Four-Year Undergraduate Programme in Electronics under NEP2020

Course Structure

Semester	Course Type - I	Course Type - II	Course Type - III
I	ELE122J **Network Analysis & Analog Electronics** *(4+2 Credits)*	-	-
II	ELE222J **Digital Electronics** *(4+2 Credits)*	-	-
III	ELE322J **Operational Amplifier & Linear Integrated Circuits** *(4+2 Credits)*	-	-
IV	ELE422J1 **Signals and Systems** *(3+1 Credits)*	ELE422J2 **Applied Mathematics and Programming** *(4+2 Credits)*	ELE422J3 **Electromagnetic Waves and Antennas** *(4+2 Credits)*
V	ELE522J1 **Microprocessors & Microcontrollers** *(3+1 Credits)*	ELE522J2 **Digital System Design and VHDL** *(4+2 Credits)*	ELE522J3 **Microwave Engineering** *(4+2 Credits)*
VI	ELE622J1 **Communication Electronics – I** *(3+1 Credits)*	ELE622J2 **Advanced Microprocessors and Microcontrollers** *(4+2 Credits)*	ELE622J3 **Artificial Intelligence & Machine Learning** *(4+2 Credits)*
VII	ELE722J1 **Electronic Instrumentation** *(3+1 Credits)*	ELE722J2 **Embedded Systems and Internet of Things** *(4+2 Credits)*	ELE722J3 **Communication Electronics – II** *(4+2 Credits)*
VIII	ELE822J1 **Power Electronics & Photonics** *(3+1 Credits)*	***Honours***	
		ELE822J2 **Control Systems** *(4+2 Credits)*	ELE822J3 **Material Sciences and VLSI Technology** *(4+2 Credits)*
		Research	
		ELE822JP **Research Project** *(0+12 Credits)*	

Under-Graduate Programme with ELECTRONICS: 1st SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE122J: NETWORK ANALYSIS & ANALOG ELECTRONICS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To review the basic concepts of emf sources and Kirchhoff's laws*
2. *To study network topology, network theorems and two port networks*
3. *To provide a comprehensive understanding of electronic devices and circuits*
4. *To understand the working of diode and transistor and to study basic circuits using diodes and transistors*
5. *To understand the diode and transistor characteristics*
6. *To study the effect of feedback on amplifiers*

Expected Learning Outcomes:

After going through this course, the student shall be able to

1. *Have a comprehensive understanding of electronic devices and circuits*
2. *Apply their knowledge in analyzing Circuits by using network theorems*
3. *Know the characteristics of diodes and transistors*
4. *Know the benefits of feedback in amplifiers*

THEORY (4 Credits):

UNIT-I: Circuit Analysis (15 HOURS)

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

Unit-II: Semiconductor Devices-I (15 HOURS)

Junction Diode and its applications: PN junction diode (Ideal and practical)- I-V characteristics, dc load line analysis, Quiescent (Q) point. Zener diode, Rectifiers- Half wave rectifier, Full wave rectifiers (center tapped and bridge), circuit diagrams, working and waveforms, ripple factor and efficiency. Zener diode as voltage regulator, Introduction to Tunnel diode, metal contact diode.

Unit-III: Semiconductor Devices - II (15 HOURS)

Bipolar Junction Transistor: Review of the characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), Current gains α and β. Relations between α and β. dc load line and Q point. Unipolar Devices: JFET and MOSFET. Construction, working and I-V characteristics (output and transfer), Pinch- off voltage.

Unit-IV: Transistor Biasing and Amplifiers (15 HOURS)

Transistor biasing and Stabilization Circuits-Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Transistor as a two- p or t network, h-parameter equivalent circuit. Small signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains. Class A, B and C Amplifiers. Cascaded Amplifiers, two stage RC Coupled Amplifier and its Frequency Response. Concept of feedback, negative and positive feedback.

Recommended Books:

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
2. Network, Lines and Fields, J.D.Ryder, Prentice Hall of India.
3. Electronic Devices and Circuits, David A. Bell, 5th Edition 2015, Oxford University Press.
4. Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, Tata McGraw Hill
5. Electrical Circuit Analysis, Mahadevan and Chitra, PHI Learning
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.

7. Integrated Electronics, J. Millman and C. C. Halkias, Tata McGraw Hill (2001)
8. 2000 Solved Problems in Electronics, J. J. Cathey, Schaum's outline.
9. Electronic Devices and Circuits, Allen Mottershead, Goodyear Publishing Corporation

PRACTICAL (2 CREDITS: 60 HOURS)

Note: The student is required to attempt at least 10 experiments

1. To familiarize with basic electronic components (R, C, L, diodes, transistors),
2. Measurement of Amplitude, Frequency & Phase difference using Oscilloscope.
3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.
4. Verification of (a) Superposition Theorem and (b) Reciprocity Theorem.
5. Verification of the Maximum Power Transfer Theorem.
6. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.
7. Study of (a) Half wave rectifier and (b) Full wave rectifier (FWR).
8. Study the effect of (a) C- filter and (b) Zener regulator on the output of FWR.
9. Study of the I-V Characteristics of UJT and design relaxation oscillator.
10. Study of the output and transfer I-V characteristics of common source JFET.
11. Study of Fixed Bias and Voltage divider bias configuration for CE transistor.
12. Design of a Single Stage CE amplifier of given gain.

Under-Graduate Programme with ELECTRONICS: 2nd SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE222J: DIGITAL ELECTRONICS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables*
2. *To describe and explain the operation of fundamental digital gates*
3. *To study the design and implementation of various combinational and sequential logic circuits*
4. *To study various logic families.*

Expected Learning Outcomes:

After successful completion of the course the student will be able to:

1. *Use the basic logic gates and various reduction techniques of digital logic circuits*
2. *Analyze and design combinational and sequential circuits*
3. *Analyze the operation of standard combinational circuits like encoder, decoder, multiplexer, demultiplexer, adder etc.*
4. *Analyze the operation of flip-flops and examine relevant timing diagrams*
5. *Analyze the operation of counters and shift registers*
6. *Classify the digital ICs.*

THEORY (4 Credits):

UNIT-I: Number System and logic Gates (15 HOURS)

Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD code. Binary, octal and hexadecimal arithmetic; addition, subtraction by 2's complement method, multiplication. Logic Gates and Boolean algebra: Truth Tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra.

Unit-II: Combinational Logic Analysis and Design (15 HOURS)

Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP). Arithmetic Circuits: Binary Addition. Half and Full Adder. Half and Full Subtractor, 4- bit binary Adder/Subtractor. Multiplexers, De-multiplexers, Decoders, Encoders.

Unit-III: Sequential Circuits (15 HOURS)

SR, D, T and JK Flip-Flops. 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 (only up to 4 bits). Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Unit-IV: Logic Families (15 HOURS)

Classification of digital ICs. IC terminology, Characteristics of logic families- Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, RTL, DTL, ECL and TTL, circuit description of TTL, NAND gate with totem pole and open collector. TTL and CMOS, Comparison of TTL and CMOS families.

Recommended Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
5. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
6. R. L. Tokheim, Digital Principles, Schaum’s Outline Series, Tata McGraw- Hill (1994)

PRACTICAL (2 CREDITS: 60 HOURS)

Note: The student is required to attempt at least 10 experiments

1. To design a combinational logic system for a specified Truth Table.

2. To convert Boolean expressions into logic circuits and design circuits using logic gate ICs a

3. To minimize a given Boolean Expression and design Circuits using logic gates.

4. To design Half Adder and Full Adder Circuits.

5. TO Design Half Subtractor and Full Subtractor Circuits.

6. To design binary adder and adder-subtractor Circuits using Full adder IC.

7. To design seven-segment decoder Circuit.

8. To build Flip-Flop (RS, Clocked RS) circuits using NAND gates.

9. To build Flip-Flop (D-type and JK) circuits using NAND gates.

10. To build JK Master-slave flip-flop using Flip-Flop ICs

11. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.

12. To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.

Under-Graduate Programme with ELECTRONICS: 3rd SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE322J: OPERATIONAL AMPLIFIER AND LINEAR INTEGRATED CIRCUITS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To introduce students to the basic concepts of operational amplifiers.*
2. *To expose students to different applications of operational amplifiers.*
3. *To expose the students to some specialized ICs which are based on operational amplifiers.*

Expected Learning Outcomes:

After going through this course, the student shall be able to use operational amplifier IC and design several applications. Besides, the student shall be able to use some specialized ICs for different applications. After studying the course, the student shall be confident to convert any idea into its circuit-based product.

THEORY (4 Credits):

UNIT-I: Operational Amplifier (15 HOURS)

Operational Amplifiers: Basic differential Amplifier, Block Diagram of Op-Amp (IC 741), Characteristics of an Ideal and Practical Operational Amplifier, Open and Closed Loop configuration, Concept of Virtual Ground.

Op-Amp Parameters: Input Offset Voltage, Input Offset Current, Input Bias Current, Common Mode Rejection Ratio (CMRR), Slew Rate, Power Supply Rejection Ratio (PSRR).

Unit-II: Operational Amplifier Applications (15 HOURS)

Op-Amp with Negative feedback: General concept of Voltage Series, Voltage Shunt, Current Series and Current Shunt Negative Feedback, Op Amp circuits with Voltage Series and Voltage Shunt Feedback,

Applications of Op-Amps: Inverting and Non-inverting Amplifiers, Summing and Difference Amplifier, Instrumentation Amplifier, Differentiator and Integrator, Comparator and Schmitt Trigger.

Unit-III: Data Converters and Active Filters (15 HOURS)

Data Converters: Analog-to-Digital (Flash and Successive Approximation type), Digital-to-Analog Converters (Weighted Resistor and R-2R Ladder type).

Active Filters using Op-Amps: First and Second Order Active Low Pass, high Pass, Band Pass and Band Stop Butterworth Filters.

Oscillators and Signal Generators: Barkhausen criterion for Sustained Oscillations, Phase Shift Oscillator, Wien-bridge oscillator, Square Wave Generator, Triangle Wave Generators.

Unit-IV: Specialized ICs and applications (15 HOURS)

IC 555 Timer: Introduction, Block diagram, Astable and Monostable multivibrator circuits.

Phase Locked Loops (PLL): Block Diagram and Characteristics, IC565 PLL, Phase Detectors, Voltage Controlled Oscillator (IC 566), Overview of PLL Applications.

Voltage Regulators: Basic circuit configuration and characteristics, Basic blocks of linear voltage regulator, three terminal fixed regulators (78XX and 79XX), Concept of Adjustable and Switching Regulators.

Text Books:

1. Microelectronics circuits By Sedra and Smith, HRW Publishing.
2. Integrated Electronics By Milliman, McGraw Hill Book Company
3. OP- Amp and Linear Integrated Circuits by R. A. Gayakward, Prentice Hall of India Ltd.

References:

1. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Drisiol, Gayakward, Prentice Hall of India Private Ltd.
2. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, McGraw Hill, 2002.

PRACTICAL (2 CREDITS: 60 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Study Op-Amp Characteristics: CMRR and Slew Rate.
2. Design Inverting Amplifier of given Gain using Op-Amp.
3. Design of Non-Inverting Amplifier of given Gain using Op-Amp
4. Design Analog Adder and Subtractor Circuit using Op-Amp.
5. Design Integrator using Op-Amp.
6. Design Differentiator using Op-Amp.
7. Design First Order Low-Pass and High-Pass Filters using Op-Amp.
8. Design Second Order Low-Pass Filter using Op-Amp.
9. Design Second Order High-Pass Filter using Op-Amp
10. Design RC Phase Shift Oscillator using Op-Amp.
11. Design Wien Bridge Oscillator using Op-Amp.
12. Design of Square Wave and Triangle Wave Generators.
13. Study IC 555 as Astable Multivibrator.
14. Study IC 555 as Monostable Multivibrator.
15. Study the operation of 565 PLL with a given free running frequency.
16. Study line and load regulation using three-terminal regulators.

Under-Graduate Programme with ELECTRONICS: 4th SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE422J1: SIGNALS AND SYSTEMS

Credits: THEORY: 3, PRACTICAL: 1

Course Objectives:

1. *To understand the fundamental characteristics of signals and systems.*
2. *To understand signals and systems in terms of both the time and transform domains.*
3. *To develop the mathematical skills to solve problems involving convolution, filtering and sampling.*

Expected Learning Outcomes:

At the end of this course students will demonstrate the ability to:

1. *Analyse different types of signals.*
2. *Analyse linear shift-invariant (LSI) systems.*
3. *Represent continuous and discrete systems in time and frequency domain using Fourier series and transform.*
4. *Analyse discrete time signals in z-domain.*
5. *Study sampling and reconstruction of a signal.*

THEORY (3 Credits):

UNIT-I: Representation and Classification of Signals and Systems (15 HOURS)

Representation and Classifications of Continuous and Discrete Time Signals and Systems; Linear and Nonlinear systems, Causal and non-causal Systems, Time varying and Time Invariant systems, Singularity Functions; Convolution Operation of Continuous and Discrete Time Signals; Impulse Response and Its Properties.

Unit-II: Fourier Series and Frequency analysis of Continuous time systems(15 HOURS)

Fourier Transform and its Properties; System Analysis Using Fourier Transform; Hilbert Transform; Representation and Analysis of Bandpass Signals and Systems: Review of Laplace Transform; Two-Sided Laplace Transform; System Analysis of I and II Order Systems; Transfer Function; Frequency Response of I and II Order Systems.

Unit-III: Discrete Time Systems (15 HOURS)

Sampling: Representation of a Continuous-Time Signal by its Samples, Sampling Theorem. Reconstruction of a Signal from its Samples, Aliasing, Discrete-Time Processing of Continuous-Time Signals: Arithmetic operations on discrete time signals. Solutions of Discrete time systems using Z-transform. Introduction to Random Variables; Probability Distribution and Probability Density Functions; Uniform, Gaussian, Exponential and Poisson Random Variables; Statistical Averages; Random Processes; Correlation; Power Spectral Density.

Recommended Books:

1. Alan V, Oppenheim and A.S Wilsky, Signals and Systems, prentice Hall India
2. Simon Hykin, Signals and systems, John Wiley.
3. B. P Lathi, Signals and systems
4. Simon Hykin, Communication systems, John wiley
5. D. M. Etter, D.C, Kuncicky, H. Moore, Introduction to MATLAB 7, Pearson.

PRACTICAL (1 CREDIT: 30 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Familiarization with MATLAB software.
2. Introduction to Signal Processing toolbox.
3. Matrix Operations & Plotting using MATLAB.
4. Generation of Signals & Signal Operations.
5. Convolution on Continuous Time Signals.
6. Study of Laplace Transforms using MATLAB.

7. To Study sampling of continuous signals using MATLAB.

Under-Graduate Programme with ELECTRONICS

4th SEMESTER

ELECTRONICS

MAJOR

ELE422J2: APPLIED MATHEMATICS & PROGRAMMING

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To understand Fourier series and its applicability in different fields of electronics.*
2. *To understand the Fourier transform and its application in electronics.*
3. *To use Laplace transform methods to solve differential equations.*
4. *To understand various numerical techniques for the solution of algebraic equations.*
5. *To develop programming skills using C-programming.*

Expected Learning Outcomes:

At the end of this course students will demonstrate the ability to:

1. *Familiarize with the concept of Fourier transform & Fourier series*
2. *Understand the utility of Laplace transform*
3. *Develop algorithms for arithmetic and logical problems and write programs in C language*

THEORY (4 Credits):

UNIT-I: Fourier Series and Fourier Transform (15 HOURS)

Dirichlet's Condition, Determination of Fourier Coefficients, Fourier Series for functions of arbitrary period, Half-wave expansion, Fourier Integral Theorem, Fourier Sine and Cosine integrals, Fourier Transforms: Properties of Fourier Transforms, Fourier Transform and Dirac delta function, Application of Fourier Transformation in Electronics.

Unit-II: Laplace Transformation (15 HOURS)

Integral transforms, Laplace transforms, Properties of Laplace transforms, Laplace transform of some elementary functions, Shifting theorems, Laplace Transform of a derivative, Laplace transforms of integrals, Inverse of Laplace transform by partial fractions, Heavisize's expansion formula, Solving differential equation using Laplace transform, Applications of Laplace transform in the field of Electronics.

Unit-III: Numerical Methods (15 HOURS)

Empirical laws & Curve fitting methods: Method of group averages, Method of least squares Solution of Algebraic & transcendental equations: Bisection Method, Method of False Position, Iteration Method, Newton –Raphson Method, Solution of Simultaneous Algebraic equations: Cramer's rule, Matrix Inversion method, Gauss Elimination method, Gauss-Jordan Method.

Unit-III: C Programming (15 HOURS)

Character set, Variables and Identifiers, Data Types, Variables, operators and Expressions, Constants and Literals, assignment and Basic input/output statement, Conditional Statements and Loops- Relational Operators, Logical, Switch Statement, Arrays and their processing; Functions and their processing, Pointer Arithmetic. Introduction to files and their processing.

Recommended Books:

1. Advanced Engineering Mathematics by Edwin Kreyzing, Wiley Eastern Ltd.
2. Applied Mathematics for Engineers and Physicist by Pipes and Harvill, McGraw Hill Book Company.
3. Fourier Transformation and Laplace Transformations, Schaum Series Book, TMH Course
4. Numerical Methods, E. Balaguruswamy, TMH
5. Introductory Methods of Numerical Analysis, S.S.Sastry, PHI
6. Computer Oriented Numerical Methods, R.S. Salaria, Khanna Publishing House

7. Numerical Methods in Engineering and Science, B. S. Grewal

8. Numerical Methods, Khandasamy, K. Thilagavathy, K. Gunavathy.

9. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, R. K. Jain. New Age International Publisher.

10. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale, TMH

11. C How to Program by Deitel

12. Programming with C by Byron S Gottfried

PRACTICAL (2 CREDIT: 60 HOURS)

Note: The student is required to attempt at least 15 experiments

1. Write a C program to Generate the Fibonacci series up to the given limit N and also print the number of elements in the series.
2. Write a C program to Find minimum and maximum of N numbers.
3. Write a C program to Find the GCD of two integer numbers.
4. Write a C program to Calculate factorial of a given number.
5. Write a C program to Generate and print prime numbers up to an integer N.
6. Write a C program to Sort given N numbers in ascending order.
7. Write a C program to add two Matrices Using Multi-Dimensional Arrays.
8. Write a C program to multiply two Matrices Using Multi-Dimensional Arrays.
9. Write a C program to multiply two Matrices by passing Matrix to a Function.
10. Write a C Program to Find Largest Element in an Array

11. Write a program to evaluate the sine series using recursive and non-recursive functions.

12. Write programs using structures, and unions for selected cases.

13. Write programs employing pointers instead of the use of arrays.

14. Write programs to create files, and read and write on these files.

15. Write a program to evaluate the sine series using recursive and non-recursive functions.

16. Write a C program to find the solution of a non-linear equation using repetitive substitution method.

17. Write a C program to find the solution of a non-linear equation using Bisection method.

18. Write a C program to find the solution of a non-linear equation using Regula Falsi method.

19. Write a computational program for solving algebraic equations by Newton Rapson method.

20. Write a computational program for solving simultaneous algebraic equations by Gaussian Elimination method.

21. Write a C program of fitting a straight line, exponential curve, geometric curve, hyperbola and a polynomial

Under-Graduate Programme with ELECTRONICS: 4th SEMESTER

ELECTRONICS

MAJOR

ELE422J3: ELECTROMAGNETIC WAVES & ANTENNAS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *Use Maxwell's equations to calculate fields from dynamic charge/current distributions.*
2. *Analyse plane waves in lossless and lossy media.*
3. *Calculate fields from antennas and antenna systems.*
4. *To study various polarization techniques.*

Expected Learning Outcomes:

At the end of this course students will demonstrate the ability to:

1. *Understand the radiation mechanism of EM waves by antennas and their radiation patterns.*
2. *Analyse the power radiated by different antennas and their radiation characteristics.*
3. *Interpret the relationships between antenna parameters.*
4. *Design and analyse different antennas and antenna arrays. 5. understand the wave propagation mechanism at different frequencies.*

THEORY (4 Credits):

UNIT-I: Electromagnetic Fields and Maxwell's Equations (15 HOURS)

Introduction, Coulomb's law of forces, Principle of Superposition of Maxwell's Equations in differential and integral form. fields, Electric scalar potential, Relation of Electric field lines and equi-potential contours, The electric dipole and dipole moment, Gauss's law, Characteristics of dielectrics. Boundary relations, Capacitance, Divergence of flux density, Divergence Theorem, Poisson's and Laplace Equations, Equations of continuity for time varying fields, inconsistency of Amperes law, Boundary condition, Boundary Conditions at media interface (Dielectric and Conducting interface). Homogenous unbounded medium, Wave equation for time harmonic fields, solution of the wave equation, uniform plane wave.

Unit-II: Wave Polarization and Communication (15 HOURS)

Biot Savart law, Force between two parallel linear conductors, Magnetic flux and flux density, Magnetic field relations, Torque of a loop, Energy stored in a magnetic field, Inductance, Ampere's law, Maxwell's First curl equation, Comparison of divergence and curl, The vector potential, permeability, Analogies between electric and magnetic fields. M wave polarization, power flow and pointing vector (Physical interpretation), plane wave at dielectric interface, reflection and refraction of waves in dielectric interface, Normal Incidence on a layered medium, Total Internal Reflection, Wave Polarization at Media interface.

Unit-III: Antenna Fundamentals (15 HOURS)

Basics of antenna radiation, Potential functions, solution of potential functions, radiation from the hertz dipole, total power radiated by the hertz dipole, radiation resistance of the hertz dipole, radiation pattern of the hertz dipole, directivity, antenna gain, effective area of antenna. Folded dipole antennas, modification of folded dipoles, loop antennas, far-field patterns of circular loop antennas, Antenna Theorems – Applicability and Proofs for equivalence of directional characteristics, Loop Antennas: Small Loops - Field Components, Comparison of far fields of small loop and short dipole, Concept of short magnetic dipole, D and Rr relations for small loops.

Unit-IV: Antenna Arrays and Special Structures (15 HOURS)

Two element arrays – different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, Endfire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison; Concept of Scanning Arrays, Yagi-Uda Arrays, Folded Dipoles and their characteristics, Introduction, Traveling wave radiators – basic concepts, Long wire antennas – field strength calculations and patterns, Microstrip Antennas-Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas.

Recommended Books:

1. Antennas and Wave propagation: John D Kraus, Ronald J Marhefka, Ahmad S Khan McGraw Hill, 4th edition.
2. Electromagnetic Waves: R. K. Shevgaonkar Tata McGraw Hill.
3. Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi
4. Antenna Theory - C.A. Balanis, John Wiley and Sons, 2nd Edition,2001.

PRACTICAL (2 CREDIT: 60 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Measurement of Antenna Parameters using Microwave Antenna Training System
2. Plot of Polarization (Horizontal and Vertical).
3. Design of dipole antenna system using waveguide.
4. Some experiments using Microwave Antenna Trainer and CST Tool or HFSS.

Under-Graduate Programme with ELECTRONICS: 5th SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE522J1: MICROPROCESSORS & MICROCONTROLLERS

Credits: THEORY: 3, PRACTICAL: 1

Course Objectives:

1. *To understand the differences in architecture and applications between Microprocessors and Microcontrollers*
2. *To understand basic architecture of 8085 microprocessor*
3. *To understand the 8085 instruction set and write programs in assembly language*
4. *To understand basic architecture of 8051 microcontroller*
5. *To understand the 8051 instruction set and write programs in assembly language*

Expected Learning Outcomes:

On completion of this course the students will be:

1. *Familiar with the components and functioning of a computer system, gaining an understanding of how a computer system operates.*
2. *Familiar with the fundamental concepts and architecture of 8085 microprocessor and 8051 Microcontroller.*
3. *Familiar with the addressing modes, computer instructions and its types.*
4. *Able to write assembly language programs for microprocessors and microcontrollers.*
5. *Able to interface different peripherals with 8051 Microcontrollers.*

THEORY (3 Credits):

UNIT-I: Introduction to Microprocessors and Microcontrollers (15 HOURS)

Computer System: Central Processing Unit, Memory, I/O, System Bus; Functions of a computer system. Introduction/History/Evolution and Applications of Microprocessors, types and Characteristics of a Microprocessors, Programmer's Model of Microprocessors, Von Neumann and Harvard Architectures, CISC and RISC Architectures. Introduction/Evolution and Applications of Microcontrollers, Comparison of Microprocessor and Microcontroller, Microcontrollers for embedded system, Criteria for choosing a Microcontroller, Programming Languages.

Unit-II: 8085 Architecture and Programming (15 HOURS)

Introduction and Architecture of 8085 Microprocessor, 8085 Bus Structure, Addressing Modes, 8085 instructions set (Data transfer including stacks. Arithmetic, logical, branch, and control instructions), Subroutines, delay loops, Instruction and Data Formats. Instruction Timing Diagram, Memory read/write Timing Diagrams. 8085 Interrupts. Programming of 8085 using Data Transfer, Arithmetic and logic Instructions.

Unit-III: 8051 Architecture and Programming (15 HOURS)

Introduction and Architecture of 8051 microcontroller, Pin description of 8051 microcontroller, Input/Output Ports and Port circuits, Timers and counters, Serial data input/output Interrupts, register set and Addressing Modes of 8051, Instruction set of 8051 (data transfer/arithmetic/logic/bit level and byte control transfer instructions), 8051 Assembly Language Programming: I/O port programming, bit manipulation, programming using Data Transfer, Arithmetic and logic Instructions. Interfacing of LED.

Recommended Books:

1. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
2. Microprocessors and Microcontrollers: Architecture, Programming & Interfacing using 8085, 8086, and 8051, S.K Mandal, Tata Mcgraw Hill Education.
3. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
4. Microprocessor Theory and Applications, M. Rafiq-u Zaman, McGraw Hill Publishing Company
5. Microprocessor Techniques by A. P. Godse, 2nd Ed., Technical Publications

PRACTICAL (1 CREDIT: 30 HOURS)

Programs using 8085 Microprocessor:

1. Arithmetic and logical operations of 8-bit/16-bit numbers.
2. Count number of 1's/0's in a given number.
3. Multiplication by repeated addition.
4. Division by repeated subtraction.
5. Block Data transfer.
6. Programs handling 32-bit numbers.
7. Calculate the sum of series of Even/Odd numbers
8. Find larger/smaller of two 8 and 16-bit numbers
9. Find the square of given number.
10. Delay loops.

Programs using 8051 Microcontroller:

1. Arithmetic and logical operations of 8-bit/16-bit numbers.
2. Data Transfer and shift operations.
3. Program to toggle the bits of port with some delay
4. Find the Largest/smallest number in a series of 10 numbers.
5. Sort Numbers in Ascending/Descending Order.
6. Singly and Multibit Shifting, Rotation and manipulation.
7. To find the factorial of a number.
8. Program to make the two numbers equal by increasing the smallest number and decreasing the largest number.

Under-Graduate Programme with ELECTRONICS: 5th SEMESTER

ELECTRONICS

MAJOR

ELE522J2: DIGITAL SYSTEM DESIGN AND VHDL

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To impart basic concepts of computer architecture and organization.*
2. *To explain key skills of constructing cost-effective computer systems.*
3. *To familiarize the basic CPU organization.*
4. *To help students in understanding various memory devices.*
5. *To facilitate students in learning IO communication.*

Expected Learning Outcomes:

At the end of this course students will be able to:

1. *Identify various components of computer and their interconnection*
2. *Identify basic components and design of the CPU: the ALU and control unit.*
3. *Compare and select various Memory devices as per requirement.*
4. *Compare various types of IO mapping techniques*
5. *Critique the performance issues of cache memory and virtual memory.*

THEORY (4 Credits):

UNIT-I: Introduction to VHDL programming (15 HOURS)

Fundamental units of VHDL, Library declaration, Entity declaration, Architecture declaration, Data types, Primitive programming Data flow programming, Structural Programming, Signals and variables, Test benches, State machines.

Unit-II: Structure of Computers (15 HOURS)

Computer types, Functional units, Basic operational concepts, Von-Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Computer Arithmetic's: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic. Implementation of Arithmetic circuits in VHDL.

Unit-III: Register Transfer, Micro-Operations & Memory Systems (15 HOURS)

Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. MICRO-PROGRAMMED CONTROL: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit. Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory. Implementation of registers in VHDL

Unit-IV: Basic Computer Organization and Design (15 HOURS)

Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC. Implementation of simple CPU in VHDL.

Recommended Books:

1. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
2. M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India.
3. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
4. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,

5. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGraw Hill
6. Nikrouz Faroughi, (2015), Digital Logic Design and Computer Organization with computer architecture for security, 1st edition, McGraw Hill Education.

PRACTICAL (2 CREDIT: 60 HOURS)

Note: The student is required to attempt at least 15 experiments

1. Design the Datapath of a computer from its register transfer language transcription
2. Implement a simple instruction set computer with a control unit and a data path.
3. Design a control unit of a computer using the Microprogrammed logic based on its RTL.
4. Design an 8-bit ALU using VHDL?
5. Implement the HALF Adder using VHDL?
6. Implement the FULL Adder using VHDL?
7. Implement the Binary to Gray and Gray to Binary code converters using VHDL?
8. Design a 3 x 8-line decoder using VHDL?
9. Implement the 4 x 1 and 8 x 1 Multiplexer using VHDL?
10. Implement the various flip-flops using VHDL and verify the excitation tables?
11. Implementation of various logic gates using VHDL?
12. Implementation of Booth's Algorithm using VHDL?
13. Implementation of direct mapped cache design using VHDL?
14. Implementation of restoring division algorithm using VHDL?

15. Implementation of synchronous counters using VHDL?

16. Implementation of Ripple Carry Ahead (RCA) using VHDL?

17. Design an 8-bit Barrel Shifter using VHDL?

18. Using VHDL to implement Subtractors circuits using 2’s compliment method?

19. Implementation of Moore’s Machines using VHDL?

20. Implementation of Melay Machine using VHDL?

21. Verification of the designed circuits using FPGA.

Under-Graduate Programme with ELECTRONICS: 5^{th} SEMESTER

ELECTRONICS

MAJOR

ELE522J3: MICROWAVE ENGINEERING

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To understand and gain complete knowledge about microwave devices and components.*
2. *To learn about transmission lines and analysis of wave guides.*
3. *To learn the importance of S parameters and VSWR in microwave measurements.*

Expected Learning Outcomes:

At the end of this course students will be able to demonstrate the:

1. *Use of different types of waveguides and their respective modes of propagation.*
2. *Analyse typical microwave networks using impedance, admittance, transmission and scattering matrix representations.*
3. *Design microwave matching networks using L section, single and double stub and quarter wave transformer.*
4. *Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.*
5. *Describe and explain working of microwave tubes and solid-state devices.*
6. *Perform measurements on microwave devices and networks using power meter and VNA*

THEORY (4 Credits):

UNIT-I: Microwave Transmission Lines (15 HOURS)

Transmission Line and Distributed parameters, Basic Transmission line equations, Solutions of Transmission line equations, Physical significance of Transmission line equations, Distortions in Transmission line, Condition for Distortion less line, Characteristic impedance, Propagation Constant, Reflection and Transmission coefficients, Velocity of propagation, Standing wave and Standing wave ratio, Reflection of line terminated in impedance other than characteristic impedance, Single stub impedance matching, Smith Chart.

Unit-II: Microwave Network Analysis (15 HOURS)

Impedance and Equivalent Voltages and Currents, Equivalent Voltages and Currents, The Concept of Impedance, Even and Odd Properties of Z(ω) and (ω), Impedance and Admittance Matrices, Reciprocal Networks Lossless Networks, The Scattering Matrix , Reciprocal Networks and Lossless Networks, A Shift in Reference Planes , Power Waves and Generalized Scattering Parameters, The Transmission (ABCD) Matrix, Relation to Impedance Matrix, Equivalent Circuits for Two-Port Networks, Signal Flow Graphs, Decomposition of Signal Flow Graphs, Application to Thru-Reflect-Line Network Analyzer Calibration.

Unit-III: Microwave Waveguides (15 HOURS)

Rectangular Waveguides, Solution of Wave Equations in Rectangular Coordinates, TE modes in rectangular magnitudes, TM Modes in Rectangular waveguide, Power Transmission in Rectangular Waveguides, Power Losses in Rectangular Waveguides, Excitations of Modes in Rectangular waveguides, Circular Waveguides, TEM Modes in Circular Waveguide.

Unit-IV: Microwave Devices and Strip lines (15 HOURS)

Klystrons: Multi-cavity Klystron and Reflex Klystron, Microwave Tunnel Diode Gunn Oscillator, Travelling Wave Tube, Characteristic Impedance of Micro strip Lines and Quality factor of Micro-strip lines, Characteristic impedance of Parallel strip lines and Attenuation losses, MMIC Fabrication techniques.

Recommended Books:

1. G. S. Raghuvanshi, Microwave Engineering; Cengage
2. S.Y. Liao, Microwave Devices & Circuits; PHI 3rd Ed.
3. A Das and S.K. Das, Microwave Engineering; McGraw Hill Education
4. S. Vasuki, D Margaret Helena, R Rajeswari, Microwave Engineering; MHE

5. Om P. Gandhi, Microwave Engineering and Applications; Pergamon Press
6. Microwave Engineering Fourth Edition David M. Pozar University of Massachusetts at Amherst, John Wiley & Sons, Inc 4th Edition.

PRACTICAL (2 CREDIT: 60 HOURS)

Laboratory Work I:

Study of different Microwave guide components, determination the frequency and wavelength in a rectangular wave guide working on T_{E10} mode, Finding the standing wave ratio and reflection coefficient. Measurement of an unknown impedance with smith chart,

Laboratory Work II:

VI characteristics of Gunn diode, O/P power and frequency as a function of voltage in case of Gunn diode, Magic tee, Characteristics of Klystron tube and determination of its electronic tuning range, various experiments using MATLAB and HFSS Tool.

Under-Graduate Programme with ELECTRONICS: 6^{th} SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE622J1: COMMUNICATION ELECTRONICS - I

Credits: THEORY: 3, PRACTICAL: 1

Course Objectives:

1. *To understand the transmission of signals through communication channels.*
2. *To understand analog communication systems using amplitude modulation and demodulation.*
3. *To learn about analog communication systems using angle modulation and demodulation.*
4. *To know about various types of noise in communication systems.*

Expected Learning Outcomes:

At the end of this course students shall be able to demonstrate:

1. *Basic working of communication system*
2. *Analog Modulation Techniques and their comparative analysis and applications suitability*
3. *Process of Modulation and Demodulation*
4. *Types, characterization and performance parameters of transmission channels*
5. *Multiplexing Techniques*
6. *Basic working principles of existing and advanced communication technologies*
7. *Conversion of analog speech into digital speech using PCM.*

THEORY (3 Credits):

Unit-I: Amplitude Modulation and Demodulation (15 HOURS)

Introduction to Signals and its classification, Basic Mathematical theory of A. M modulation, Time domain and Frequency domain representation, Generation and demodulation of AM Signal, Double Side band Suppressed Carrier, (DSB- SC) System, Generation and Demodulation of DSB- SC signals, Advantages of SSB transmission, Generation of SSB; Vestigial Side-Band Modulation (VSB). SSB and VSB demodulation, independent sideband transmission and reception.

Unit-II: FM Modulation, Reception and Noise (15 HOURS)

Concept of Angle Modulation: Mathematical theory, Bandwidth calculation, Generation of FM by Direct Methods. Indirect Generation of FM; The Armstrong Method, FM Receiver Direct Methods of Frequency Demodulation; Slope Detector, FM Detector using PLL, Noise in Communication System, Time-domain representation of Narrow band Noise, Filtered White Noise, Noise figure. AM Receiver model, Noise analysis of DSBSC and SSBSC using coherent detection, Noise in AM using Envelope detection, Noise in FM using Limiter-discriminator detection, FM threshold effect, Pre- emphasis and De-emphasis in FM.

Unit-III: Pulse Modulation (15 HOURS)

Introduction to PCM, PAM and PWM. Review of Sampling Theorem, Signal Reconstruction: The Interpolation Formula, Elements of Pulse Code Modulation (PCM), Quantization: Uniform and Non-uniform Quantization, Companding Characteristics, Encoding, Bandwidth and Noise in PCM Systems, Differential PCM, Delta modulation and Adaptive DM.

Recommended Books:

1. P.Z. Peebles.Jr., Probability, Random Variables and Random Signal Principles, Tata McGraw Hill Education, 3rd edition, 2002.

2. A.Papoulis, Probability, Random variables and Stochastic Processes, McGraw Hill, 3rd edition, 1991

3. Modern Digital and Analog Communication Systems, by B. P. Lathi, Oxford Press.

4. George Kennedy, “Electronic Communication System”, McGraw- Hill.

5. Gary M. Miller and Jeffery S. Beasley, “Modern Electronic Communications “, PHI.

6. Simon Haykin, “Communication Systems”, 8th edition, Wiley Publishers

PRACTICAL (1 CREDIT: 30 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Study of ICs (AD633/AD734)
2. Design and realize AM modulator using Square Law modulator and calculate its modulation index and power
3. Design and realize AM detector using Square Law detector and Envelope detector
4. Design and realize DSB-SC signal Modulator using Analog Multiplier
5. Design and realize DSB-SC signal demodulator using Coherent detection and Squaring loop
6. Simulation of SSB-SC modulator and demodulator using MATLAB/Simulink
7. Simulation of Hilbert transformer and VSB filter using MATLAB/Simulink
8. Derivation of modulation index in case of FM signal
9. To design and realize FM generation and Detection
10. To study & realize Op- amp based Pre-Emphasis & De-Emphasis circuits
11. Field study/visit to place such as Radio Kashmir Srinagar

Under-Graduate Programme with ELECTRONICS: 6th SEMESTER

ELECTRONICS

MAJOR

ELE622J2: ADVANCED MICROPROCESSORS & MICROCONTROLLERS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To understand basic architecture of 8086 microprocessor*
2. *To understand 8086 instruction set and write programs in assembly language*
3. *To understand interrupt system of 8086 microprocessor*
4. *To study PIC microcontroller family*

Expected Learning Outcomes:

On completion of this course the students will be able to

1. *Write programs for 8086 microprocessors.*
2. *Interface memory and I/O devices with 8086 microprocessors.*
3. *Write programs for PIC microcontrollers*
4. *Design and implement PIC microcontroller-based systems*

THEORY (4 Credits):

UNIT-I: Introduction to x86 Microprocessor family (15 HOURS)

Introduction to 8086 Microprocessor, Working and Architecture of 8086, Register organization of 8086 Microprocessor, Addressing Modes and memory segmentation in 8086. Pin Description of 8086. Features and comparison of 80186, 80286, 80386, 80486 and Pentium Processors. Recent trends in microprocessor design.

Unit-II: 8086 Instructions set and Assembly language Programming (15 HOURS)

Instruction set of 8086 Microprocessor: Data transfer instructions, Arithmetic and Logical instructions, Branch Instructions, Processor control instruction, String operation instructions. Assembly language Programming for 8086 microprocessors. Use of Macros and Procedures in ALP.

Unit-III: Interrupts, Timing and Peripheral Devices (15 HOURS)

Interrupts and interrupt service subroutines, 8086 Interrupt Structures, Interrupt Vector table, various types of Interrupts. ALP using interrupts, 8259 Programmable Interrupt Controller, Interfacing & Programming, Architecture and operation of 8284A Clock Generator, Buffering and Latching of 8086 Microprocessor, Bus timings, Timing Diagrams, Wait States, Minimum and Maximum Mode 8086 System, 8288 Bus Controller. 8086 Memory Interfacing.

Unit-IV: PIC Microcontrollers (15 HOURS)

Introduction to PIC Microcontroller families (8/16 and 32 bit), PIC 16F series family overview of architecture and peripherals, Pin diagram and Architecture of PIC16F84/PIC16F84A Microcontroller, Memory organization, configuration, memory addressing, and special function registers, parallel and serial ports, timer and counters, Interrupts, Watchdog Timer. Instruction set of PIC16F84 Microcontroller. Programming of PIC16F84 Microcontroller. Introduction to 18F, 24F and 32F series of PIC microcontrollers.

Recommended Books:

1. Introduction to 8086, 80186,80286, 80386, 80486, Pentium and Pentium Pro Processors, B. Bray, TMG
2. Advanced Microprocessors by Daniel Tabak McGraw-Hill.
3. Advanced Microprocessors by A. P. Godse, D. A. Godse Technical Publications.
4. Advanced Microprocessors and Peripherals by K. M. Burchandi, A. K. Ray Tata McGraw Hill Education
5. Designing Embedded Systems with PIC Microcontrollers: Principles and Applications, 2nd Edition, Tim Wilmshurst, Elsevier Publication.
6. Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation by Martin Bates, Elsevier Publication.

PRACTICAL (2 CREDIT: 60 HOURS)

Experiments using 8086 Microprocessor:

1. WAP for Arithmetic and logic operations of 8-bit/16-bit and 32- bit numbers.
2. WAP for signed multiplication of 16-bit numbers.
3. WAP to add a series 10-byte array stored in Data Segment.
4. WAP to find square/cube of a given number.
5. WAP to transfer a block of 10 bytes from Data Segment to Extra Segment.
6. WAP to find whether a given number is positive or negative.
7. WAP to Convert a Hex number into Decimal Number.
8. WAP to find whether a given number is Even or Odd.
9. WAP to find whether a given byte is bit wise Palindrome
10. WAP to find Factorial of a number.
11. WAP to SORT a series of 10 numbers in ascending/ descending order
12. WAP to find Maximum/Minimum in a given series of 10 numbers.

Experiments using PIC16F84 microcontroller:

1. WAP for Arithmetic and logic operations of 8-bit and 16-bit numbers.
2. WAP for Multiplication and Division.
3. WAP to add a series 10-byte array stored in data memory.
4. WAP to find square/cube of a given number.
5. WAP to find Factorial of a number.
6. WAP to SORT a series of 10 numbers in ascending/ descending order
7. Interfacing of LED with PIC16F84 Microcontroller.
8. Interfacing a Switch with PIC16F84 Microcontroller.

9. Interfacing of both LED and Switch with 16F84 Microcontroller.

10. PIC 16F84 Microcontroller and Seven segment interfacing.

11. WAP to generate a square waveform with PIC16F84 Microcontroller

12. 8-bit ADC Interfacing

13. PWM signal generation at various frequencies.

Under-Graduate Programme with ELECTRONICS: 6th SEMESTER

ELECTRONICS

MAJOR

ELE622J3: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *Study about uninformed and Heuristic search techniques.*
2. *Learn techniques for reasoning under uncertainty*
3. *Introduce Machine Learning and supervised learning algorithms*
4. *Study about ensembling and unsupervised learning algorithms*
5. *Learn the basics of deep learning using neural networks*

Expected Learning Outcomes:

At the end of this course students will demonstrate the ability to:

1. *Use appropriate search algorithms for problem solving*
2. *Apply reasoning under uncertainty*
3. *Build supervised learning models*
4. *Build ensembling and unsupervised models*
5. *Build deep learning neural network models*

THEORY (4 Credits):

UNIT-I: Problem Solving and Probabilistic Reasoning (15 HOURS)

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP).

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

Unit-II: Supervised Reasoning (15 HOURS)

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

Unit-III: Ensemble Techniques And Unsupervised Learning (15 HOURS)

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

Unit-IV: Neural Networks (15 HOURS)

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

Recommended Books:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020
3. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education,2007
4. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
5. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
6. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
7. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

8. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
9. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
10. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016

PRACTICAL (2 CREDIT: 60 HOURS)

Laboratory Work I (Python Programming I):

Python Data structure and Data types, Simple Input-Output operators, String Operators, if, if-else, nested if, Loops, functions, classes in Python , Instance methods, inheritance, polymorphism, python GUI

Laboratory Work II (Python Programming II):

1. Implementation of Uninformed search algorithms (BFS, DFS)
2. Implementation of Informed search algorithms (A*, memory-bounded A*)
3. Implement naïve Bayes models
4. Implement Bayesian Networks
5. Build Regression models
6. Build decision trees and random forests
7. Build SVM models
8. Implement ensembling techniques
9. Implement clustering algorithms
10. Implement EM for Bayesian networks
11. Build simple NN models
12. Build deep learning NN models

Under-Graduate Programme with ELECTRONICS: 7th SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE722J1: ELECTRONIC INSTRUMENTATION

Credits: THEORY: 3, PRACTICAL: 1

Course Objectives:

1. *To introduce students to the use of various electrical/electronic instruments, their construction, applications, principles of operation, standards and units of measurements.*
2. *To expose the students to various types of sensors and their applications.*
3. *To expose the students to various measuring and analysing instruments.*

Expected Learning Outcomes:

After going through this course, the student shall be able to use different instruments and measure different electrical parameters. Besides, the students shall be able to design sensory systems for measuring different physical parameters.

THEORY (3 Credits):

Unit-I: Measurement and Meters (15 HOURS)

Measurement and its Significance, methods of measurement. Basic definitions of instruments, Classification of instruments, Performance parameters: Accuracy, Precision, Sensitivity, Resolution, Errors, Significant figure. D'Arsonval movement: Construction and working, DC ammeter and voltmeter, Ammeter and Voltmeter loading, DC ohmmeters (Series and Shunt type). Rectifier type of instruments (half wave and full wave), Multi range AC voltmeter, Peak to peak AC voltmeter, Single phase wattmeter and single phase watt-hour meter. Digital frequency meters and time meters, Digital Voltmeter: General Characteristics, Ramp type DVM, Staircase ramp DVM, Successive approximation type DVM, Integrating type DVM Digital ohm meter, Digital capacitance meter, Digital modulation index meter, Digital quality factor meter.

Unit-II: Bridges and Sensors (15 HOURS)

Bridges: Types, Condition for Bridge balance. DC Bridges: Wheatstone Bridge, Kelvin double Bridge. AC Bridges: Maxwell Bridge, Hay bridge, Schering Bridge, Wein bridge, Sensors: Classification of sensors, characteristics and choice of sensors; Resistance, Capacitance, Inductive, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Techogenerators, Measurement of displacement, velocity, acceleration, force, torque, strain, speed, and sound, temperature, pressure, flow, humidity, thickness, pH, position.

Unit-III: Oscilloscope and Signal Analyzers (15 HOURS)

Block diagram of CRO, Electrostatic and electromagnetic focusing (Qualitative), Horizontal and vertical deflection system, Vertical amplifier, Horizontal amplifier, Sweep generators, vertical input and sweep generator, Signal synchronization, Measurement of voltage, Frequency and phase angle. Dual trace Oscilloscope, Dual beam Oscilloscope, Sampling Oscilloscope, Digital Storage Oscilloscope. Function generator, Harmonic distortion analyzer, Wave analyzer, Spectrum Analyzer, Spectrum Analyzer characteristics.

Recommended Books:

1. W. D. Cooper, A. D. Helfrick, Modern Electronic Instrumentation and Measurement Techniques, PHI.
2. David E. Bell, Instrumentation.
3. Goldein, Instrumentation
4. T. S. Rathore, Digital Measurement Techniques, Narosa Publishing House, New Delhi.

PRACTICAL (1 CREDIT: 30 HOURS)

Note: The student is required to attempt at least 8 experiments

1. Design of single and multi-range ammeters.
2. Design of single and multi-range voltmeters.

3. Design of single and multi range ohmmeters.

4. Measurement of Resistance by Wheatstone bridge.

5. Measurement of small resistances using Kelvin double bridge

6. Measurement of Inductance using Maxwell bridge.

7. Measurement of Capacitance using Hay bridge.

8. Measurement of Capacitance using Schering bridge.

9. Measurement of Frequency using Wein bridge,

10. Study of Oscilloscope.

11. Measurement of voltage, Frequency and phase angle using Oscilloscope.

12. Measurement of pressure using Strain gauge.

13. Measurement of Force using Piezo- electric transducer,

14. Measurement of Temperature using Thermistor/Thermocouple.

15. Measurement of Displacement using Linear Variable Differential Transformer (LVDT).

Under-Graduate Programme with ELECTRONICS: 7th SEMESTER

ELECTRONICS

MAJOR

ELE722J2: EMBEDDED SYSTEMS & INTERNET OF THINGS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. To introduce the Building Blocks of Embedded Systems.
2. To Educate in Various Embedded Development Strategies.
3. To introduce Basics of Real time operating system.
4. To understand the Internet of Things and various technologies and architectures involved in it.
5. To understand various platforms and sensors employed in Internet of Things.

Expected Learning Outcomes:

On completion of this course the students will be able to

1. Understand the embedded systems and its applications.
2. Design strategy of embedded systems for real time applications.
3. Understand the prime aspects of real time embedded system design.
4. understand the applications of IoT.
5. Realize the internet of things cloud, sensors and various platforms.
6. Design real time applications of IoT

THEORY (4 Credits):

UNIT-I: Introduction to Embedded Systems (15 HOURS)

Embedded Systems and general purpose computer systems, Classifications, applications and purpose of embedded systems. Core of Embedded Systems, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, Characteristics and quality attributes of embedded systems: Characteristics, Operational and non-operational quality attributes. Hard and Soft Real time systems, Hardware-software Co-design.

Unit-II: Real Time Embedded Systems (15 HOURS)

Introduction to Real Time Embedded Systems. Real-time operating system for embedded systems., Real time design issues with examples, Hardware considerations (logic states, CPU, Memory, Architectures), Real time building blocks, Real time case studies (Micro C/OSII, RT Linux, VxWorks, Tiny OS).

Unit-III: Introduction to Internet of Things (IoT) (15 HOURS)

IoT fundamentals, IoT Architecture and protocols, Overview of IoT networks, components (Hardware & Software) of IoT, IoT Communication Technologies (3G, 4G & 5G, IEEE 802.15.4, IEEE 802.11), Challenges in IoT. Layering concepts, IoT Services and Standards. Application of IoT.

Unit-IV: IoT Platforms and Cloud Computing (15 HOURS)

Introduction to IoT supported hardware platforms - Arduino, ESP32, Raspberry Pi, Beagle bone and ARM Cortex processors and SparkFun. Operating system for IoT, Cloud Enabling Technologies, Characteristics of Cloud Computing - Benefits of Cloud Computing, Cloud Service Models, Cloud Deployment models, Cloud computing Infrastructure.

Recommended Books:

1. Introduction to Embedded Systems, K. V. Shibu Mc. Graw Hills.
2. Embedded Systems, Raj kamal, Tata Mc Graw Hill
3. Embedded Systems, Lyla B. Das, Pearson
4. Internet of Things, Kamlesh Lakhwani, BPB Publications.
5. Internet of Things with Raspberry Pi, Packet Publications.
6. Raspberry Pi, Tyler Goldberg

PRACTICAL (2 CREDIT: 60 HOURS)

Embedded System Design Lab:

1. Fundamentals of Embedded C, Data-types, variables, logic structures, etc.
2. Use of if-else, loops, nested loops, and conditional statements.
3. Writing Embedded C programs for microcontrollers.
4. Using Timer mode for blinking an LED using polling and interrupt methods (8051 μc).
5. Writing Programs to generate the delays using Timers,
6. Writing Programs for the generation of PWM wave, stepper motor control, LCD interface.
7. Writing the Embedded C code for AVR microcontrollers.

IoT Lab:

1. Acquiring familiarization of Arduino, ESP32, Raspberry Pi, etc. and perform necessary installations.
2. Blinking an LED on various platforms.
3. To interface the various sensors on Node MCU.
4. To interface various types of sensors (DHT11/DHT22, LDR, Rain Sensor, Particulate sensor, Pressure Sensor) with Arduino and Raspberry Pi.
5. To collect the data from various sensor and integrate with cloud (ThingSpeak cloud/etc.) for data analytics using node RED.
6. To install the SQL database on Raspberry Pi and perform basic SQL queries.
7. Configuration of Arduino and Raspberry Pi to subscribe to MQTT broker for various topics.
8. To configure Raspberry Pi as DHCP Server.

Under-Graduate Programme with ELECTRONICS: 7^{th} SEMESTER

ELECTRONICS

MAJOR

ELE722J3: COMMUNICATION ELECTRONICS - II

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To learn the basic concepts of information theory and coding.*
2. *To understand the building blocks of digital communication system.*
3. *To prepare mathematical background for communication signal analysis.*
4. *To understand spread spectrum modulation techniques.*

Expected Learning Outcomes:

At the end of this course students will be able to demonstrate:

1. *Understand basic science of information theory and its applications*
2. *Design and implement base band transmission schemes*
3. *Design and implement band pass signalling schemes*
4. *Analyse the spectral characteristics of band pass signalling schemes and their noise performance*
5. *Design error control coding schemes*
6. *Understand Spread spectrum modulation schemes*
7. *Understand basic concepts of Computer Communications*

THEORY (4 Credits):

UNIT-I: Information Theory (15 HOURS)

Introduction to Information Theory, Measure of information, Information content of Messages, Information Inequalities; Discrete Memoryless source, Information, Entropy, Mutual Information — Discrete Memoryless channels — Binary Symmetric Channel, Channel Capacity — Hartley — Shannon law — Source coding theorem — Shannon — Fano & Huffman codes.

Unit-II: Base Band Transmission & Reception (15 HOURS)

Inter Symbol Interference (ISI), Nyquist criterion for distortion less transmission, Pulse shaping, Correlative coding, Eye pattern, Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization.

Unit-III: Band Pass Digital Carrier Modulation and Channel Coding (15 HOURS)

Digital modulation techniques: Generation and Detection of Amplitude Shift Keying (ASK), frequency Shift keying (FSK), Phase Shift Keying, and Differential Phase Shift Keying (PSK and DPSK), base band receiver Optimum Filter, Co-relator, Probability of Error in each Scheme, Error Control Coding: Linear Block codes, (7, 4) Linear Block Coding, matrix representation of linear block codes, Cyclic Codes, polynomial representation (examples).

Unit-IV: Wide Band Digital Communications & Computer Communication (15 HOURS)

Basics of Wide band Systems, Generation of Spreading Codes (PN Codes, Gold Codes), Properties of PN codes, Theory of Spread Spectrum Modulation, Model of Spread Spectrum Digital Communication System, Direct-Sequence Spread Spectrum (DSSS): Processing Gain, Performance and Generation and Detection, Frequency Hopping Spread- Spectrum (FHSS): Generation and Detection, Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet.

Recommended Books:

1. Digital Communication by Simon Hykin.
2. Digital and Analog Communication by K. Shan Mugam.
3. Digital and Analog Communication by Tomasi.
4. Digital Communications by Bernard Sklar, Pearsons Education.
5. Digital Communications by John G. Proakis McGraw- Hill International Editions.

6. Information Theory Coding and Cryptography by Ranjan Bose, TMH.

PRACTICAL (2 CREDIT: 60 HOURS)

Laboratory Work I:

1. Study of Entropy using Simulation
2. Plot of Graph between Entropy and Probability
3. Study of Digital Communication Channels
4. Study of Mutual Information
5. Study of Schanon Hartley Theorem

Laboratory Work II:

6. Study of ISI problem using Equalization and Nuquist Criterion
7. Study of Block and Cyclic Codes
8. Study of different digital Modulation Techniques
9. Study of PN Codes
10. Study of Spread Spectrum Modulation System

Under-Graduate Programme with ELECTRONICS: 8^{th} SEMESTER

ELECTRONICS

MAJOR/ MINOR

ELE822J1: POWER ELECTRONICS & PHOTONICS

Credits: THEORY: 3, PRACTICAL: 1

Course Objectives:

1. *To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.*
2. *To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.*
3. *To introduce students to the basic theory of photonic devices and their practical applications.*
4. *To familiarize students with the principle of operation of various photonic devices.*

Expected Learning Outcomes:

1. *Explain the characteristics and operating principles of power semiconductor devices such as diodes, transistors, and thyristors.*
2. *Analyse and design basic power electronic circuits, including rectifiers, inverters, and converters, considering efficiency and power losses.*
3. *Explain the operating principle of various photonic devices.*
4. *Demonstrate a comprehensive understanding of the fundamental principles underlying Light-Emitting Diodes (LEDs).*
5. *Explain the operating principles of lasers and other light sources, as well as their applications in communications, sensing, and manufacturing.*

THEORY (3 Credits):

Unit-I: Introduction to Power Devices and Converters (15 HOURS)

Review of switching characteristics of Power diodes, BJTs, Characteristics of an ideal switch, Types of electronic switches. Thyristor construction and characteristics, Methods of turning ON, Turn-off, effect of high di/dt and dv/dt, Snubber circuits, Gate triggering circuits, Device specifications and ratings, DIAC, TRIAC, Controlled rectifiers, AC voltage controllers, Principle of ON- OFF control, Principle of phase control, Single phase bi- directional controllers with resistive loads, Natural commutation, Impulse commutation, complementary commutation, external pulse commutation, Load side and line side commutation, Series and Parallel combination of SCRs.

Unit-II: DC to DC converters, Inverters and Cyclo-converters (15 HOURS)

Principle of step down and step- up operation, Performance parameters of DC-DC converters, Design of BUCK converters, BOOST converters, BUCK–BOOST converters, Forward converter, Half-Bridge converter and Full Bridge converter. Inverter: Principle of operation, performance parameters, Pulse width modulation techniques, Design of inverters, Single-phase half bridge inverter, Single phase full bridge inverter, Analysis in each case (for resistive and inductive loads), Cyclo-converters: step up and step down, design of single-phase step down Cycloconverters, Power supplies: SMPS, UPS.

Unit-III: Photonics (15 HOURS)

Band structure, Direct and Indirect Transitions, Spontaneous and Stimulated Recombination, P-N junctions: Heterojunctions, Carrier injection and Quasi Fermi energy, LED: Spontaneous emission spectrum - Gaussian approximation. Current - Output Power dependence and Peak Emission wavelength. Surface and Edge emitting LEDs. Efficiency Calculation of LEDs. Emission Intensity Pattern of LEDs. Diode Lasers: Gain, Fabry-Perrot Cavity. Types of semiconductor diode lasers. Noise in semiconductor lasers, Introduction to photo detectors: PIN photo diode, Avalanche Photodiode.

Recommended Books:

1. Power Electronics, Circuits, Devices and Applications by M. H. Rashid, PHI

2. Power Electronics by Mohan, Undeland, Robbins, John Wiley and Sons

3. Power Electronics by P. C. Sen, Tata McGraw Hill, Pub. Co

4. Introduction to Thyristors and their Applications, by M. Ramamorty

5. J. Wilson & J.F.B. Hawkes, "Optoelectronics – An Introduction", Prentice Hall, India, 1996

6. P. Bhattacharya, "Semiconductor optoelectronic devices", Second Ed. Pearson Education, Singapore, 2002.

PRACTICAL (1 CREDIT: 30 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Verify switching action of a Power BJT and MOSFET,
2. IV characteristics of SCR and DIAC.
3. IV characteristics of TRIAC and UJT.
4. Calculation of Holding and latching currents of SCR,
5. To study various Commutation Techniques,
6. Design of BUCK Converter.
7. Design of BOOST Converter.
8. IV characteristics of LED and photodiode.
9. Study of laser diode
10. Study of PIN diode

Under-Graduate Programme with ELECTRONICS: 8^{th} SEMESTER

ELECTRONICS

MAJOR

ELE822J2: CONTROL SYSTEMS

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To learn basics of control systems and to understand the purpose of control systems.*
2. *To analyze the control systems in time and frequency domain and to understand the purpose of control systems.*
3. *To analyze the stability of control systems.*
4. *To acquaint the students with the understanding of modern control theory*

Expected Learning Outcomes:

On completion of this course the students will be able to

1. *Understand various types of Control Systems and their modelling*
2. *Understand time and frequency analysis of Control Systems*
3. *Analyze and apply the methods of stability to Control Systems*
4. *Perform state variables analysis for any Control Systems.*

THEORY (4 Credits):

UNIT-I: Introduction to Control (15 HOURS)

Introduction to Systems & Control, Types of control systems, Feedback & its effects, Cascade and feed-forward control, Modeling of systems, Elements of modeling, Transfer function modeling, Block diagram representation, Block diagram reduction and Signal Flow Graph, Transfer function calculation using block diagram algebra and signal flow graph methods.

Unit-II: Time Domain Analysis (15 HOURS)

Time Domain Analysis of Control Systems: Standard test signals, Time response of first order and second control systems, Steady- state and transient response, Time response specifications, S-plane root location & the transient response, Error analysis, Static and dynamic error coefficients, Controllers: Basics of control design, Proportional, PI, PD and PID controllers.

Unit-III: Stability and Frequency Analysis (15 HOURS)

Stability: Conditional and absolute stable systems, Routh- Hurwitz criterion, Closed loop system and stability, Root-locus technique, Introduction to frequency response, Frequency domain analysis: advantages and disadvantages, Frequency domain specifications, Relative stability, Polar plot, Bode plot, Gain margin and Phase margin, Nyquist criterion.

Unit-IV: Introduction to Modern Control Theory (15 HOURS)

State equations, Advantages of state space techniques, State space representation of electrical networks, state transition matrix, state transition equations, state diagrams, Block diagram representation of state equations, state space representation from ordinary differential equations.

Recommended Books:

1. Modern Control Engineering by K-Ogata.
2. Automatic Control systems by B. C. Kuo.
3. Analog and Digital Control Systems by Ramakant A. Gayakwad, Leonard Sokoloff, Prentice-Hall, 1988
4. Feedback and Control Systems by Joseph J. DiStefano, Allen R. Stubberud, Ivan J. Williams, McGraw-Hill Education, 2012
5. Linear Control System Analysis & Design by D. Azzo, Houfi.

PRACTICAL (2 CREDIT: 60 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Calculate RC time constant using RC circuit on bread board.
2. Time domain analysis of 1st order system (Impulse and Step Response)
3. Time domain analysis of 2nd order system (Impulse and Step Response)

4. Calculate rise time, peak time, maximum overshoot and settling time of a second order under damped circuit

5. Study PI controller using op-amp on breadboard

6. Study PD controller using op-amp on breadboard

7. Study PID controller using op-amp on breadboard

8. Design and analyze P, PI, PD and PID controllers using MATLAB

9. To study the effect of addition of poles and zeros on Root locus using MATLAB

10. To study frequency response using bode plot in MATLAB

11. To study frequency response using polar plot in MATLAB

12. Study of Gain Margin and Phase Margin using MATLAB.

13. To obtain & study the root locus plot for a given transfer function using MATLAB.

14. To carry out the stability analysis of linear systems using Routh-Hurwitz method using MATLAB

15. To determine the transfer function for the given state space representation using MATLAB.

Under-Graduate Programme with ELECTRONICS: 8th SEMESTER

ELECTRONICS

MAJOR

ELE822J3: MATERIAL SCIENCES & VLSI TECHNOLOGY

Credits: THEORY: 4, PRACTICAL: 2

Course Objectives:

1. *To make students grasp the basic concepts of various steps involved in the fabrication of an integrated circuit.*

2. *To expose the students to the digital system design.*

3. *To expose the students to the layout and its rules*

Expected Learning Outcomes:

After going through this course, the student will be able to select the process steps for the fabrication of ICs. Besides, the students will get hold on the design strategies of digital ICs.

THEORY (4 Credits):

UNIT-I: Materials and Their Properties (15 HOURS)

General classification of Materials, An overview of Electrical, Dielectric, Magnetic and Optical properties of materials. Introduction to nanotechnology, Classification of Low Dimensional Materials, Influence of physical dimension on different properties. Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc.

Unit-II: IC Fabrications Steps (15 HOURS)

IC fabrication: Crystal Growth and Wafer Preparation, Epitaxy, Oxidation, Diffusion, Lithography, Etching.

Unit-III: VLSI and Characterization Techniques (15 HOURS)

Isolation Methods, Metallization, Bonding. MOS technology and VLSI, scaling of MOS devices, NMOS and CMOS structures and fabrication. Characterization Techniques: XRD, TEM, SEM, EDX.

Unit-IV: CMOS Design (15 HOURS)

Characteristics of MOS transistors and threshold voltage. Switching characteristics of inverter (Fall Time, Rise Time, Delay Time), Dynamic Characteristics. CMOS Logic Structures (Static and Dynamic Design). Stick diagrams, Layout: Design Rules/Floor planning. Simple Layout Examples.

Recommended Books:

1. S. M. Sze, VLSI Technology, Mcgraw Hill Publishing Company.
2. Azeroff and Brophy, Electronic Processes in Semiconductors, McGraw Hill Publishing company.
3. Digital Intended Circuits: A Design Perspective by Jan M. Rabaey
4. CMOS VLSI Design: A Circuits & Systems Perspective by N Weste. D Hams & A. Bannerper.

PRACTICAL (2 CREDIT: 60 HOURS)

Note: The student is required to attempt at least 10 experiments

1. Finding the Electrical, magnetic and optical properties of material.
2. Study about Microwind tool and λ (Lambda) Rules for Layout Generation.
3. Study the temperature dependence of resistivity of a semiconductor using four probe method.
4. Study C-V characteristics of MOSFET.
5. Finding the performance parameters of CMOS inverter.
6. Design of basic and universal gates using static design technique.
7. Design of basic and universal gates using dynamic design technique.

8. Design of combinational logic circuits using static design technique.

9. Design of combinational logic circuits using dynamic design technique.

10. Design of sequential logic circuits using static design technique.

11. Design of sequential logic circuits using dynamic design technique.

12. Design of arithmetic circuits using static design technique.

13. Design of arithmetic logic circuits using dynamic design technique.

14. Learning Layout in simulation tool kit.