		
2. Skill Enhancement Courses (SEC)		
(Minimum 2)	2 × 2=4	2 × 2=4
(2 Papers of 2 credit each)		
Total credit	**140**	**140**

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

SEM	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	(Communicative English/MIL			GE-1
	Mathematics Foundation for Electronics				
II	Semiconductor Devices	Environmental Science			GE-2
	Applied Physics				
III	Electronic Circuits		SEC -1		GE-3
	Digital Electronics				
	C Programming and Data Structures				
IV	Operational Amplifiers and Applications		SEC -2		GE-4
	Signals and Systems				
	Electronic Instrumentation				
V	Microprocessors and Microcontrollers			DSE-1	
	Electromagnetics			DSE -2	
VI	Communication Electronics			DSE -3	
	Photonics			DSE -4	

SEMESTER-WISE SCHEDULE FOR B.Sc. (HONOURS) ELECTRONICS

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

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

CORE COURSE(C): (Credit: 06 each) (1 period/week for tutorials 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
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. Control Systems
4. Numerical Techniques

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. Chemistry
5. Commerce

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

1. Network Analysis and Analog Electronics
2. Digital System Design
3. Communication Systems
4. Instrumentation

For Papers having practical, distribution of 50 marks be as follows:

i) *Internal Assessment*: 20% of 50 marks = 10 marks which is distributed as follows:

Class Attendance (Theory) – 05 and Class Test/ Assignment/ Tutorial – 05

ii) 15 marks be allotted for ***Semester-end- Practical Examination*** of each paper, distribution of which may be as under:

a) Lab. Note Book: 03 Marks
b) Viva-voce: 02 Marks
c) Experiment: 10 marks

iii) 25 marks be allotted for ***Semester-end-Theoretical Examination*** of each paper (Duration of Exam: 1 hour 15 min), distribution of which may be as under:

a) Answer 3 questions out of 8 carrying 1 marks each = 3×1 = 3
b) Answer 3 questions out of 8 carrying 2 marks each = 3×2 = 6
c) Answer 2 questions out of 5 carrying 5 marks each = 2×5 = 10
d) Answer 1 questions out of 4 carrying 6 marks each = 1×6 = 6

For each SEC paper, distribution of 50 marks be as follows:

i) *Internal Assessment:* 20% of 50 marks = 10 marks be reserved for
Class Attendance (Theory) – 05 marks and Class Test/ Assignment/ Tutorial – 05 marks

ii) 40 marks be allotted for ***Semester-end-Theoretical Examination*** of each paper (Duration of Exam: 2 hours), distribution of which may be as under:

a) Answer 5 questions out of 10 carrying 2 marks each = 5×2 = 10
b) Answer 4 questions out of 8 carrying 5 marks each = 4×5 = 20
c) Answer 1 question out of 3 carrying 10 marks each = 1×10 = 10

N.B.: However, questions, carrying 5 or 10 marks, need not necessarily to be a single question.

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)

Theory Lectures 60

Course Learning Objectives

- To study the basic circuit concepts in a systematic manner suitable for analysis and design.
- To study and analyze the transient and steady-state response of circuits.
- To analyze electric circuits using network theorems and two-port parameters.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Study basic circuit concepts in a systematic manner suitable for analysis and design.
- CO2: Understand transient analysis.
- CO3: Determine AC steady state response.
- CO4: Analyze the electric circuit using network theorems.
- CO5: Understand the two–port network parameters.

Unit- 1 (10 Lectures)

Basic Circuit Concepts: Resistors: Fixed and Variable resistors, Color coding of resistors, 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, Mesh Analysis, Linear Circuits, Principle of Duality, Star-Delta Conversion

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, Root Mean 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.

Two Port Network Parameters: 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)

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Verify the network theorems and operation of typical electrical circuits.
- CO2: Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits.
- CO3: Prepare the technical report on the experiments carried.

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. Verification of Kirchhoff's Law.
3. Verification of Norton's theorem.
4. Verification of Thevenin's Theorem.
5. Verification of Superposition Theorem.
6. Verification of the Maximum Power Transfer Theorem.
7. RC Circuits: Time Constant, Differentiator, Integrator.
8. Designing of a Low Pass RC Filter and study of its Frequency Response.
9. Designing of a High Pass RC Filter and study of its Frequency Response.
10. 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)

Theory Lectures 60

Course Learning Objectives

The purpose of this course is to provide students with the skills and knowledge to perform calculations for solution of problems related to various topics they would study in their programme, particularly the use of ordinary differential equations. The course aims to prepare students with the mathematical tools they would require while solving transient circuits in power electronics and problem solving in Electromagnetic Theory.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Use mathematics as a tool for solving/modeling systems in electronics
- CO2: Solve non-homogeneous linear differential equations of any order using a variety of methods, solve differential equations using power series and special functions
- CO3: Understand methods to diagonalize square matrices and find eigen values and corresponding eigen vectors for a square matrix, and check for its diagonalizability
- CO4: Familiarize with the concept of sequences, series and recognize convergent, divergent, bounded, Cauchy and monotonic sequences.
- CO5: Perform operations with various forms of complex numbers to solve equations

Unit – 1 **(14 Lectures)**

Ordinary Differential Equations, Power Series solution of differential equations: Basic concepts, different types of Differential Equations, Constant and variable co-efficient type, 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 Frobenious Power series method, Partial Differential equation and solution by separation of variable methods-wave equation and its solution.

Special functions: Error functions, Gamma function, Beta function and its characteristics, Evaluation of Gamma function of some arguments, Relation between Gamma and Beta functions.

Unit-2 (10 Lectures)

Matrices: Introduction to Matrices, Rank of 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, Inversion, Powers of a Matrix, Classification of different types of Real and Complex Matrices.

Unit-3 (8 Lectures)

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

Unit-4 (12 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, Zeroes and Poles, Singular points and poles, Residue integration method, Residue integration of real Integrals, Residue as a pole of order m, Evaluation of simple complex integrals.

Unit-5 **(10 Lectures)**

Vector Analysis: Definitions and notations: Basic operations vector addition, multiplication by scalar, Product of Vectors –Scalar (dot) & Vector (cross), important identities, Vectors Calculus -differentiation and integration of vectors, gradient, Divergence, Curl, Important theorems – Gauss', Stokes, Green's theorems (statement and explanation only).

Unit - 6 (6 Lectures)

Fourier Series: Set of functions – linear independence and completeness, Fourier's theorem (statement only), Analysis of simple waveforms using Fourier series.

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)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Perform operations with various forms of complex numbers to solve equations
- CO2: Use mathematics as a tool for solving/modeling systems in electronics
- CO3: Prepare the technical report on the experiments carried.

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): Vacuum Tubes and Semiconductor Devices (Credits: Theory-04, Practicals-02)

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

Theory Lectures 60

Course Learning Objectives

- To understand the basic crystal structure and different types of semiconductor materials and physics of semiconductor devices
- To be able to plot the current voltage characteristics of Diode, Transistors and MOSFETs
- The student should be able to explain and calculate small signal parameters of semiconductor devices.
- The student should be able to understand the behavior, characteristics and applications of power devices such as SCR, UJT, DIAC, TRIAC.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Describe the behavior of semiconductor materials
- CO2: Reproduce the I-V characteristics of diode/BJT/MOSFET devices
- CO3: Apply standard device models to explain/calculate critical internal parameters of semiconductor devices
- CO4: Explain the behavior and characteristics of power devices such as SCR/UJT etc.

Unit- 1 (18 Lectures)

Vacuum Tube Devices: Structure and characteristics of Diode, Triode, Tetrode and Pentode.

Semiconductor Basics: Introduction to Semiconductor Materials, 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 Electrostatic Potential 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 (14 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,

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)

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Examine the characteristics of basic semiconductor devices.
- CO2: Perform experiments for studying the behavior of semiconductor devices for circuit design applications.
- CO3: Calculate various device parameter’s values from their IV characteristics.
- CO4: Interpret the experimental data for better understanding the device behavior.

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 UJT.
5. Study of the I-V Characteristics of the SCR.
6. Study of the I-V Characteristics of JFET.
7. Study of the I-V Characteristics of MOSFET.
8. Study of Characteristics of Solar Cell
9. Study of Hall Effect.

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

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

Theory Lectures 60

Course Learning Objectives

The objective of the course is to make the students understand the inadequacies of Classical Physics and know basic postulates of Quantum Mechanics.in order to be able to apply the wave equation. The course also discusses mechanical, thermal, electric and magnetic properties of material relevant in today's scenario.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Explain the limitation of classical physics and basic concepts of quantum physics
- CO2: Describe the mechanical, thermal and magnetic properties of materials
- CO3: Understand the various thermal effects like Seebeck and Peltier effect and their usefulness in solving the real life problems

Unit-1 (20 Lectures)

Quantum Physics: Inadequacies of Classical physics, Electron diffraction experiment, Compton's effect, Photo-electric Effect, Plank's law, Wave-particle duality, 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.
Quantum statistics: Quantization of phase space, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein probability distribution functions and their importance.

Unit-2 (10 Lectures)

Crystal bonding – ionic, covalent, metallic and Vander wall bond, Unit cell, Bravai's Lattice, symmetries – rotation, reflection, inversion, Diffraction of X-Rays by crystal lattice, Laue Equation, Bragg's law, Miller indices, Reciprocal lattice, Ewald construction.

Unit-3 (10 Lectures)

Classical Free Electron Theory: Electrical properties of matter – relaxation time and mean free path, Fermi energy and Fermi surface parameters, electrical conductivity, Weidman-Franz law; Thermionic emission, Richardson-Dushman equation (Qualititive).

Unit-4 (10 Lectures)

Band Theory of Solids: Qualitative discussion of Bloch function, Kronig -Penney model, E-K diagram, Reduced zone representation, Brillouin zone, Effective mass, concept of hole, classification of solids - metal, insulator and semiconductor.

Unit-5 (10 Lectures)

Thermodynamics and Thermal Properties: Brief Introduction to Laws of Thermodynamics, Concept of Entropy, Reversible and irreversible processes, Isothermal and adiabatic changes, indicator diagram, Carnot's cycle and its efficiency, Second law of thermodynamics, Enthalpy function, Joule-Thompson effect, Gibb's paradox, T-S diagram, Regenerative cooling, Inversion temperature, Concept of Phonons, Heat Capacity, Debye's Law (concept only), Lattice Specific Heat, Electronic Specific Heat (concept only), Thermal Conductivity

Thermoelectricity: Seebeck Effect, Peltier Effect, Thomson Effect-Explanation, Thermoelectric power, Application of Thermodynamics to thermoelectric circuits, Thermocouple and its uses.

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

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Perfrom lab experiments for studying mechanical, thermal and magnetic parameters of materials
- CO2: Calculate and determine mechanical parameters such as young modulus, rigidity etc.
- CO3: Collect data and present it in the form of lab report

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)

Theory Lectures 60

Course Learning Objectives

- Understand diode and it‘s applications in clipping and clamping circuits, Rectifiers and design regulated power supply using Zener diodes.
- Understand frequency response of BJT and MOSFET amplifiers.
- Understand the concept of feedback and design feedback amplifiers and oscillators.
- Understand different power amplifiers and single tuned amplifiers.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Illustrate about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances of its low frequency models.
- CO2: Describe the frequency response of MOSFET and BJT amplifiers.
- CO3: Explain the concepts of feedback and construct feedback amplifiers and oscillators.
- CO4: Summarizes the performance parameters of amplifiers with and without feedback

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, Hybrid parameters, 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 and Oscillators: Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage and current feedback amplifiers, gain, input and output impedances. Bark hausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.

Unit- 4 (18 Lectures)

MOSFET Circuits: Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits.

Power Amplifiers: Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C, Class AB and their comparisons.

Operation of 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, Limitations of single tuned 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)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Study various stages of a zener diode based regulated power supply.
- CO2: Understand various biasing concepts, BJT and FET based amplifiers.
- CO3: Understand the concept of various BJT based power amplifiers and Oscillators.
- CO4: Prepare the technical report on the experiments carried.

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

Theory Lectures 60

Course Learning Objectives

- To represent information in various number systems
- To convert data from one number system to another and do various arithmetic operations
- To analyze logic systems and able to implement optimized combinational circuit using Karnaugh Map.
- To analyze and implement sequential circuits

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand and represent numbers in powers of base and converting one from the other, carry out arithmetic operations
- CO2: Understand basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions
- CO3: Analyze and design combinational as well as sequential circuits
- CO4: Explain the concepts related to PLD‘s

Unit-1 (15 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 of OR, 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 power product, RTL, DTL, DCTL, ECL, TTL and CMOS families and their comparison.

Unit-2 (12 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 (15 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.

Unit-4 (18 Lectures)

Memory Technology: Classification of different types of memory (Semiconductor memory, magnetic memory, Optical memory), 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.

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. Fundamentals of Digital Circuits, A. Anand Kumar, PHI (4th Edition)

C-VI (Practical): ***60 lectures***

Digital Electronics Lab (Hardware and Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: To understand and design simple digital systems.
- CO2: Familiarize with Simulation and Synthesis Tools, Test Benches used in Digital system design.
- CO3: Prepare the technical report on the experiments carried.

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.

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

Theory Lectures 60

Course Learning Objectives: To understand

- The basic structure of the C-language, declaration and usage of variables
- Operators, conditional, branching, iterative statements and recursion
- Arrays, string and functions (modular programming)
- Pointers to access arrays, strings and functions
- Input/Output statement and library functions (math and string related functions)
- User defined data types-structures
- The basic data structures and their implementations
- Various searching and sorting techniques.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Develop algorithms for arithmetic and logical problems and write programs in C language
- CO2: Implement conditional branching, iteration and recursion.
- CO3: Use concept of modular programming by writing functions and using them to form a complete program.
- CO4: Understand the concept of arrays, pointers and structures and use them to develop algorithms and programs for implementing stacks, queues, link list, searching and sorting.

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, switch statement, break, for loop, while loop and do loop, Functions: Defining functions, function arguments and passing, returning values from functions.
Structures: defining and declaring a structure variables, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions, Pointers.

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, post order and in order 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

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Develop algorithms and write programs in C language for arithmetic and logical operations.
- CO2: Write programs in C language to implement the concept of conditional branching, iteration, recursion, arrays and pointers.
- CO3: Write Programs in C language to implement data structures.
- CO4: Prepare the technical report on the experiments carried.

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. Calculate the subject wise and student wise totals and store them as a part of the structure.
13. Implement linear and circular linked lists using single and double pointers.
14. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list
15. Create circular linked list having information about a college and perform Insertion at front, Deletion at end.

16. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
17. Implement polynomial addition and subtraction using linked lists.
18. Implement sparse matrices using arrays and linked lists.
19. Create a Binary Tree to perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
20. Implement binary search tree using linked lists. Compare its time complexity over that of linear search.
21. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

SEC-I: Programming with MATLAB (Credits: 02)
F.M. = 50 (Theory - 40, Internal Assessment – 10)

Total Lectures: 60

Course Learning Objectives

- To Impart the Knowledge to the students with MATLAB software.
- To provide a working introduction to the MATLAB technical computing environment.
- Introduce students the use of a high-level programming language

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Able to use MATLAB for interactive computations.
- CO2: Familiar with memory and file management in MATLAB.
- CO3: Able to generate plots and export this for use in reports and presentations.
- CO4: Able to program scripts and functions using the MATLAB development environment.
- CO5: Able to use basic flow controls (if-else, for, while).
- CO6: Familiar with strings and matrices and their use.

MATLAB Basics (10 Lectures)

The MATLAB environment-Command Window, Command History Window, Workspace, Current Directory, Editor Window, Help feature, Types of Files – M-files, MAT files, MEX files, Some useful MATLAB commands, MATLAB toolboxes.

Constants, Variables, Expressions and control structures (10 Lectures)

Character set, Data types, Constants and variables, Operators, Hierarchy of operators, Built-in-functions, Loops (for, nested for, while), Branches (if, switch), Break, Continue.

Matrices and vectors (10 Lectures)

Scalars and vectors, Assigning data to elements of a vector/scalar, vector products, vector transpose, Entering data in Matrices, Multidimensional Matrices, Matrix manipulations, Generation of special matrices, Matrix and array operations.

Input and Output statements (10 Lectures)

Assignment statement and variable declaration, Interactive inputs (input, keyboard, menu and pause), Reading/storing file data, Output commands (format, disp), Formatted input/output functions.

MATLAB Graphics (10 Lectures)

Two dimensional plots, Multiple plots, Style options, Legend, Subplots, Specialized 2-D plots (polar, area, bar, barh, hist, rose, pie, stairs, stem, compass etc.), Three dimensional plots (plot3, bar3, barh3, pie3, stem3, meshgrid, mesh, surf, contour etc.).

MATLAB applications in computational mathematics (10 Lectures)

Solution of simultaneous linear algebraic equations, Finding eigen values and eigen vectors of a matrix, Factorization of Matrices, Solution of Non-Linear Linear Algebraic equations, Solution of Non-Linear Algebraic equations involving only one variable/several variables, Solution of ordinary differential equations.

Numerical simulations: Numerical methods and simulations - Random number generation –Monte carlo methods.

Suggested Books

1. Mastering MATLAB, Duane C. Hanselman, Bruce L. Littlefield, Pearson, 2012.

2. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Rudra Pratap, 2009.

3. MATLAB and Its Applications in Engineering, Raj Kumar Bansal, Ashok K. Goel, Manoj Kumar Sharma, Raj Kumar Bansal, Ashok K. Goel, Manoj Kumar Sharma, Pearson Education, 2009.

4. Lab Primer Through Matlab: Digital Signal Processing, Digital Image Processing, Digital Signal Processor and Digital Communication, A. K. Navas, R. Jawadevan, Prentice Hall India Learning Private Limited, 2014.

SEMESTER-IV

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

Theory Lectures 60

Course Learning Objectives

- To develop understanding of Analog Devices starting with ideal Op Amp model and assessing the practical device limitations covering the direct and cascading approach and learning importance of the Data Sheets.
- Design not only linear applications but also design of non-linear application without feedback (voltage comparators), with positive feedback(Schmitt Trigger), and the negative feedback but using non-linear elements such as diodes and switches (sample and hold circuits).
- Study of Signal Generators including also Timers, Multivibrators using IC 555, and V-F conversion with IC 566, and also a Study of various fixed and variable IC Regulators 78XX and 79XX and ICLM317.
- Understanding of non-linear circuits such as log/anti-log amplifiers and also study of Phase Locked Loop (PLL), a topic that covers many important concepts of this paper.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand basic building blocks of an op-amp and its parameters for various applications design.
- CO2: Elucidate and design the linear and non-linear applications of an op-amp.
- CO3: Understand the working of multivibrators using IC 555 timer and V-F inter-conversion using special application ICs 565 and 566.
- CO4: Study various fixed and variable IC regulators.

Unit-1 (18 Lectures)

Basic Operational Amplifier: Concept of differential amplifiers (Dual input balanced and unbalanced output), 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 input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Unit-2 (14 Lectures)

Op-Amp Circuits: Open and closed loop configuration, Frequency response of an op-amp in open loop and closed 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 wave generator, saw tooth wave generator and Voltage controlled oscillator(IC 566).

Unit-3 (10 Lectures)

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable 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 (10 Lectures)

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

Unit-5 (8 Lectures)

A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)

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

C-VIII (Practical) ***60 Lectures***

Operational Amplifiers and Application Lab (Hardware and Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the non-ideal behaviour by parameter measurement of Op-amp.
- CO2: Design application oriented circuits using Op-amp ICs.
- CO3: Generate square wave using different modes of 555 timer IC.
- CO4: Prepare the technical report on the experiments carried.

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

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

Theory Lectures 60

Course Learning Objectives

- Understand mathematical description and representation of continuous and discrete time signals and systems.
- Develop input-output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
- Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
- Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Represent various types of continuous-time and discrete-time signals
- CO2: Understand concept of convolution, LTI systems and classify them based on their properties and determine the response of LTI system
- CO3: Determine the impulse response, step response and frequency response of LTI systems
- CO4: Analyze system properties based on impulse response and Fourier analysis.
- CO5: Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis
- CO6: Understand Laplace transform and its properties and apply the Laplace transform to obtain impulse and step response of simple circuits.

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 time LTI 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 the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Simple RC high pass and low pass 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)

C-IX (Practical): 60 Lectures

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

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Learn the practical implementation issues stemming from the lecture material.
- CO2: Learn the use of simulation tools and design skills.
- CO3: Learn to work in groups and to develop SCILAB/MATLAB/other mathematical simulation software simulations of various signals and systems.
- CO4: Prepare the technical report on the experiments carried.

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.

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

Theory Lectures 60

Course Learning Objectives

The objective of this subject is to provide insight into electronic instruments being used in the industries and labs. It details the basic working and use of different instruments used for measuring various physical quantities. Also, it details the identification, classification, construction, working principle and applications of various transducers used for displacement, temperature, pressure and intensity measurement.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Describe the working principle of different measuring instruments.
- CO2: Choose appropriate measuring instruments for measuring various parameters in their laboratory.
- CO3: Correlate the significance of different measuring instruments, recorders and oscilloscopes.

Unit-1 (12 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, ohm meter, AC measurement, Digital voltmeter systems (integrating and non- integrating types), digital multimeters, digital frequency meter system (different modes and universal counter).

Unit – 2 (16 Lectures)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Medium Resistance 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, De Sauty's bridge, Measurement of frequency, Wien's bridge.

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 Power scope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).

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

Unit -4 (16 Lectures)

Transducers and sensors: Classification of transducers, Basic requirement/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 (photo resistors, 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, Dhanpat Rai and Sons (2007).
10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).

C- X (Practical): 60 Lectures

Electronic Instrumentation Lab

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Perform experiments on the measuring instruments.
- CO2: Perform measurements of various electrical/electronic parameters using appropriate instruments available in the laboratory.
- CO3: Prepare the technical report on the experiments carried.

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 Sauty bridge.
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.

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

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

Total Lectures 60

Course Learning Objectives

The main objective of the course is to introduce the students to the industrial tools, Protocols and Design Specifics used in PCB Designing, so that students are able to design an electronic printed circuit board for a specific application using industry standard software after going through the complete procedural steps of developing circuit schematic, board files, image transferring, assembly, soldering and testing.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Familiarize with the type of devices/components that may be mounted on PCB
- CO2: Understand the PCB layout techniques for optimized component density and power saving.
- CO3: Perform design and printing of PCB with the help of various image transfer and soldering techniques
- CO4: Understand the trends in the current PCB industry

PCB Fundamentals **(10 Lectures)**

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 **(20 Lectures)**

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 **(15 Lectures)**

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 **(5 Lectures)**

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 McGraw Hill

SEMESTER-V

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

Theory Lectures 60

Course Learning Objectives

- To understand basic architecture of 8085 microprocessor
- To understand the instruction set and write programs in assembly language
- To interface 8085 microprocessor with common peripheral devices
- To understand the differences in architecture and applications between Microprocessors and Microcontrollers
- To understand basic architecture , instruction set and simple interfacing of PIC16F887 microcontroller

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the basic blocks of microcomputers i.e. CPU, Memory, I/O and architecture of microprocessor‘s and Microcontroller‘s
- CO2: Apply knowledge and demonstrate proficiency of designing hardware interfaces for memory and I/O as well as write assembly language programs for target microprocessor and microcontroller.
- CO3: Derive specifications of a system based on the requirements of the application and select the appropriate Microprocessor or Microcontroller

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 (18 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

C-XI (Practical): ***60 Lectures***

Microprocessor and Microcontrollers Lab 8085
Assembly language programs:

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Be proficient in use of IDE‘s for designing, testing and debugging microprocessor and microcontroller based system
- CO2: Interface various I/O devices and design and evaluate systems that will provide solutions to real world problem
- CO3: Prepare the technical report on the experiments carried.

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 sort numbers in ascending/descending order.

PIC Microcontroller Programming

Note: Programs to be written using C programming language

1. LED blinking with a delay of 1 second.

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. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
10. Interfacing of matrix keyboard (4X4).

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

Theory Lectures 60

Course Learning Objectives

- To introduce the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Getting familiar with vector algebra, coordinate system and coordinate conversion
- CO2: Plotting of fields (Electrostatic and Magnetostatics) and solution of Laplace‘s equation.
- CO3: Physical interpretation of Maxwell‘s equation and problem solving in different media.
- CO4: Understanding of propagation of an electromagnetic wave.

Unit-1 (16 Lectures)

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 TM waves, 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)

C-XII (Practical): 60 Lectures

Electromagnetics Lab (using SCILAB/MATLAB/ any other similar freeware)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the basic mathematical concepts related to electromagnetic vector fields. .
- CO2: Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
- CO3: Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
- CO4: Understand the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.
- CO-5: Apply Maxwell‘s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

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. Solutions of Poisson and Laplace Equations – contour plots of charge and potential distributions
8. Introduction to Computational Electromagnetics: Simple Boundary Value Problems by Finite

Difference/Finite Element Methods.

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

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

Theory Lectures 60

Course Learning Objectives

- To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Relate basic semiconductor physics and properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices.
- CO2: Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits
- CO3: Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.
- CO4: Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.

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

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.

Unit- 4 (15 Lectures)

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.

Suggested Books

1. Power Electronics, P.C. Sen, TMH
2. Power Electronics & Controls, S.K. Dutta
3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education
5. Power Electronics, Applications and Design, Ned Mohan, Tore.
6. Power Electronics, K. Hari Babu, Scitech Publication.
7. Power Electronics, M.S. Jamil Asghar, PHI.
8. A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand

DSE 1 (Practical): ***60 Lectures***

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Reproduce the characteristics of power semicondcutor devices like SCR, DIAC, TRIAC etc.
- CO2: Calculate the various device parameters from their characteristics.
- CO3: Design power control circuits using semicondcutor power devices.
- CO4: Prepare the technical report on the experiments carried.

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
9. Study of chopper circuits

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

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

Theory Lectures 60

Course Learning Objectives

The course discusses the fundamentals of propagation of electromagnetic waves. The basics of transmission lines along with its parameters is included. Wave propagation along with modes in waveguides is discussed along with their applications. Antenna parameters along with their types is also discussed.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Describe the principals of electromagnetic wave propagation and various effects involved in it
- CO2: Explain the phenomenon of transmission line, its types and finding out performance parameters of transmission lines like losses, SWR.
- CO3: Calculate input impedance and reflection co-efficient of an arbitrarily terminated transmission-line and can use Smith chart to convert these quantities.
- CO4: Concept of retarded potential to explain radiation, half wave dipole and characteristics of antenna, radar equation.

Unit-1 (10 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 (10 Lectures)

Transmission Lines: Typical Transmission lines- Co-axial, Two Wire, Microstrip, Coplanar and Slot Lines, Transmission Line Parameters, Transmission Line Equations, Electrical transmission/low frequency transmission, Wave propagation in Transmission lines, low loss, 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 (10 Lectures)

Television system: TV standards, Concept of scanning, Video bandwidth calculation, TV camera and picture tube, Transmitter and Receiver, Concept of colour TV, Features of cable TV, LCD and LED.

Unit-4 (8 Lectures)

RADAR System: Basic system, Range equation, Transmitter and Receiver, CW RADAR, Application of RADAR, Satellite communication (Idea only), UP-linking and down-linking

Unit-5 (10 Lectures)

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

Unit-6 (12 Lectures)

Radiation of electromagnetic waves: Concept of retarded potentials, Antenna Parameters: Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Radiation Pattern, Radiation Power Density, Radiation Intensity, 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 (Practical): ***60 Lectures***

(Use SCILAB/MATLAB/Other Mathematical Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understanding the propagation of plan electromagnetic wave in different types of media
- CO2: Study of various types of transmission line, power flow and power loss along the length.
- CO3: Study of various types of waveguide power flow and power attenuation along the length.
- CO4: Study of Antenna types, characteristics and radar Transmission equation.

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

SEMESTER-VI

C-XIII (Theory): Communication Electronics (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

Theory Lectures 60

Course Learning Objectives

- Basic working of communication system
- Analog Modulation Techniques and their comparative analysis and applications suitability.
- Process of Modulation and Demodulation.
- Types, characterization and performance parameters of transmission channels.
- Analog to digital conversion and Digital data transmission and Multiplexing Techniques.
- Basic working principles of existing and advanced communication technologies.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the basic concept of a communication system and need for modulation
- CO2: Evaluate modulated signals in time and frequency domain for various continuous modulation techniques
- CO3: Describe working of transmitters and receivers and effect of noise on a communication system
- CO4: Understand baseband Pulse Modulation

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)

C-XIII (Practical): ***60 Lectures***

Communication Electronics Lab (Hardware and Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand basic elements of a communication system.
- CO2: Analyze the baseband signals in time domain and in frequency domain.
- CO3: Build understanding of various analog and digital modulation and demodulation techniques.
- CO4: Prepare the technical report on the experiments carried.

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. Study of TDM, FDM
7. Study of Pulse Code Modulation
8. Study of Amplitude Shift Keying
9. Study of Phase Shift Keying,
10. Study of Frequency Shift Keying.

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

Theory Lectures 60

Course Learning Objectives

- To understand light as an electromagnetic wave and various phenomenon like interference, diffraction and polarization.
- Interaction between a photon and electron and its relevance to laser and various other optoelectronic devices.
- Understand the propagation of wave in optical fibre

Course Learning Objectives: At the end of this course, students will be able to

- CO1: Describe optics and simple optical systems.
- CO2: Understand the concept of light as a wave and the relevance of this to optical effects such as interference and diffraction and hence to lasers and optical fibers.
- CO3: Use mathematical methods to predict optical effects e.g. light-matter interaction, interference, fiber optics, geometrical optics

Unit-1 (22 Lectures)

Light as an Electromagnetic Wave: Plane waves in homogeneous media, concept of spherical 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 Fraunhoffer approximations. 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 for amplification, 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 transistors and Photodiodes (p-i-n, avalanche), quantum efficiency and responsivity.
LCD Displays: Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays.

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)

C-XIV (Practical): 60 Lectures

Course Learning Objectives: At the end of this course, students will be able to

- CO1: Perform experiments based on the phenomenon of light/photons.
- CO2: Measure the parameters such as wavelength, resolving power, numerical aperture etc. using the appropriate photonic/optical technique.
- CO3: Prepare the technical report on the experiments carried

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.

DSE-3 (Theory): Control Systems (Credits: Theory-04, Practicals-02)
F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)

Theory Lectures 60

Course Learning Objectives

- Mathematical modelling and analysis of open-loop and closed-loop control systems.
- Time-domain and Frequency-domain analysis of control systems.
- Methods for accessing absolute and relative stability of control systems.
- State-space analysis

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the concepts of closed loop control systems.
- CO2: Analyse the stability of closed loop systems.
- CO3: Apply the control techniques to any electrical systems.
- CO4: Compute and assess system stability.

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, Parameter Variation and sensitivity.

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–Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.

Unit 3 (14 Lectures)

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

Unit 4 (16 Lectures)

State Space Analysis: Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
Controllers and Compensation Techniques: Response with P, PI and PID Controllers, Concept of compensation, Lag, Lead and Lag-Lead networks

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-3 (Practical): ***60 Lectures***

(Hardware and SCILAB/MATLAB/Other Mathematical Simulation software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Perform experiments involving concepts of control systems
- CO2: Design experiments for controlling devices like AC/DC motors etc.
- CO3: Study the behaviour of First and Second Order systems.
- CO4: Comparison of various types of control mechanisms.

1. To study position control of DC motor
2. To study speed control of DC motor
3. To study time response of type 0, 1 and 2 systems
4. To study frequency response of first and second order systems
5. To study time response characteristics of a second order system.
6. To study effect of damping factor on performance of second order system
7. To study frequency response of Lead and Lag networks.
8. Study of P, PI and PID controller.

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

Theory Lectures 60

Course Learning Objectives

- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Analyze and evaluate the accuracy of common numerical methods.
- Implement numerical methods in MATLAB.
- Write efficient, well-documented MATLAB code and present numerical results in an informative way.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the common numerical methods and how they are used to obtain approximate solutions to mathematical problems.
- CO2: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- CO3: Analyze and evaluate the accuracy of common numerical methods.

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, Partial Pivoting, 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-4 (Practical): 60 Lectures

(C language/ SCILAB/MATLAB/Other Mathematical Simulation software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Implement numerical methods in C language/ SCILAB/MATLAB/Other Mathematical Simulation software.
- CO2: Write efficient, well-documented code in the above mathematical simulation softwares and present numerical results in an informative way.
- CO3: Prepare the technical report on the experiments carried.

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

GE: SEMESTER-I and II

GE-1 (Theory): Network Analysis and Analog Electronics (Credits: Theory-04, Practicals-02)

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

Theory Lectures 60

Course Learning Objectives

- To impart knowledge of basic concepts in Electronics
- To provide the knowledge and methodology necessary for building electronics circuits.
- The practical exposure enables students to learn circuit implementations and troubleshooting.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Analyze the electric circuit using network theorems.
- CO2: Illustrate about rectifiers, transistor based amplifiers and its biasing.

Unit-1 (15 Lectures)

Circuit Analysis: Concept of Voltage and Current Sources, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Mesh Analysis, Node Analysis, Star and Delta Networks, Star-Delta Conversion, Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, Two Port Network Parameters- h, Z and Y Parameters and their Conversions.

Unit 2 **(13 Lectures)**

Semiconductor Diode and its applications: PN junction diode and characteristics, ideal diode 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 **(20 Lectures)**

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.
Transistor biasing: Need for biasing, Fixed Bias, Collector to Base Bias, Voltage Divider Bias and Emitter Bias, Circuits and Working, DC Load Line and Operating (Q) Point, Thermal Runaway, Stability and Stability factor.
BJT Amplifiers: Small Signal Analysis of Single Stage CE Amplifier, r_e-Model and h-Parameter equivalent circuit, Frequency Response, Input and Output Impedance, Current and Voltage Gains, Class A, B and C amplifiers, Two Stage RC Coupled Amplifier and its Frequency Response.
Sinusoidal Oscillators: Barkhausen Criterion for Sustained Oscillations, Phase Shift, Colpitt's and Hartley Oscillators, Determination of Frequency and Condition of Oscillation.

Unit-4 **(12 Lectures)**

Unipolar Devices: JFET, Construction, Working and I-V Characteristics (Output and Transfer), Pinch-off Voltage, MOSFET, MOS Capacitor, Channel Formation, Threshold Voltage (Ideal and Real), Current-Voltage Relation, Depletion and Enhancement Type MOSFET, Complementary MOS (CMOS), UJT, Basic Construction, Working, Equivalent Circuit and I-V Characteristics.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Hyat, Kemmerly and Durbin, Engineering Circuit Analysis, Tata McGraw Hill.
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. Kuo, Network Analysis and Synthesis, Wiley.
7. Neamen, Electronic Circuits: Analysis and Design, Tata McGraw Hill.

GE-1(Practical): ***60 Lectures***

(Hardware and Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Verify the network theorems and operation of typical electrical circuits.
- CO2: Study various stages of a zener diode based regulated power supply.
- CO3: Understand various biasing concepts, BJT and FET based amplifiers

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 r_i, r_o and β.
8. Design and study of voltage divider biasing.
9. Study of the I-V Characteristics of the UJT.
10. Study of the I-V Characteristics of JFET.
11. Study of the I-V Characteristics of MOSFET.

GE: SEMESTER-I and II

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

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

Theory Lectures 60

Course Learning Objectives

As there are lot of industrial and research based job opening in the area, the course offers a hands-on in designing digital systems on hardware (fabrication) and testing with a holistic approach to the subject, making students ready for the industry or research.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand and represent numbers in powers of base and converting one from the other
- CO2: Understand basic logic gates, concepts of Boolean algebra and techniques
- CO3: Analyze and design combinatorial as well as sequential circuits

Unit-1 (15 lectures)

Number System and Codes: Decimal, Binary, Octal and Hexadecimal Number Systems, Base Conversions, 1's and 2's Complements, Representation of Signed and Unsigned Numbers, BCD Code, Grey Codes, Binary, Octal and Hexadecimal Arithmetic, Addition, Subtraction by 2's Complement Method, Multiplication.

Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. 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 **(10 lectures)**

Combinational logic analysis and design: Half and Full Adder, Half and Full Subtractor, 4-Bit Binary Adder and Subtractor, Multiplexers, Demultiplexers, Encoder, Decoder, Code Converter (Binary to BCD and Vice Versa).

Unit-3 **(15 lectures)**

Sequential logic design: Latches, Flip flop, SR, JK, D and T Flip Flops, Truth Table, Excitation Table and Excitation Equation, Clocked (Level and Edge Triggered) Flip Flops, Preset and Clear Operations, Race Around Conditions in JK flip flop, Master-Slave JK Flip Flop.

Shift Registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers.

Counters: Ripple, Ring, Synchronous, Asynchronous, Decade and Modulo-N Counters, State Table and State

Diagram, Excitation Table and Excitation Equation.

Unit-4 **(20 Lectures)**

D-A and A-D Conversion: 4-Bit Binary Weighted and R-2R D-A Converter, Circuit and Working, Accuracy and Resolution, A-D Conversion Characteristics, Successive Approximation ADC. (Mention of relevant ICs for all).

Memory Technology: Classification of different types of memory (Semiconductor memory, magnetic memory, Optical memory), ROM, PROM, EPROM, EEPROM, Flash memory, SRAM, DRAM, SDRAM, Concept of Primary, Secondary and Cache memory, Concept of CCD.

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)

GE-2 (Practical) ***60 Lectures***

(Hardware and Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

- CO1 Familiarize with combinational circuit design.
- CO2 Familiarize with sequential circuit design.
- CO3 Prepare the technical report on the experiments carried.

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.

GE: SEMESTER-III and IV

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

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

Theory Lectures 60

Course Learning Objectives

- Basic concept & block diagram of communication system, types of noise & noise parameters.
- Need of modulation, AM , types of AM & their comparison , block diagram of AM transmitter & receiver
- Frequency modulation basics, bandwidth requirements of FM, block diagram of FM transmitter & receiver, comparison of AM & FM.
- Need for sampling & types of pulse communication, types of digital communication techniques, concepts of TDMA, FDMA and their comparison.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1 Familiarization with the basic concept of a communication system and need for modulation
- CO2 Familiarization with various continuous modulation techniques
- CO3 Familiarization with various digital modulation techniques

Unit-1 (16 Lectures)

Electronic Communication: Introduction to Communication, Means and Modes, Need for Modulation, Block Diagram of an Electronic Communication System, Brief Idea of Frequency Allocation for Radio Communication System in India (TRAI), Electromagnetic Communication Spectrum, Band Designations and Usage, Channels and Base-Band Signals, Noise, Internal and External Noises, Signal-to-Noise (S/N) Ratio and Noise Figure.

Amplitude Modulation: Definition, Representation, Modulation Index, Expression for Instantaneous Voltage, Power Relations, Frequency Spectrum, Concept of DSBFC, DSBSC, SSBSC Generation and Detection, Limitations of AM, Demodulation, AM Detection, Diode Detector Circuit, Principle of Working and Waveforms, Concept of VSB, Block Diagram of AM Transmitter and Receiver.

Unit-2 (12 Lectures)

Frequency Modulation and Phase Modulation: Definition, Representation, Modulation Index, Frequency Spectrum, Bandwidth Requirements, Frequency Deviation and Carrier swing, Equivalence between FM and PM, Generation of FM using VCO, Demodulation, FM Detector, Slope Detector Circuit, Principle of Working and Waveforms, Block Diagram of FM Transmitter and Receiver, Comparison of AM and FM, Qualitative Idea of Super Heterodyne Receiver.

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)

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.

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 (Practical) ***60 Lectures***

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Basic understanding of analog modulation and demodulation techniques.
- CO2: Basic understanding of digital modulation and demodulation techniques.
- CO3: Basic understanding of various types of pulse modulation.
- CO4: Prepare the technical report on the experiments carried

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

GE: SEMESTER-III and IV

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

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

Theory Lectures 60

Course Learning Objectives

- Explain the importance and working principle of different electronic measuring instruments.
- Use the complete knowledge of various instruments and transducers to make measurements in the laboratory.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Familiarize with the working principle of different measuring instruments
- CO2: Understand measuring instruments used in the laboratory like oscilloscopes, signal generators
- CO3: Understand working principle of transducers
- CO4: Familiarize with the working principle of data acquisition devices and biomedical instruments.

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 synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Power scope: 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 non-electrical quantities: Types and their principle of working, measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature.

Unit - 4 (20 Lectures)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Medium Resistance 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, De Sauty's bridge, Measurement of frequency, Wien's bridge.

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.

GE-4 (Practical) ***60 Lectures***

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: To measure various electrical parameters.
- CO2: To measure characteristics of various sensors and transducers.
- CO3: Understand ECG pattern.
- CO4: Prepare the technical report on the experiments carried.

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.