COURSE STRUCTURE (R20)
AND
DETAILED SYLLABUS
(III YEAR)

ELECTRONICS & COMMUNICATION ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2020-21)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUK, Kakinada
Accredited by NAAC with "A" Grade and NBA (CSE, ECE, EEE & ME)
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

B. Tech III-Year Course Structure and Syllabus –R20

III Year - I Semester							
S. No	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R20ECE-PC3101	Linear Integrated Circuits andApplications	PC	3	0	0	3
2	R20ECE-PC3102	Antennas and Wave Propagation	PC	3	0	0	3
3	R20ECE-PC3103	Digital Communications	PC	3	0	0	3
4	R20ECE-PE3101.1 R20ECE-PE3101.2 R20ECE-PE3101.3 R20ECE-PE3101.4 R20ECE-PE3101.5	**Professional Elective-I** 1. Information Theory and Coding 2. Digital System Design using Verilog 3. Sensors and Actuators 4. GPS Systems and itsApplications 5. Bio-Medical Engineering	PE	3	0	0	3
5	R20CSE-OE3104 R20CSS-OE3101 R20CIT-OE3101 R20EEE-OE3102 R20MEC-OE3101	**Open Elective-I** 1. OOPS through JAVA 2. Cloud Computing 3. Computer Architecture andOrganization (CAO) 4. Electrical Measurements 5. Industrial Robotics	OE	3	0	0	3
6	R20ECE-PC3104	Linear Integrated Circuits andApplications Laboratory	PC	0	0	3	1.5
7	R20ECE-PC3105	Digital Communications Laboratory	PC	0	0	3	1.5
8	R20ECE-SC3101	Digital System Design using CAD Tools (Skill Oriented Course)	SC	0	0	3	2
9	R20BSH-MC3102	Constitution of India (Mandatory Course)	MC	2	0	0	0
10	R20BSH-MC3103	English for JobSeekers (Mandatory Course)	MC	0	0	2	0
11	R20ECE-SI3101	Summer Internship-1 (Evaluation only)	SI	0	0	0	1.5
Total				**16**	**0**	**8**	**21.5**
Honors Course -2/Minor Course-2							

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III Year - II Semester							
S. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R20ECE-PC3201	Micro Processors and Micro Controllers	PC	3	0	0	3
2	R20ECE-PC3202	Digital Signal Processing	PC	3	0	0	3
3	R20ECE-PC3203	VLSI Design	PC	3	0	0	3
4	R20ECE-PE3201.1 R20ECE-PE3201.2 R20ECE-PE3201.3 R20ECE-PE3201.4 R20ECE-PE3201.5	**Professional Elective-II** 1. Telecommunication SwitchingSystems & Networks 2. Analog IC Design 3. Electronic Measurements & Instrumentation 4. Microwave and Radar Engineering 5. Advanced Signal Processing	PE	3	0	0	3
5	R20CSE-OE3201 R20CSS-OE3201 R20CIT-OE3201 R20EEE-OE3201 R20MEC-OE3201	**Open Elective-II** 1. Computer Networks 2. Software Engineering 3. Introduction to Artificial Intelligence 4. Power Electronics 5. 3D Printing	OE	3	0	0	3
6	R20ECE-PC3204	Micro Processors and Micro Controllers Laboratory	PC	0	0	3	1.5
7	R20ECE-PC3205	Digital Signal Processing Laboratory	PC	0	0	3	1.5
8	R20ECE-PC3206	VLSI Design Laboratory	PC	0	0	3	1.5
9	R20ECE-SC3201	High frequency and AntennaEngineering (Skill Oriented Course)	SC	1	0	2	2
10	R20BSH-MC3201	Intellectual Property Rights & Patents (Mandatory Course)	MC	2	0	0	0
Total				**15**	**0**	**11**	**21.5**
Honors Course -3/Minor Course-3							
Summer Internship-2(After Second Year & Evaluated in IV-I Semester)							

**The Eligible students who opted the courses for B.Tech with Honors/Minor only*
Note:L-Lecture, T-Tutorial, P-Practical, C-Credits

III Year –I Semester Syllabus

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3101	Linear Integrated Circuits and Applications	3	0	0	3

Course Objectives:

- To introduce the basic building blocks and operation of linear integrated circuits.
- To understand the linear and non-linear applications of operational amplifiers.
- To acquire the knowledge in analysis and design of different types of active filters using op-amps.
- To learn the internal structure, operation and applications of different analog ICs such as Timers andPLL.
- To understand the various types of ADCs and DACS using ICs.

Course Outcomes:

At the end of the Course, the Student will be able to

1. Demonstrate the internal circuitry (structure) andcharacteristicsofOp Amp(L3)
2. RealizebasiclogicgatesandBooleanexpressionsintologiccircuitsusingVerilog HDLconstructsandcodingstyles.(L3)
3. Model combinational circuits like encoders, decoders, multiplexer, de multiplexer,comparatorsetc.,usingVerilogHDL.(L3)
4. Construct digital sequential circuits like flip-flops, counters andshift registers usingVerilogHDL.(L3)
5. BuilddigitallogicsystemsandstatemachineslikeALU,sequentialmultiplieretc.(L3)

UNIT-I

Introduction to Operational Amplifiers: Introduction and Classification of IC's, basic information of Op- Amp IC741 Op-Amp and its features, Op-Amp internal circuit, Op-Amp characteristics - DC and AC, Op- Amp parameters and Measurements.

Applications:

- Op-amps are used as amplifier
- Op-amps used as voltage regulator current regulator
- Op-amps used as Oscillators and waveform generators.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the internal components and pin diagram of Op-Amp (L2).
- Understand the characteristics of Op-Amp (L2).

UNIT-II

Linear Applications of Op-Amps: Inverting and Non-inverting amplifier, adder, Difference amplifier,Integrator and differentiator, Instrumentation amplifier, AC amplifier, V to I and I to V converters.

Non-Linear Applications of Op-Amps: Sample and Hold circuits, Log and Anti log Amplifiers, Comparators, Schmitt trigger, Precision rectifiers, Triangular and Square wave generators.

Applications:

- Sign changer, scale changer, inverting, and non-inverting amplifier.
- Integrator, differentiator, and its application in analog computer.
- Used as a conversion circuits.
- Different circuits using Op-Amps are analysed with input and output signal waveforms.

Learning Outcomes:

At the end of this unit, the student will be able to

- Design Op-Amps for various linear applications (L3).
- Design Op-Amps for various Non-linear applications (L3).

UNIT-III

Active Filters: Introduction, Design and Analysis of Butterworth active filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters, IC 723 Regulators.

Applications:

- Active filters are used in communication systems for suppressing noise
- Active filters are used in biomedical instruments
- Used in Pre-amplification, Equalization, Tone Control in Audio Systems
- They are used in Radio tuning to a specific frequency

Learning Outcomes:

At the end of this unit, the student will be able to

- Develop various active filters using Op-Amp (L3).
- Design a filter using Op-Amp (L3).

UNIT-IV

Timers: Introduction to 555 timer, functional diagram, Multivibrators – A stable Multivibrators, Monostable Multivibrators description, functional diagram and Applications, Schmitt trigger.

Phased Locked Loop: Introduction, block schematic, principles and description of individual blocks of 565 PLL, PLL Applications for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation, VCO, Applications of VCO (566).

Applications:

- PLL is used to synthesize new frequencies
- Recovery of clock timing information from a data stream such as from a disk drive
- VCOs are used in function generators
- VCOs are used in Electronic jamming equipment.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the function of 555 IC (L2).
- Understand thoroughly the function of PLL and VCO (L2).

UNIT-V

Mixed Signal Circuits: Introduction, Different types of ADCs Flash type, Successive Approximation type, Dual Slope type, A/D Converter using Voltage-to-Time Conversion, Different types of DACs -weighted resistor type, R-2R Ladder type, R - 2R Ladder types, DAC and ADC Specifications.

Applications:

- DACs can in Televisions and mobile phones to convert digital data to analog audio signal.
- DACs can in music players to convert digital data to analog audio signal.
- ADCs can used in microcontrollers, digital signal processing.
- ADCs can used in digital storage oscilloscopes, scientific instruments etc.,

Learning Outcomes:

At the end of this unit, the student will be able to

- Compare various techniques of ADCs (L4).
- Distinguish various techniques of DACs (L4).

Text Books

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition, 2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.

Reference Books

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma, SK Kataria & Sons, 2ndEdition, 2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill,1988.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3102	Antennas and Wave Propagation	3	0	0	3

Course Objectives

- To introduce fundamentals of antennas and basic performance assessment parameters.
- To illustrate the different types of arrays and their radiation patterns.
- To introduce the design concepts of various antennas types with their geometrical and radiationcharacteristics.
- To obtain the knowledge on practical measurements of antenna characteristics
- To understand the concepts of radio wave propagation in the atmosphere.

Course Outcomes

At the end of the Course, the Student will be able to:

1. Understand the antenna fundamentals and its radiation mechanism (L2).
2. Design antenna arrays for enhanced radiation performance (L3).
3. Distinguish the resonant, non-resonant and broadband antennas (L4).
4. Choose the antennas suitable for VHF, UHF and Microwave applications (L3).
5. Understand the radio wave propagation at different frequencies through various atmospheric layers(L2).

UNIT-I

Antenna Fundamentals and Radiation Mechanism: Introduction, Radiation Mechanism – single wire, 2 wire, dipoles, current distribution on a thin wire antenna. Antenna parameters: Radiation Pattern – patterns in principal planes, radiation lobes, Beamwidths, Polarization, Beam area, Radiation Intensity, Directivity, Antenna Efficiency, Gain, Antenna Apertures, Aperture Efficiency, Effective Height, Input Impedance, Illustrated Problems.

Applications: Antenna parameters can be computed for various antennas.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the Radiation mechanism and basic antenna characteristics (L2)
- Understand the performance of the antenna based on its parameter specifications (L2).

UNIT-II

Thin Linear Wire Antennas and Antenna Arrays: Radiation from Small Electric Dipole, Quarter wave Monopole and Half-wave dipole – Evaluation of field components, and radiation properties. 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. Two Element Arrays, Principal of Pattern Multiplication. N- Element Linear Arrays – BSA, EFA, N-Element Linear Array with Uniform and Non-Uniform Amplitudes, Binomial Arrays, Arrays with parasitic elements, Yagi-Uda Arrays, Concept scanning arrays, Related Problems.

Applications:

- Dipoles, monopoles are used for mobile and cellular communications as base station antennas.
- Array antennas can be used for enhanced gain/directivity for long range wireless communications,scanning purposes, see-through wall applications, RADARs.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the design principles, radiation mechanism and radiation properties of linear wireantennas (L2)
- Understand the radiation mechanism of antenna arrays (L2)
- Design Antenna Array with desired radiation beam characteristics (L3)

UNIT-III

Non-resonant, Broadband and Microstrip Antennas: Introduction to non-resonant radiators, Travelling wave Radiators – basic concepts. Broadband Antennas: Helical Antennas – Significance, Geometry, basic properties; Design considerations for monofilar helical antennas in Axial Mode and Normal Modes. Microstrip Antennas-Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas –Geometry and Parameters.

Applications:

- Dipoles, monopoles are used for mobile and cellular communications as base station antennas.
- Array antennas can be used for enhanced gain/directivity for long range wireless communications,scanning purposes, see-through wall applications, RADARs.

Learning Outcomes:

At the end of this unit, the student will be able to

- Analyze the radiation properties of non-resonant antennas, resonant and broadband radiators (L4)
- Understand the design principles for obtaining the circular polarized antenna through helicalantennas (L2)
- Design microstrip patch antenna for desired specifications (L3)

UNIT-IV

VHF, UHF and Microwave Antennas: Reflector Antennas: Flat Sheet and Corner Reflectors. Paraboloidal Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Cassegrain Feeds. Horn Antennas – Types, Optimum Horns, Design Characteristics of Pyramidal Horns; Lens Antennas – Geometry, Features, Dielectric Lenses and Zoning, Applications, Measurement of Radiation patterns and Gain in Anechoic chamber.

Applications:

- Domestic satellite television reception, terrestrial microwave data links, general satellitecommunication etc.
- Functional verification of antennas and its quality analysis.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the phenomenon of obtaining the directional radiation beams through reflectors, lenses,feed horns (L2)
- Select antennas for various VHF, UHF, Microwave range of wireless communications (L3).
- Explain the measurement setup and procedure for testing the various types of antennas afterfabrication or manufacturing (L2).

UNIT-V

Wave Propagation: Concepts of Propagation – Frequency ranges and types of propagation. Sky wave propagation – Formation of Ionospheric layers and their characteristics, Mechanism of reflection and refraction, critical frequency, MUF and Skip distance. Space wave propagation – Mechanism, LOS and Radio Horizon – Radius of curvature of path, M-curves and Duct propagation.

Applications:

- Line-of-sight communication, Aircraft-to-land communication, Tracking using Radars, Satellitecommunications, Direct-to-home broadcasting, etc.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand effects of earth's magnetic field on wave propagation (L2)

- Identify layers in ionosphere and their ionization densities (L1)
- Understand signal losses/attenuation through various atmospheric layers (L2).

Text Books

1. Antennas and Wave Propagation – John D. Kraus, Ronald J Marhefka, Ahmad S Khan, 5th Edition,McGraw Hill Education (India) Private Limited, SIE, 2018
2. Antenna Theory: Analysis and Design –C.A. Balanis, 3rd Edition, Wiley India Pvt. Ltd.,2016.

Reference Books

1. Antennas and Wave Propagation – K.D.Prasad, 2nd Edition, Satya Prakashan, Tech IndiaPublications, New Delhi, 2001.
2. Antennas and Wave Propagation – A.R. Harish, M. Sachidananda, 1st Edition, Oxford UniversityPress, 2007.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3103	Digital Communications	3	0	0	3

Course Objectives:

- Understand basic components of Digital Communication Systems.
- Familiarize with Digital modulation and demodulation techniques in communication systems.
- Analyze error performance of a digital communication system in presence of noise and otherinterferences.
- Understand the redundancy present in Digital Communication by using various source codingtechniques.
- Understand Block codes, cyclic codes and convolution codes.

Course Outcomes:

At the end of the Course, the Student will be able to

1. Understand the key modules of digital communication systems with emphasis on pulse digitalmodulation systems (L2)
2. Understand the importance of modulations for various applications (L2)
3. Analyze the performance of a Digital Communication System with different modulation schemesfor probability of error (L4)
4. Understand the various channel coding techniques in digital communication (L2)
5. Analyze different error control coding schemes for realistic transmission of digital informationover the channel (L4)

UNIT-I

Soure coding systems: Introduction, Elements of digital communication systems, Advantages of Digital Communication Systems, Sampling process, Quantization, Quantization Noise, Waveform Coding Techniques: Pulse-Code Modulation (PCM) Generation and Reconstruction, Quantization Noise, Companding, Differential PCM systems (DPCM), Delta modulation, Adaptive delta modulation, comparison of above systems.

Applications:

- Pulse and digital modulation techniques are used in Ethernet communication, many micro-controllers for generating control signals.
- These techniques are used in Photo-biology, an electronic driver for LED lighting.

Learning outcomes:

At the end of this unit, the student will be able to

1. Understand source coding techniques & pulse modulation techniques. (L2)
2. Illustrate different pulse modulation techniques & Distortions. (L2)
3. Explain the performance of different pulse modulation Schemes. (L2)

UNIT-2

Digital Modulation Techniques: Introduction, Generation and detection of binary phase shift keying (BPSK), Quadrature shift keying (QPSK), and Binary Frequency shift keying (BFSK), ASK, DPSK, QPSK, M-ary PSK, Mary quadrature amplitude modulation (M-ary QAM), Comparison of power bandwidth requirements for all the above schemes.

Applications:

- Digital modulation techniques are used in QPSK, CDMA, Cellular service, Wireless local loop,Digital video broadcasting-satellite.

Learning outcomes:

At the end of this unit, the student will be able to

- Explain the generation & detection of pass band modulated signals. (L2)
- Understand the significance of power bandwidth required for various pass band data transmissionscheme. (L2)

UNIT-3

Data Transmission: Introduction, Base band signal receiver, Error Rate Due to Noise, Intersymbol interference, probability of error, the optimum filter, matched filter, probability of error using matched filter, coherent reception, non-coherent detection of FSK, calculation of error probability of ASK, BPSK, BFSK, QPSK.

Applications:

- Baseband Transmission is a signalling technology that sends digital signals over a single frequency
- as discrete electrical pulses.
- The application of matched filter is Radar imaging for Matched-filtering is an optimum detectiontechnique used to remove a transmitted signal which is monitored throughout the noise signal.

Learning outcomes:

At the end of this unit, the student will be able to

- Analyze the performance of baseband pulse transmission system. (L4)
- Analyze probability of error for various pass band data transmission schemes. (L4)

UNIT- 4

Channel Coding: Discrete memory less channels, Entropy and its properties. Information rate, Mutual information and its properties, Shanon-Fano coding, Huffman coding, efficiency calculations, Bandwidth- S/N Trade off, Hartley Shannon Law.

Applications:

- Huffman encoding is widely used in compression formats like GZIP, PKZIP (winzip) and BZIP2.
- Multimedia codecs like JPEG, PNG and MP3 uses Huffman encoding (to be more precised thePrefix codes)

Learning outcomes:

At the end of this unit, the student will be able to

- Understand information theory and linear algebra in Channel coding. (L2)

UNIT-5

Error Control Codes: Linear Block Codes: Matrix Description of Linear Block Codes, Error Detectionand Error Correction Capabilities of Linear Block Codes. Cyclic Codes: Algebraic Structure, Encoding, Syndrome Calculation, Decoding. Convolution Codes: Introduction, encoding of convolution codes, Graphical approach: state, tree and trellis diagram decoding using Viterbi algorithm.

Applications:

- Deep space communication, satellite communication, data transmission, data storage, mobilecommunication, file transfer, and digital audio/video transmission.

Learning outcomes:

At the end of this unit, the student will be able to

- Distinguish various error control encoding and decoding techniques. (L4)
- Understand the performance of error control codes. (L2)

Text Books

1. Digital communications – Simon Haykin, John Wiley, 2005.
2. Digital and Analog Communication Systems – Sam Shanmugam, John Wiley,2005.

Reference Books

1. Principles of Communication Systems – H. Taub and D. Schilling, TMH,2003.
2. Modern Digital and Analog Communication Systems –B.P.Lathi, Zhi Ding, Hari Mohan Gupta,Oxford University Press,4th Edition, 2017.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3101.1	Information Theory & Coding **(Professional Elective-1)**	3	0	0	3

Course Objectives:

- To impart the information theory techniques for maximum utilization of the channel.
- To introduce the concepts of source coding, channel capacity and bandwidth relations.
- To summarize the various linear block coding techniques.
- To show the use of various cyclic and BCH codes.
- To familiarize with various convolution codes

Course Outcomes:

At the end of the Course, the Student will be able to

1. Derive equations for entropy mutual information and channel capacity for all types of channels(L3).
2. Apply Shannon's theorem for obtaining properties of discrete channels (L3).
3. Design a digital communication system by selecting an appropriate error correcting codes for aparticular application (L3).
4. Explain various methods of generating and detecting different types of error correcting codesFormulate the basic equations of linear block codes (L2).
5. Compare the performance of digital communication system by evaluating the probability of errorfor different error correcting codes (L4).

UNIT-I

Information Theory and Source Coding: Uncertainty, information, entropy and its properties, entropy of binary memory less source and its extension to discrete memory less source, source coding theorem, data compression, prefix coding, Huffman coding,

Applications: Efficiency and Capacity of the computers and similar devices

Learning outcomes

At the end of this unit, the student will be able to

- Calculate information rate of a discrete memory less source (L3).
- Select a suitable lossy data compression technique for a given situation (L3).

UNIT-II

Discrete Channels: Binary Symmetric Channel, mutual information & its properties, Channel capacity, channel coding theorem and its application to BSC, Shannon's theorem on channel capacity, capacity of a channel of infinite bandwidth, bandwidth - S/N trade off, practical communication systems in light of Shannon's theorem, Fading channel, channels with memory.

Applications: Used in communication to transfer desired channels

Learning outcomes

At the end of this unit, the student will be able to

- Apply Shannon's Theorems for computation of channel capacities and knowing the properties (L3).
- Calculate the capacity of typical digital communication channels (L3)

UNIT III

Groups, Fields and Linear Block Codes: Galois field and its construction in GF(2m) and its basic properties, vector spaces and matrices in GF(2), Linear block codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, decoding circuit, Hamming code and their applications. Modified linear codes

Application: Digital Audio and Video transmission and in computer memory

Learning outcomes

At the end of this unit, the student will be able to

- Design simple linear block error correcting codes (L3).
- Explain the mathematical theory of linear channel codes for error detection and correctiontechniques applied in communication system (L2).
- Understand the significance of field extensions and Galois theory (L2).

UNIT-IV

Cyclic Codes and BCH Codes: Basic properties of Cyclic codes, Generator and parity check matrix of cyclic codes, encoding and decoding circuits, syndrome computation and error detection, cyclic Hamming codes, encoding and decoding of BCH codes, error location and correction.

Applications: Used in designing of Decoders

Learning outcomes

At the end of this unit, the student will be able to

- Understand the cyclic block codes for using in feedback shift register logic circuits (L2).

UNIT V

Convolutional Codes: Introduction to convolution code, its construction and Viterbi algorithm for maximum likelihood decoding. Automatic repeat request strategies and their throughput efficiency considerations.

Applications: These codes are often used to improve the transmission quality, which is otherwise compromised by interference and power limitations

Learning outcomes

At the end of this unit, the student will be able to

- Understand the significance of simple convolution codes (L2).
- Make use of convolutional codes speech, image and video compression (L3)
- Distinguish the Automatic repeat request strategies (L4)

Textbooks

1. Lathi B. P., Modern Analog and Digital Communication Systems, Oxford Univ. Press
2. Shu Lin and Costello, Error Control Coding Fundamentals and Applications, 2nd Edition, Pearson.

Reference Books

1. Haykin Simon, Digital Communication, Wiley Publ.
2. Proakis, Digital Communication, McGraw Hill.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3101.2	Digital System Design using Verilog **(Professional Elective-1)**	3	0	0	3

Course Objectives:

- To Introduce the basics and programming fundamentals of Verilog HDL
- To describe the primitive instances of gates and explain the various modelling constructs ofVerilog.
- To familiarize various behavioural and switch level modeling constructs of Verilog essential fordesigning digital circuits.
- To Design and implement various combinational logic circuits in Verilog HDL
- To Design and implement various sequential logic circuits in Verilog HDL.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Understand the fundamentals of verilog HDL (L2)
2. Apply various Gate Level modeling and Dataflow modelling techniques to design logic circuits(L3)
3. Apply various Behavioural and switch level modeling elements to design different logic circuits(L3)
4. Design combinatorial digital circuits using verilog HDL programming constructs (L3)
5. Design sequential digital circuits using verilog HDL programming constructs (L3)

UNIT-I

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis Tools. Language Constructs and Conventions: Introduction, Keywords, Identifiers, Comments,Tasks and functions, Numbers, Strings, Logic Values, Data Types, Scalars and Vectors, Parameters, Operands and Operators.

Applications:

- Applied to design of electronic system modules.
- Verilog HDL is used for timing analysis and for logic synthesis.

Learning Outcomes:

At the end of this unit the student will be able to

- Understand the fundamentals of Verilog HDL (L2)
- Understand the essentiality of various Verilog design parameters in the design of digital Systems(L2).

UNIT-II

Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives,Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Design of Basic Circuits. Design of Flip-flops with Gate Primitives.

Data Flow Modelling: Introduction, Continuous Assignment Structure, Delays, Assignment to Vectors, Operators and Examples.

Applications:

- Verilog HDL Programming language is used to model any digital system using various modelingtechniques.

Learning Outcomes:

At the end of this unit the student will be able to

- Understand the modeling of digital systems suiting various applications (L2).
- Understand the utility of modeling techniques to design logic circuits (L2).

UNIT-III

Behavioral Modeling: Procedural constructs, Timing Controls, Blocking and Non-Blocking Assignments, The case statement, Simulation Flow i*f* and i*f*-else constructs, Assign-De-Assign construct, Repeat loop, for loop, While loop, Forever loop, Force-Release construct.

Switch Level Modeling: Basic Transistor Switches, CMOS Switch, Bi-directional switches.
Applications:

- Behavioral modeling attempts to explain why an individual makes a decisions and the model is thenused to help predict future behavior.
- Behavioral models in Verilog contain procedural statements which control the simulation andmanipulate variables of the data types.

Learning Outcomes:
At the end of this unit the student will be able to

- Understand high level abstraction of digital systems with behavioral modeling of systems (L2).
- Learn modeling of various behavioral constructs essential for designing digital systems (L2).

UNIT IV

Design of combinational circuits Elements: Logic design of combinational circuits using Verilog HDL: Logic gates, Half Adders, Full Adders, Subtractors, Decoders, Encoders, Multiplexers, Demultiplexers & Comparators.
Applications:

- Combinational circuits are used in calculators, digital measuring techniques, computers, digitalprocessing, automatic control of machines etc.
- Combinational circuits are used in ALU's, data transmission, home alarm, car parking slot systems,multiple access techniques.

Learning Outcomes:
At the end of this unit the student will be able to

- Implement logic functions with decoders and multiplexers (L3)
- Design combinational circuits such as adders, subtractors, multipliers, comparators etc.

UNIT-V

Design of Sequential circuits Elements: Logic design of Sequential circuits using Verilog HDL : RS, D,T, JK Latches & Flip Flops, Registers and Counters.
Applications:

- Sequential Logic circuits are used in design of digital systems.
- Sequential Logic circuits are employed in CPLD & FPGA architectures.

Learning Outcomes:
At the end of this unit the student will be able to

- Understand applicability of sequential elements in design of digital systems (L2).
- Construct complex digital systems based on flip-flops and registers (L3)

Text Books

1. T.R Padmanabhan, B.Bala Tripura Sundari Design through Verilog HDL ,Wiley India publications,2009
2. J.Bhaskar, A Verilog HDL Primer, BS Publications, 3rd Edition.

Reference Books

1. Verilog HDL – Samir Palnitkar, 2nd Edition, Pearson Education, 2009
2. John F.Wakerly , Digital Design, Pearson, 4th Edition.
3. Zainalabdien Navabi, Verilog Digital System Design, TMH, 2nd Edition.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3101.3	Sensors And Actuators **(Professional Elective-1)**	3	0	0	3

Course objectives:

- To understand basic laws and operation of sensors and actuators for transformation of energy
- To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterised, and analysed.
- To study the various instruments displays, panels in the aircraft and cockpit layout
- To study the aircraft instrumentation is to know the functions of all the flight, gyroscopic and power plant instruments in the aircraft.
- To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the basic fundamental concepts of sensors and Working principles of Sensors (L2).
2. Explain the different types sensors and working principle of different types of sensors (L2).
3. Understand the basic fundamental concepts of Actuators and Working principles of Actuators (L2).
4. Illustrate the different types of actuators and operating Principles of Actuators (L2).
5. Understand the fabrication of different types of Sensors (L2).

UNIT-I

Introduction: Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

Applications:

- Heating, ventilation, and Air-condition
- Navigation, Smart Cruising

Learning outcomes:

At the end of this unit, the student is able to

- Define the Transducer, Sensor and Transmitter (L1)
- Explain the different characteristics of Sensors (L2)
- Understand the working principle of Sensors (L2)

UNIT-II

Different types of Sensors: Gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured based gas sensors. Micro sensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications.

Applications:

- Air Bags – Anti Cushion Restraint System (ACRS)
- Braking and Traction control
- Remote locking

Learning outcomes:
At the end of this unit, the student is able to

- Explain the difference between different types of Sensors (L2)
- Understand the Working principle of Different types of Sensors (L2)
- Summarize the different applications of Micro sensors (L2)

UNIT-III

Introduction to Actuators: Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor.

Applications:

- Robotics
- Food Beverage and manufacturing
- Window automation

Learning outcomes:
At the end of this unit, the student is able to

- Define the Transducer and Actuators (L1)
- Understand the different characteristics of Actuators (L2)
- Understand the working principle of Actuators (L2)

UNIT-IV

Different Types of Actuators: Piezoelectric and Piezoresistive actuators, micro pumps. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

Applications:

- Agriculture machinery, Solar panel operation, Cutting equipment

Learning outcomes:
At the end of this unit, the student is able to

- Know the difference between different types of Actuators (L2)
- Understand the Working principle of Different types of Actuators (L2)
- Outline the different applications of Micro Actuators (L2)

UNIT-V

Sensor Materials and Processing Techniques: Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

Applications:

- Temperature monitoring system
- Distance measurement system
- Global positioning system

Learning outcomes:
At the end of this unit, the student is able to

- Know the materials used to manufacture the Sensors (L1)
- Understand the process of manufacturing the Sensors using different techniques (L2)
- Summarize different types of practical applications based on the Manufacturing techniques (L2)

Text Books

1. Patranabis.D, “Sensors and Transducers”, Wheeler publisher, 1994.
2. SergejFatikow and Ulrich Rembold, “ Microsystem Technology and Microbotics”, First edition,Springer –Verlag, Newyork, Inc, 1997.

Reference Books

1. Robert H Bishop, “The Mechatronics Hand Book”, CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishingCo. Pvt. Ltd.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3101.4	GPS Systems and Its Applications **(Professional Elective-1)**	3	0	0	3

Course Objectives:

- To understand the Principles of geodesy with reference to GPS, processing of GPS data to help forsatellite survey.
- Discuss the different techniques of GPS and the implications of its modernization.
- Be aware of various segments and GPS Signal Structure.
- Explain the ambiguities RINEX format and how they can be overcome.
- Describe the differences between GALILEO, COMPASS and IRNSS.

Course Outcome:

At the end of the course the student able to

1. Identify GPS components and development applications in Satellite Geodesy (L3)
2. Illustrate the GPS survey Techniques (L2)
3. Interpret the segments and signals received by the GPS (L2)
4. Identify sources in GPS data processing and software modules (L3)
5. Apply the corrections for accurate positioning using Remote Sensing for Engineering applications(L3).

UNIT- I

Basics : Definition – Fundamental goals of Geodesy – Definitions – basic concepts – Historical perspective development applications in Satellite Geodesy – Geoid and Ellipsoid satellite orbital motion – Keplerian motion – Kepler's Law – Perturbing forces – Geodetic satellite

Applications:

- Floodplain Mapping
- GIS data
- Engineering and Construction
- Physical sciences

Learning Outcomes:

At the end of this unit, the student is able to

1. Identify and describe Kepler's law of planetary motion (L3).
2. Understanding the Kepler's law of harmonies to make calculations regarding the radius and periodof orbits of planets (L3).
3. Computation of positions of points on the earth's surface (L3).
4. Understand the figure of the Earth and navigation (L2).
5. Explain GEOID, Earth's gravity field and its temporal variations (L2).

UNIT-II

Different Techniques: Determination of direction by photography – SECOR – Electronic observation techniques – Doppler effect – Positioning concept – Development of TRANSIT satellites.

Applications:

- An accurate all-weather navigational aid for seagoing vessels
- Continuous navigation satellite service

Learning Outcomes:

At the end of this unit, the student is able to

- Understanding the direction by photography (L2)
- Understanding the development of TRANSIT satellites (L2)

UNIT-III

Satellite System: GPS – Different segments – space control and user segments – satellite configuration – GPS signal structure – Orbit determination and Orbit representation Anti Spoofing and Selective Availability – Task of control segment – GPS receivers – main receiver components – Example of GPS receivers.

Applications:

1. Location, Navigation, Tracking, Mapping, Timing

Learning Outcomes:

At the end of this unit, the student is able to

- Apply the fundamental theory and concepts of the Global Positioning System (L3)
- Calculate GPS satellite orbit positions and velocities (L3).
- Demonstrate a basic, practical understanding of global positioning systems (GPS) (L2)

UNIT- IV

GPS Data Processing: GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips ambiguities RINEX format. Concepts of rapid static methods with GPS semi kinematic and pure kinematic methods – basic constellation of satellite geometry & accuracy measures

Applications:

- GPS surveying
- Android API services for RINEX format

Learning Outcomes:

At the end of this unit, the student is able to

- Develop a way of thinking about GPS data processing (L3)
- Understand the concept of GPS semi kinematic and pure kinematic methods (L2)

UNIT-V

Applications of Satellite Geodesy: Geodetic control surveys, Cadastral surveying, Photogrammetry & Remote Sensing, Engineering applications, and Monitoring – GIS. GLONASS, GALILEO, COMPASS and IRNSS satellite configuration comparison – Satellite Laser Ranging & Applications – Concepts of satellite altimetry.

Applications:

- To collect position, velocity and time information
- Accident Analysis and Hot Spot Analysis
- Telecom and Network Services
- Disaster Management and Mitigation
- Internet of Things (IoT)

Learning Outcomes:

At the end of this unit, the student is able to

- Understand the potential of GPS interoperability with GLONASS and GALILEO systems (L2)
- List the accurate real-time positioning and timing services over India and the region around thecountry with help of IRNSS (L1)
- Design survey and mapping activities using the latest technology in the fields of geodesy controlsystems (L3)

Textbooks

1. Satellite Geodesy by Gunter Seeber, Copy Right 2003 By Walter De Gruyter 1993, ISBN: 3- 11-017549-5.
2. Global Positioning System – Theory and Practice – Hofmann W. B, Lichtenegger. H, Collins. J –Springer Verlag Wein, New York, 2008

Reference Books

1. Global Navigation Satellite Systems by G. S. Rao, 2010 Tata McGraw Hill Education Pvt. Ltd.
2. GPS Theory, Algorithms and Applications. Guocheng Xu, Springer Verlag, 2003.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3101.5	Bio-Medical Engineering **(Professional Elective-1)**	3	0	0	3

Course Objectives:

- To explain the importance of various sources of bio-electric potentials in human body.
- To enhance the knowledge of various electrodes and transducers used for measuring bio- electricalpotentials.
- To familiarize mechanisms of cardiovascular and respiratory systems and their measuringequipments.
- To introduce elements of patient care & monitoring system and various therapeutic & prostheticdevices.
- To provide fundamentals of various diagnostic techniques and introduce the concepts of bio-telemetry.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Identify various sources of bio-electric potentials in man-instrumentation system (L3)
2. Interpret how electrodes and transducers are involved in biomedical engineering concepts (L2)
3. Outline the anatomy of Cardiovascular and respiratory system and their measuring instruments.(L2)
4. Summarize the functionality of patient care & monitoring equipments used to identify themalfunction of human body (L2)
5. Identify the different diagnostic imaging techniques and monitors, recorders and electrical accidentprevention methods (L3)

UNIT-I

Introduction to Biomedical Instrumentation: Age of Biomedical Engineering, Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Physiological System of the Body, Problems Encountered in Measuring a Living System, Sources of Bioelectric Potentials, Muscle, Bioelectric Potentials, Sources of Bioelectric Potentials, Resting and Action Potentials, Propagation of Action Potential, Bioelectric Potentials-ECG, EEG and EMG, Envoked Responses.

Applications:

- Biomedical instrumentation is used in many applications such as ECG, EEG, EMG, etc.

Learning outcomes:

At the end of the unit, the student will be able to

- Explain the components of Biomedical instrumentation (L2)
- Classify various Physiological systems of the human body (L2)

UNIT-II

Electrodes and Transducers: Introduction, Electrode Theory, Biopotential Electrodes, Examples of Electrodes, Basic Transducer Principles, Biochemical Transducers, The Transducer and Transduction Principles, Active Transducers, Passive Transducers, Transducers for Biomedical Applications, Pulse Sensors, Respiration Sensor, Transducers with Digital Output.

Applications:

- The transducers are mainly used in every biomedical instruments to study the pulse rate, respirationand heart beat etc.

Learning outcomes:

At the end of the unit, the student will be able to

- Illustrate the origin of bio potentials and explain the role of biopotential electrodes (L2)
- Classify various Transducers (L2)

UNIT-III

Cardiovascular System and Measurements: The Heart and Cardiovascular System, Electro Cardiography, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output,Measurement of Heart Sound, Plethysmography.

Measurements in the Respiratory System: The Physiology of the Respiratory System, Tests and Instrumentation for The Mechanics of Breathing, Respiratory Therapy Equipment.

Applications:

- The main application of this unit is to measurement of the heartbeat , BP and ECG
- The respiratory system and breathing.

Learning outcomes:

At the end of the unit, the student will be able to

- Explain and contrast measurement principles for blood flow, pressure and volume as well asrespiratory variables (L2)
- Understand various tests and equipment of Respiratory system (L2)

UNIT-IV

Patient Care And Monitoring: Elements of Intensive-Care Monitoring, Patient Monitoring Displays, Diagnosis, Calibration and Repair ability of Patient-Monitoring Equipment, Other Instrumentation for Monitoring Patients, Organization of the Hospital for Patient-Care Monitoring, Pacemakers, Defibrillators, Radio Frequency Applications of Therapeutic use.

Therapeutic and Prosthetic Devices: Audiometers and Hearing Aids. Myoelectric Arm, Laparoscope, Ophthalmology Instruments, Anatomy of Vision,. Electro physiological Tests, Ophthalmoscope, Tonometer for Eye Pressure Measurement. Diathermy, Clinical Laboratory Instruments, Biomaterials,Stimulators.

Applications:

- In every hospital, patient care and monitoring system consist of biomedical instruments such astransducers, pacemakers, and sensors etc.

Learning outcomes:

At the end of the unit, the student will be able to

- Outline the design of cardiac pacemakers, Stimulators and defibrillators (L2)
- List various instruments to perform physiological tests (L2)

UNIT-V

Diagnostic Techniques and Bio-Telemetry: Principles of Ultrasonic Measurement, Ultrasonic Imaging, Ultrasonic Applications of Therapeutic Uses, Ultrasonic Diagnosis, X-Ray and Radio-Isotope Instrumentations, CAT Scan, Emission Computerized Tomography, MRI, Introduction to Biotelemetry, Physiological Parameters Adaptable to Biotelemetry, The Components of Biotelemetry System, Implantable Units, Telemetry for ECG Measurements during Exercise, Telemetry for Emergency Patient Monitoring.

Monitors, Recorders and Shock Hazards: Biopotential Amplifiers, Monitors, Recorders, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Isolated Power Distribution System.

Applications:

- X-rays, MRI, ECG, etc instruments are used in hospitals .
- Recorders, Amplifiers, and power distributed systems etc are used in hospitals.

Learning outcomes:

At the end of the unit, the student will be able to

- Explain basic principles of Ultrasonic Imaging (L2)
- Explain the components of Biotelemetry system (L2)
- Identify, explain and judge patient safety issues related to biomedical instrumentation (L3)
- List various Amplifiers, Monitors and Recorders (L3)
- Text Books

1. Bio-Medical Electronics and Instrumentation, Onkar N. Pandey, Rakesh Kumar, Katson Books.
2. Bio-Medical Instrumentation, Cromewell , Wiebell, Pfeiffer

References

1. Introduction to Bio-Medical Equipment Technology, 4th Edition, Joseph J. Carr, John M. Brown,Pearson Publications.
2. Hand Book of Bio-Medical Instrumentation, Instrumentation, Kandahar. McGrawHill

Subject Code	Subject Name	L	T	P	C
R20CSE-OE3104	OOPS THROUGH JAVA **(Open Elective-1)**	3	0	0	3

Course Objectives:

- To understand the structure and environment of Java.
- To apply data hiding strategy in objects.
- To implement text processing and error handling.
- To organize data using different data structures.
- To create multi threaded graphical user interface applications.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Understand the environment of JRE and Control Statements (L2)
2. Implement real world objects using class Hierarchy (L3)
3. Implement generic data structures for iterating distinct objects (L3)
4. Implement error handling through exceptions and file handling through streams (L3)
5. Design thread-safe GUI applications for data communication between objects (L3)

UNIT-I

Java Environment and Program Structure: History of Java, Features, Applications, Java Installation - JDK and JRE, JVM Architecture, OOPS Principles, Class and Object, Naming Convention, Data Types, Type Casting, Type Conversion, Wrapper classes, Operators, instance of operator, Command Line Arguments, Decision making, Arrays, and Looping statements.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand architecture of Java Virtual Machine (L2)
- Understand the structure of java program and its environment (L2)

UNIT-II

Class Hierarchy & Data Hiding: Property, Method, Constructor, Inheritance (IS-A) , Aggregation and Composition (HAS-A), this and super, static and initialize blocks, Method overloading and overriding, static and final keywords, Types of Inheritance, Compile time and Runtime Polymorphism, Access Specifiers and scope, packages and access modifiers, Abstract class, Interface, Interface Inheritance, Achieving Multiple Inheritance, Class casting, Object Cloning, Inner Classes.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the class hierarchy and their scope (L2)
- Implement relationship between objects (L3)
- Understand data hiding and nested classes (L2)
- Implement data type casting and cloning of objects (L3)

UNIT-III

Strings and Collections:

String: Methods, String Buffer and String Builder, String Tokenizer,

Collections: Exploring java.util.*, Scanner, Iterable, Collection Hierarchy, Set, List, Queue and Map, Comparable and Comparator, Iterators: foreach, Enumeration, Iterator and List Iterator.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the usage of String and its properties and methods (L2)
- Understand data structures and Iterators (L2)
- Develop the data structures and implement different utility classes (L3)

UNIT-IV

IO and Error Handling:

IO Streams: Exploring java.io.*, Character and Byte Streams, Reading and Writing, Serialization and De-serialization,

Error Handling: Error vs Exception, Exception hierarchy, Types of Exception, Exception handlers, Userdefined exception, Exception propagation.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand character and byte streams (L2)
- Understand the hierarchy of errors and exceptions (L2)
- Implement data streams and exception handlers (L3)

Unit V

Threads and GUI:

Multi Threading: Process vs Thread, Thread Life Cycle, Thread class and Runnable Interface, Threadsynchronization and communication.

GUI: Component, Container, Applet, Applet Life Cycle, Event delegation model, Layouts, Menu,MenuBar, MenuItem.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the Thread Life Cycle and its scheduling (L2)
- Implement the synchronization of threads (L2)
- Create graphical components using Abstract window toolkit (L3)

Text Books

1. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition,Pearson.
2. Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press

Reference Books

1. Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education.
2. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.

Subject Code	Subject Name	L	T	P	C
R20CSS-OE3101	Cloud Computing **(Open Elective-1)**	3	0	0	3

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms
- Apply Map-Reduce concept to applications
- To build Private Cloud
- Broadly educate to know the impact of engineering on legal and societal issues involved

Course Outcomes:

At the end of the course, student will be able to

1. Interpret the key dimensions of the challenge of Cloud Computing (L2)
2. Examine the cloud infrastructure and softwares for cloud computing (L3)
3. Outline the various cloud virtualization techniques (L2)
4. Understand the storage systems, models for cloud computing, its security and risks (L2)
5. Explain the data streaming and client connections through various cloud computing appdevelopment platforms (L2)

UNIT-I

Introduction: Network centric computing, Network centric content, peer-to .peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. Parallel and Distributed Systems: introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, and model concurrency with Petri Nets.

Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the key dimensions of the challenges of Cloud Computing (L2)

UNIT-II

Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing,

Cloud Computing :

Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, HPC on cloud.

Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the concepts of Cloud infrastructure (L2)
- Examine the various open source software platforms used for cloud computing (L3)

UNIT III

Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

Learning Outcomes:

At the end of the unit, the student will be able to

- Outline the various cloud virtualization techniques (L2)
- Illustrate the resource management in cloud computing (L2)

UNIT IV

Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service (S3) (Text book 2), Cloud Security: Cloud security risks, security. a top concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the various cloud storage technologies and models (L2)
- Explain cloud security and risks (L2)

UNIT V

Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), Google: Google App Engine, Google Web Toolkit (TextBook 2), Microsoft: Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2)

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the concept of adaptive data streaming in cloud computing (L2)
- Summarize various platforms for cloud application development (L2)

Text Books

1. Cloud Computing, Theory and Practice, 1st Edition, Dan C Marinescu, MK Elsevier publisher,2013
2. Cloud Computing, A Practical Approach, 1st Edition, Anthony T Velte, Toby J Velte, RobertElsenpeter, TMH, 2017

Reference Books

1. Mastering Cloud Computing, Foundations and Application Programming,1st Edition, Raj KumarBuyya, Christen vecctiola, S Tammarai selvi, TMH,2013
2. Essential of Cloud Computing, 1st Edition, K Chandrasekharan, CRC Press, 2014.

Subject Code	Subject Name	L	T	P	C
R20CIT-OE3101	Computer Architecture and Organization **(Open Elective-1)**	3	0	0	3

Course objectives:

- To understand the architecture of a modern computer with its various processing units. Also thePerformance measurement of the computer system.
- To understand the memory management system of computer.
- To understand the various instructions, addressing modes
- To understand the concept of I/O organization
- To understand the data transfer between Registers and Memory Locations.

Course Outcomes:

At the end of the course, student will be able to

1.Describe different types of bus structures and their significance in datatransfer with in a computer system.(L2)

2. Apply the instruction set to programming and compute the effective addresses of instructions.(L3)

3. Analyze different methods of communication with I/O devices and standard I/O interfaces.(L4)

4.Explain the basics of memory systems and cache memories to select optimal memory configurations.(L2)

5. Interpret instruction set executionin the Central Processing Unit.(L2)

UNIT-I

Basic Structure of Computers: Functional unit, Basic Operational concepts, Bus structures, System Software, Performance, The history of computer development. Machine Instruction and Programs: Instruction and Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types.

Applications:

- Strong basics in hardware components of a computer.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand design of the various functional units and components of computers. (L2)
- Analyze some of the design issues in terms of speed, technology, cost, performance. (L4)
- Understand concepts of register transfer notation. (L2)
- Understand the basic instructions used in the computers. (L2)

UNIT-II

Addressing Modes: Basic Input/output Operations, The role of Stacks and Queues in computer programming equation. Component of Instructions: Logic Instructions, shift and Rotate Instructions Type of Instructions: Arithmetic and Logic Instructions, Branch Instructions, Addressing Modes, Input/output Operations.

Application:

- Addressing modes, Arithmetic and logic instructions are used in the design of central processingunit (CPU) .
- 2 Design arithmetic logic unit (ALU).

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain different types of addressing modes. (L2)
- Ouline different types of computer arithmetic and logic operations (L2)
- Understand the structure, function and type of instructions used in performing computer arithmetic(L2)

UNIT -III

Input/Output Organization: Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access, Buses: Synchronous Bus, Asynchronous Bus, Interface Circuits, Standard I/O Interface: Peripheral Component Interconnect (PCI)Bus, Universal Serial Bus (USB).

Application:

- PCI bus in high speed I/O systems applications.
- USB (Universal Serial Bus) is the most popular connection used to connect a computer to devices such as digital cameras, printers, scanners, and external hard drives.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the input / output and Memory related concepts. (L2)
- Compare different types of buses inside computer organisation. (L4)
- Analyze the type of structure and function of peripheral interface used in Input /Outputorganisation. (L4)

UNIT-IV

The Memory Systems: Basic memory circuits, Memory System Consideration, Read Only Memory: ROM, PROM, EPROM, EEPROM, Flash Memory, Cache Memories: Mapping Functions,INTERLEAVING Secondary Storage: Magnetic Hard Disks, Optical Disks.

Applications:

- RAM allows your computer to perform many of its everyday tasks, such as loading applications, browsing the internet, editing a spreadsheet, or experiencing the latest game.
- ROM is the memory that is pre-written to hold the instructions for booting-up the computer.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the concept of memory organization (L2)
- Summarize the types of memory (L2)
- Understand the design and working of secondary storage elements. L2)
- Explain the use of cache memory and virtual memory (L2)

UNIT-V

Processing Unit: Fundamental Concepts: Register Transfers, Performing an Arithmetic Or Logic Operation, Fetching A Word From Memory Execution of Complete Instruction, Hardwired Control, Micro programmed Control: Microinstructions, Micro program Sequencing, Wide Branch Addressing Microinstructions with next –Address Field .

Applications:

- A cell phone or mobile device executes game instructions by use of processing unit.
- VCRs, televisions and gaming platforms also contain processing unit for executing complexinstructions and tasks.

Learning Outcomes: At the end of this unit, the student will be able to

- Understand concepts of Hardwired control and micro programmed control. (L2)
- Understand the architecture and functionality of central processing unit. (L2)
- Summarize the Instruction execution stages. (L2)
- Summarize the types of micro operations. (L2)

Text Books

1. Computer Organization, Carl Hamacher, ZvonksVranesic, SafeaZaky, 5thEdition,McGrawHill,2011.
2. Computer Architecture and Organization, John P. Hayes ,3rdEdition, McGrawHill,2002.

Reference Books

1. Computer Organization and Architecture – William Stallings SixthEdition,Pearson/PHI
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th EditionPHI/Pearson, 2012.

Subject Code	Subject Name	L	T	P	C
R20EEE-OE3102	Electrical Measurements **(Open Elective-1)**	3	0	0	3

Course objectives:

- To study the principle of operation and working of different types of instruments for measurementof voltage and current.
- To study the working principle of operation of different types of instruments for Measurement ofpower and energy.
- To understand the principle of operation and working of dc and ac potentiometers.
- To understand the principle of operation and working of various types of bridges for measurementof parameters –resistance, inductance, capacitance.
- To study the principle of operation and working of various types of magnetic measuringinstruments.

Course outcomes:

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

1. Choose the right type of instrument for measurement of voltage and current for AC and DC(L3)
2. Understand the principle of operation and working of different types of instruments formeasurement of power and Energy (L2)
3. Calibrate ammeter, voltmeter, and wattmeter by using potentiometer (L3)
4. Select suitable bridge for measurement of electrical parameters (L2)
5. Understand the measurement of Magnetic quantities using magnetic measuring instruments.(L2)

UNIT I

Measuring Instruments: Classification – Deflecting, control and damping torques – Ammeters and Voltmeters –PMMC, moving iron type, dynamometer and electrostatic instruments – Expression for the deflecting torque and control torque – Errors and compensations– Extension of range using shunts and series resistance –CT and PT**:** Ratio and phase angle errors – Numerical problems.

Learning outcomes:

At the end of this unit, students will be able to

- Choose the right type of instrument for measurement of voltage and current for DC (L2)
- Choose the right type of instrument for measurement of voltage and current for AC (L2)

UNIT-II

Measurement of Power and Energy: Single phase and three phase dynamometer wattmeter – LPF and UPF – Expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems – Type of

P.F. Meters – Single phase and three phase dynamometer and moving iron type Single phase induction type energy meter – Driving and braking torques – errors and compensations – Testing by phantom loading using R.S.S. meter– Three phase energy meter

Learning outcomes:

At the end of this unit, students will be able to

- Understand the measurement of single phase and three phase power and energy (L2)
- Understand the operation of instrument transformer (L2)

UNIT-III

Potentiometers

DC Potentiometers: Principle and operation of D.C. Crompton's potentiometer – Standardization–Measurement of unknown resistance, current and voltage- applications.

AC Potentiometers: Types of AC potentiometers –standardization – applications

Learning outcomes:

At the end of this unit, students will be able to

- Find the unknown parameters using potentiometer (L1)
- Understand the principle of operation and standardization of potentiometers (L2)
- Calibrate the measuring instruments (L3)

UNIT-IV

Measurements of Parameters:

DC bridges:

Method of measuring low, medium and high resistance –Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge formeasuring low resistance- measurement of high resistance – Megger.

AC bridges:

Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge – Anderson's bridge- Measurement of capacitance and loss angle – Desauty bridge –Schering bridge, numerical problems.

Learning outcomes:

At the end of this unit, students will be able to

- Select suitable bridge for measurement of Resistance (L2)
- Select suitable bridge for measurement of Inductance and Capacitance (L2)

UNIT-V

Magnetic Measurements: Ballistic galvanometer – Equation of motion – Flux meter – Constructional details–Determination of B–H Loop methods of reversals six point method – AC testing – Iron loss of bar samples– Core loss measurements by bridges and potentiometers.

Learning outcomes: The students are able to

- Understand the measurement of Magnetic Parameters (L2).
- Understand the concepts for measurement of Losses by using bridges and Potentiometers (L2).

Textbooks:

1. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C.Widdis, fifthEdition, Wheeler Publishing.
2. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, SpecialIndian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney DhanpatRai & Co. Publications.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput,S.Chand.

Subject Code	Subject Name	L	T	P	C
R20MEC-OE3101	Industrial Robotics **(Open Elective-1)**	3	0	0	3

Course Objectives:

- To learn the types of robots used for Industrial Applications.
- To understand the use of vision systems in automation.
- To gain knowledge on the different methods of material handling.
- To identify robots and its peripherals for industrial applications.
- To analyze the factors for selection for Robotic systems

Course Outcomes:

At the end of the course, the student will be able to

1. Illustrate the types of Industrial Robots and their architecture. (L2)
2. Explain the applications of robots in various industrial applications. (L2)
3. Analyze simple grippers for pick and place application. (L4)
4. Analyze the factors for selection of Robot for a given industrial application. (L4)
5. Summarize the features of material handling system in automation. (L2)

UNIT-I

Introduction: Types of industrial robots, Load handling capacity, general considerations in Roboticmaterial handling.

Robots For Inspection: Robotic vision systems, image representation, object recognition andcategorization.

Applications: manufacturing, space exploration, military, customer service, underwater exploration,identify errors or defects, better quality and consistency

Learning outcomes:

At the end of the unit, the student will be able to:

1. Classify the types of Robots (L2)
2. Understand the general considerations for material handling (L2)
3. Explain the significance of Vision systems (L2)

UNIT-II

Applications of Robotics: Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, biomedical applications, robots for underwater applications.

Learning outcomes:

At the end of the unit, the student will be able to:

1. Classify the types of Robots (L2)
2. Understand the applications of Robots (L2)

UNIT-III

End Effectors: Gripper force analysis and gripper design for typical applications, design of multipledegrees of freedom, active and passive grippers.

Learning outcomes:

At the end of the unit, the student will be able to:

1. Analyze the forces involved in gripper analysis (L4)
2. Choose the gripper design for typical applications (L3)
3. Distinguish the active and passive grippers (L4)

UNIT-IV

Selection of Robot: Factors influencing the choice of a robot, robot performance testing,economics of robotisation, Impact of robot on industry and society.

Learning outcomes:

At the end of the unit, the student will be able to:

1. Identify the factors influencing the choice of robots (L3)

2. Understand the Robot performance testing (L2)
3. Explain the impact of Robot on Industry and society (L2)

UNIT-V

Robots in Flexible Manufacturing Systems: Requirement of robots in FMS, advanced material handling systems with robots, Automated Guided Vehicles, automated storage and retrieval systems(ASRS), bar code technology.

Learning outcomes:

At the end of the unit, the student will be able to:

- Classify the material handling systems (L2)
- Understand the principles of material handling systems (L2)
- Apply the knowledge gained, in the usage of various types of technologies (L3)
- Explain the features of ASRS (L2)

Text Books

1. Richard D Klafter, Thomas Achmielewski and Mickael Negin, —Robotic Engineering –An integrated Approach ¦Prentice Hall India, New Delhi, 2001.
2. Mikell P Groover, "Automation, Production Systems, and Computer-IntegratedManufacturing", Pearson Education, 2015.

Reference Books

1. James A Rehg, —Introduction to Robotics in CIM Systems, Prentice Hall of India,
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, NewDelhi.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3104	Linear Integrated Circuits and Applications Lab	0	0	3	1.5

Course Objectives:

- Demonstrate the working and functional characteristics of different analog ICs.
- Familiarize the students with various applications of IC 741.
- Construct various waveform generator circuits using IC 741, IC 565 and IC 566.
- Design various multi-vibrator circuits using IC 555 timer.
- Familiarize with various fixed voltage and variable Voltage Regulator using ICs and digital toanalog converters (DAC).

Course Outcomes:

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

1. Identify the functionality of IC's 741,IC 555,IC 565 and IC 1496 ect.(L1).
2. Make use of IC 741 to model Inverting and Non-Inverting adder, subtractor, comparator, integratorand differentiator and various active filters (L3).
3. Develop various waveform generator circuits using IC 741, IC 565 and IC566 (L3).
4. Construct various multi-vibrator circuits using IC 555 timer (L3).
5. Build various fixed voltage and variable Voltage Regulator using ICs and binary weighted R-2Rladder digital to analog converters using IC 741 (L3).

List of Experiments:

Minimum of Ten Experiments has to be performed and also simulate with using Spice Software

1. Study of OP AMPs – IC 741, IC 555, IC 565, IC 566, IC 1496 – functioning, parameters andSpecifications.
2. Inverting and Non-Inverting Amplifiers using Op Amps.
3. OP AMP Applications – Adder, Subtractor, Comparator Circuits.
4. Integrator and Differentiator Circuits using IC 741.
5. Active Filter Applications – LPF, HPF (first order)
6. Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.
7. IC 741 waveform Generators-Sine, Square wave and Triangular Waves.
8. IC 555 Timer – Monostable Operation Circuit.
9. IC 555 Timer – Astable Operation Circuit.
10. Schmitt Trigger Circuits – using IC 741 and IC 555.
11. IC 565 – PLL Applications.
12. Low voltage Regulator using IC 723.
13. High Voltage Regulator using IC 723
14. Three Terminal Voltage Regulators – 7805, 7809, 7912.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3105	Digital Communications Lab	0	0	3	1.5

Course Objectives:

Students undergoing this course, are expected to

- Outline the basics of modulation and demodulation techniques in digital communication systemsusing hardware and MATLAB software.
- Illustrate various types of modulation / demodulation techniques.
- Explain the importance of channel coding and decoding modulation.
- Recall different digital pulse modulation techniques
- Analyze and design different source coding techniques experimentally and also to impart industryoriented learning.

Course Outcomes:

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

1. Demonstrate various modulation and demodulation circuits in digital communications using hardware and Matlabtools. (L2)
2. Demonstrate the performance of Analog to Digital Conversion techniques.(L2)
3. Analyze various Source & Channel Coding Techniques.(L4)
4. Apply time division multiplexing concepts indifferent pulse modulation techniques.(L3)
5. Implement Companding concept on signals.(L3)

List of Experiments: Minimum Ten Experiments to be conducted:

1. Time division multiplexing and demultiplexing.
2. Pulse code modulation and demodulation.
3. Differential pulse code modulation.
4. Delta modulation and demodulation.
5. Amplitude shift keying modulation and demodulation.
6. Frequency shift keying modulation and demodulation.
7. Phase shift keying modulation and demodulation.
8. Differential phase shift keying modulation and demodulation.
9. Source Encoder and Decoder
10. Linear Block Code-Encoder and Decoder
11. Binary Cyclic Code - Encoder and Decoder
12. Convolution Code - Encoder and Decoder
13. BCH Codes
14. Digital Companding

Equipment required for Laboratories:

1. Lab Experimental kits
2. RPS - 0 – 30 V
3. CRO - 0 – 20 MHz.
4. Function Generators - 0 – 1 MHz
5. RF Generators - 0 – 1000 M Hz./0 – 100 MHz.
6. Rated Voltmeters and Ammeters
7. Components
8. Breadboards and Multimeters
9. Spectrum Analyzer

Subject Code	Subject Name	L	T	P	C
R20ECE-SC3101	Digital System Design using CAD Tools **(Skill Oriented Course-3)**	0	1	2	2

Course Objectives:

Students undergoing this course, are expected to

- Familiarize with the CAD tool to write HDL programs.
- Understand types of modelling, modules, functions of Verilog and simulate & synthesize relatedPrograms.
- Know the behavioural modeling of combinational and simple sequential circuits.
- Run a timing simulation using Verilog libraries.
- Design and develop small scale digital design

Course Outcomes:

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

1. Explore XILINX ISE CAD Tool to utilize Verilog HDL Coding constructs and statements to realize various digital logic circuits.(L3)
2. Realize basic logic gates and Boolean expressions into logic circuits using Verilog HDL constructs and coding styles.(L3)
3. Model combinational circuits like encoders, decoders, multiplexer, de multiplexer,comparatorsetc.,usingVerilog HDL.(L3)
4. Construct digital sequential circuits like flip-flops, counters and shift registers using Verilog HDL.(L3)
5. Build digital logic systems and state machines like ALU,sequential lmultiplieretc ect..(L3)

List of Experiments: Minimum Ten Experiments to be conducted:

1. Realization of logic gates.
2. Design of Adders and Subtractors.
3. Design of Encoders and Decoders.
4. Design of Multiplexers
5. Design of De-multiplexers.
6. Design of combinational logic circuits using Boolean function.
7. Design of comparators.
8. Realization of flip-flops.
9. Design of synchronous counters.
10. Design of asynchronous counters.
11. Design of shift registers.
12. Design of sequential multiplier.
13. Design of ALU.
14. Design of State Machines.

Subject Code	Subject Name	L	T	P	C
R20BSH-MC3102	Constitution of India **(Mandatory Course)**	2	0	0	0

Course Objectives:

- Comprehend the awareness of history of India and importance of constitution
- Inculcate the basic knowledge of structure of union government and roles and responsibilitiesexecutive bodies
- Know the structure of state government and its administration in various levels
- Examine the local government structure and roles of the authorized bodies from the grass roots ofdemocracy
- Identify the importance of election commissions and other welfare commissions in the state as wellunion governments

Course Outcomes:

At the end of course, the student will be able to:

1. Understand historical background of the constitution making and its importance for building a democratic India. (L2)
2. Understand the functioning of three wings of the government ie., executive, legislative and judiciary.(L2)
3. Understand the value of the fundamental rights and duties for becoming good citizen of India.(L2)
4. Analyze the decentralization of power between central, state and local self government. (L4)
5. Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.(L3)

UNIT-I

Introduction to Indian Constitution: Constitution's meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Application:

Application of the fundamental rights and fundamental duties in present scenario.

Learning Outcomes:

After completion of this unit student will be able to

- Understand the concept of Indian constitution (L2)
- Understand the directive principles of state policy (L2)
- Outline the History, features of Indian constitution (L2)
- List the Preamble Fundamental Rights and Duties (L1)

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and CentralSecretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

Application: Role play mock parliament in the class room to understand LokSabha and RajyaSabha.

Learning Outcomes:

After completion of this unit student will be able to

- Understand the structure of Indian government (L2)
- Contrast the state and central government (L2)

- Explain the Structure of supreme court and High court (L2)

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

Application:

Study the lien of the hierarchy of ministries and list-out current ministers

Learning Outcomes:-

After completion of this unit student will be able to

- Understand the structure of state government (L2)
- Explain the role Governor and Chief Minister (L2)
- Explain the role of state Secretariat (L2)
- Outline the structure and functions of state secretariat (L2)

UNIT-IV

A Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: Zilla Panchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Application:

- Compare and contrast the functionalities of two mayors of two districts.

Learning Outcomes:

After completion of this unit student will be able to

- Understand the local Administration (L2)
- Compare and contrast district administration role and importance (L2)
- Compare the role of Mayor and elected representatives of Municipalities (L2)
- Illustrate the Zilla panchayat block level organization (L2)

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission- Functions and Commissions for the welfare of SC/ST/OBC and women.

Application:

- Make a survey of the voters for local elections in your area.

Learning Outcomes:

After completion of this unit student will be able to

- List the roles of Election Commission (L1)
- Contrast and compare the role of Chief Election commissioner and Commissionerate (L2)
- Demonstrate the role of state election commission (L2)
- Outline various commissions of viz SC/ST/OBC and women (L2)

Text Books

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. NewDelhi
2. Subash Kashyap, Indian Constitution, National Book Trust.

Reference Books

1. H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
2. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-Resources:

1. www.nptel.ac.in/courses/109104074/8
2. www.nptel.ac.in/courses/109104045/
3. www.nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Subject Code	Subject Name	L	T	P	C
R20BSH-MC3103	English for Job Seekers **(Mandatory Course)**	0	0	2	0

Course Objectives

- Encourage use of a wide range of grammatical structures and vocabulary in speech and writing
- Demonstrate good writing skills for effective paraphrasing, argumentative essays, and formalcorrespondence
- Provide training and opportunities to develop fluency in English through participation informalgroup discussions and presentations using audio-visual aids
- Knowing the best practices at the workplace to perform well in the interview.
- Encouraging smart self-learning, communication skills that focus on employability.

Course Outcomes

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

1. understand the grammatical forms of English and the use of these forms in specific communicative and career contex.(L2)
2. use a wide range of reading comprehension strategies appropriate to texts,to retrieve information.(L2)
3. strengthen their ability to write paragraphs,essays,emails and summaries. (L3)
4. Improve their speaking ability in English both in terms of fluency and comprehensibility by participating in Group discussion and oral assignments.(L3)
5. prepare their own resume and answer interview related questions unhesitatingly with acceptable of soft skills.(L3)

UNIT-I

Preparing for Written Assessment[6 Hours] Grammar: Articles: Know how to use different types of Articles**,** use articles appropriately in context Identify errors in the use of articles, **Prepositions**: Learn to use prepositions in context, Identifying errors in the use of prepositions, Look at the different functions of Prepositions, **Tenses**: understand the different form of tense used in sentences, know the various purposes of using different Tense forms, Use appropriate tense forms of verbs in context, Identify the errors in the use of tense forms, **Concord**: Know how to identify Subject-Verb-Agreement in sentences, Use SVA appropriately in Context, identify the errors in the use of SVA, **Voices**:Know when to use Active or Passive Voice, Convert Active sentences to Passive ones,Relative Clause: Know what relative pronouns are, know when to use relative clauses,know the functions of Relative Clauses.

Soft Skills: Leadership:Introduction to Leadership, Leadership Power, Leadership Styles, Leadership in Administration. **Interpersonal Relations**:Introduction to Interpersonal Relations, Analysis of different ego states, Analysis of Transactions, Analysis of Strokes, Analysis of Life position

Learning Outcomes

At the end of the module, the learners will be able to

- Comprehend the factors that influence use of grammar and vocabulary in speech and writing (L3)
- Produce a range of valid grammatical sentences in the real world situations and professionalenvironment (L3)
- Develop employability skills through Leadership skills and interpersonal skills (L3)

UNIT-II

Reading Comprehension [6 Hours]

Purposes & Strategies of Reading:know the general purpose of Reading,assess your skills of reading, develop reading Strategies **Skimming for details**:Skim through a variety of passages, understand how skimming will orient you to the text, **Identifying main Ideas**:Identify the main ideas in the give text,Look for supporting statements in a passage, understand how the writer supports main ideas with details **Scanning for information:**Scan passages for factual information, understand how scanning can help find certain answers quickly,know how to look for factual answers,**drawing inferences:**Understand how to draw inferences,infer meanings while reading passages, **vocabulary**:Learn strategies to understand difficult words used in the passage, Apply strategies of reading to understand a variety of passages,**practise tests**

Soft Skills:Communication: Introduction to Communication, Flow of Communication, Listening, Barriers of Communication, How to overcome barriers of communication. **Stress Management**:Introduction to Stress, Causes of Stress, Impact Stress, Managing StressLearning Outcomes

At the end of the module, the learners will be able to

1. Assess the reading skill by developing reading strategies (L3)
2. Understand the skimming & scanning techniques orients to identify the theme, purpose andstatements (L2)
3. Develop employability skills through communication skills and stress management (L3)

UNIT-III

Writing paragraphs & Essays [6 Hours]

Features of Good Writing: understand what makes a piece of writing good, Analyse & discuss some samples of good & bad writing, **Gathering Ideas**: Discuss various techniques for gathering ideas before you start writing, practice some of the techniques that can be used in the Prewriting stage ,**Purposes of Writing:**understand the importance of purpose of writing,explore various purpose of writing,choosecontent & language based on the purpose **Writing for Specific audience:**Study ways of tailoring content to suit a target audience,analyse text to deduce the target audience,discuss how language is used to suitthe target audience **organizing ideas:**understand the importance of organising ideas in a text,Learn the different ways of organisingideas,practiceorganising ideas while writing **Writing an introduction:**Know the importance of a good introduction, understand the different ways in which writers catch the attentionof readers, **Developing supporting ideas:** Learn how to develop your ideas in a paragraph, discuss a variety of supporting ideas

Writing a conclusion: Learn the different parts of a conclusion, Practice writing an effective conclusion **Using linkers:**Learn the different types of Linkers or cohesive devices, Discuss why it is important to use connectors in writing,**Choosing the right words:**Discuss why writers make a careful choice of language,Learn how to select language to make the intended impact, **Writing film & book reviews:** Learn the different categories of books &films,Know the elements which go into analysing books &films,Write your own film & book reviews **Common errors in writing, editing & proofreading**.:Practice correcting

errors in basic sentence structure,Learn to proof-read & edit your draft before writing the final version. **Soft Skills:** Group Dynamics and Team Building: Importance of groups in organization, Interactions in group, Group Decision Taking, Team Building, Interaction with the Team,How to build a good team?

Learning Outcomes

At the end of the module, the learners will be able to

1. Develop logically coherent argumentative essays (L3)
2. Understand the use of passive voice in academic writing (L2)
3. Make use of appropriate vocabulary to express ideas and opinions (L3)
4. Develop employability skills through group dynamics and team building (L3)

UNIT-IV

Preparing for oral Assignment [6 Hours]

Group Discussion: Group Discussions as a tool for selection, skills for GD,Leadership& Problem- Solving Skills, Types of GD, Group Dynamics, Roles & Functions: Beginning, Presenting, Elaborating, Roles & Functions: Clarifying, Synthesising& Challenging, Roles & Functions: Agreeing, Disagreeing & Summarizing., Etiquette: Body Language & Time Management, GD Activities

Soft Skills: Conflict Management: Introduction to Conflict, Causes of Conflict, Managing Conflict **Time Management:** Time as a Resource, Identify Important Time Wasters, Individual Time Management Styles, Techniques for better Time Management.

Learning Outcomes

At the end of the module, the learners will be able to

1. Participate in group discussions using appropriate conventions and language strategies and develop advanced listening skills for in-depth understanding of academic text (L3)
2. Collaborate with a partner to make discussions (L2)
3. Develop employability skills through conflict management and time management (L3)

UNIT-V

Interview Skills [6 Hours]

Purpose of interviews: Know what recruiters looking for during Interviews,Become familiar with theprocess of career search, understand your skills,interests,achievements and attitude better **Preparing a Resume:**Understand what a job application is,know the details to be included in a CV,Know how to lay out details of a CV & prepare CV on your own **Writing a Cover Letter:**Study the information which is included in a cover letter.Learn how to organise information in a cover letter, **Before and at theinterview:**Learn how to prepare for an interview,learn how to behave during the interview, discuss what the interviewer might assess you on **Answering FAQs about yourself & your families:**Learn how to answer questions about yourself & family, Learn how to identify & talk about your strengths and Weaknesses **Answering FAQs about Likes & Dislikes:**Learn to choose interests which will be relevant to your Interview.learn to speak about your likes & Dislikes **Answering FAQs about Justifying your candidature:**Know what you need to say to answer a question about yourself, Be able to answer questions about your suitability for a job **Answering FAQs about Priorities,Attitudes & Biases:**Understand what your priorities will be in a job & learn to talk about them,learn to correct understanding of your attitude, biases & prejudice, if any, towards others,know positive qualities that are valued at work **Answering FAQs about Professional goals:** Become aware of the things you need to keep in mind while choosing a job,Set goals for your professional growth & plan how to achieve them **Public Speaking: Planning, Practice &Delivery:**Plan one minute speeches on simple topics, understand how to capture the audience's attention, be able to create strong closing statements.

Soft Skills:Motivation: Introduction to Motivation, Relevance and types of Motivation, Motivatingsubordinates, Analysis of Motivation

Learning Outcomes

At the end of the module, the learners will be able to

- Prepare a CV with a cover letter to seek internship/ job (L3)
- Understand the structure of Interviews and familiar with frequently asked questions whileinterview and how to respond to it (L2)
- Develop employability skills through motivation and analysis of motivation (L3)

ASSESSMENT

The learners will demonstrate their knowledge and abilities through completion of the following required assessments while or at the end of this course. —1 Quiz, 1 GD, 2 Activities on Interview Readiness and Softskills, 1 Personal Interview

Quiz: (10M)

Quiz is conducted on Grammar, Vocabulary and Reading Comprehension. The Quiz consists of 50 questions and will be scaled down to 10 Marks. Duration of the quiz is 1hr 30 Min only and it is Computer Based Test (CBT)

GD:(10 M)

1. Each student has to perform 5 Group Discussions during the course which fetches them 5 Marks.
2. The Final Assessment through one formal GD by the External Examiner is for 10 marks that arescaled down to 5 marks .

The GD will be assessed on the following criteria :

1. Content (3M)
2. Body Language(2M)
3. Group dynamics & Leadership Skills (3M)
4. Communication Skills (2M)

Activities on Interview Readiness: (10M)

The external Examiner assess on Interview readiness

1. Tell something about Yourself (5M)

Assessment Parameters:

- Initiation
- Confidence level
- Body Language
- Attention Grabbing

JAM (5M): Student will be given a topic on-Spot and will be assessed by the External examiner onFlow of Speech (2M)

1. Accuracy and Language (2M)
2. Confidence (1M)

Soft Skills:(10M)

Student will be Assessed on

- Presentation of his/her Readiness of Interview (Grooming) with Prepared Resume (5M)
- Aptitude based question/Case study/Behavior based Question (5M)

Resume:(10 M)

Each student is required to submit 3 independently written Resumes during the course. Specific requirements for each one are accessed on the following Link: https://docs.google.com/document/d/1W15961dOEnIxlnMm9BKyO8L9WIa7nPbEfgR-9DT_mRg/edit?usp=sharing

Grading:

Assessment Model	Points
Quiz	**10**
Resume	**10**
GD	**10**
Soft Skills Activity	**10**
Personal Interview	**10**
Total	**50**

Pass Criterion:

1. Student has to Secure 30 Marks to pass this examination
2. Student who is having an achievement certificate of any National or International Level Quiz/Psychometric Analysis, he/she has to secure a Minimum 20 Marks in this examination (Certificate+20 Marks) to pass the summative exam.
3. Clearing all categories is mandatory. Need to get 60% in each category
4. 20M +Certificate=Successful or 30M+No certificate=Successful

III Year-II Semester

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3201	Microprocessors and Microcontrollers	3	0	0	3

Course Objectives:

- To explain the working of 8085 using its architectural features.
- To show the development of 8085 based assembly programming for simple problems.
- To provide 8086 architecture and its working modes of operations.
- To design different 8086 interfaces with various peripheral IC's.
- To make use of 8051 microcontroller integrated features to program simple applications.

Course Outcomes:

At the end of this course students will be able to

1. Illustrate the working of 8085 microprocessor architectural features. (L2)
2. Apply knowledge of 8085 interrupts, instruction sets,addressing modes,and programming concepts to develop basic assembly programs for the 8085 microprocessors. (L3)
3. Extend the working of 8-bit 8085 microprocessor to 16-bit 8086 microprocessor with it sarchitectural features.(L2)
4. Develop assembly programs, interface memory and peripheral functions for the 8086-microprocessor using addressing modes, instruction sets, and assembler directives.(L3)
5. Develop programs for the 8051-microcontroller using itsmemory, timers, serial communication,interrupts,and peripheral interfacing. (L3)

UNIT-I

Introduction to 8085 Microprocessor: Basic microprocessor system-working, 8085 Microprocessor Architecture, register organization, Pin Diagram, Flag Register, Instruction Cycle, Timing Diagram.

Applications:

1. Illustrate the functioning of 8051 microprocessor with its internal organization.

Learning Outcomes:

At the end of this unit students will be able to

1. Summarize features of a 8085microprocessor. (L2)
2. Explain about Instruction cycle andtiming diagram of 8085. (L2)

UNIT-II

8085 Microprocessor Programming: Interrupts of 8085, instructions set of 8085 andaddressing modes,programming of 8085 with examples.

Applications:

- Construct the machine code generation like arithmetic, logical, string, branch and machinecontrolling instructions.

Learning Outcomes:

At the end of this unit students will be able to

- Develop assembly language programsfor various problems. (L3)
- Explain about ISR and interrupt structure of 8085. (L2)

UNIT-III

8086 Microprocessor: Introduction**,** Register Organization of 8086, Architecture, Pin Diagram, Memory segmentation and organization, Stack functions, Interrupt structure of 8086. Minimum and maximum mode microprocessor system, Timing diagram and General Bus operation.

Applications:

- Develop 8086 based systems in minimum or maximum mode configuration.

Learning Outcomes:

At the end of this unit students will be able to

- Summarize features of a 8086 microprocessor (L2).
- Explain about Instruction cycle andtiming diagram of 8086 (L2).

UNIT-IV

Programming and interacting with 8086: Addressing Modes, Instruction Set of 8086, Assembler Directives, Assembly Language Programming: Simple programs, Procedures and Macros Program. Memory Interfacing, Programmable Peripheral Interface 8255, Programmable Interrupt Controller 8259,Command words of 8259,Programmable Communication Interface 8251 USART, DMA Controller 8257.

Applications:

- Design of interfacing 8086 with 8255 for peripheral control, 8251 interfacing asynchronous andsynchronous digital signals for digital transmission system.

Learning Outcomes:

At the end of this unit students will be able to

- Understand instruction set of 8086microprocessors. (L2)
- Develop assembly language programs for various problems. (L3)
- Demonstrate memory & I/O interfacing with 8086. (L2)

UNIT-V

Intel 8051 Microcontroller: 8051 Microcontroller Architecture, Microcontroller 8051 pin diagram, 8051 Ports, Internal and External Memory, Counters and Timers, Serial Communication in 8051, Interrupts in 8051, Addressing Modes, Instruction set of 8051, simple programs and peripheral Interface.

Applications:

- Construct the controller programs like addition, subtraction, multiplication, division,shift, rotateand control of peripherals.

Learning Outcomes:

At the end of this unit students will be able to

- Distinguish between microprocessor and amicrocontroller. (L2)
- Describe architecture and features of Intel8051 microcontroller. (L2)
- Develop assembly language programs to perform various operations using 8051. (L3)

Text Books

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications withthe 8085,6th edition, Penram International Publishing, 2013.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition,McGrawHill Education, 2017.

Reference Books

1. Microcontrollers and application, Ajay. V. Deshmukh, TMGH,2005
2. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3202	Digital Signal Processing	3	0	0	3

Course Objectives:

- To describe discrete time signals and systems.
- To teach importance of FFT algorithm for computation of Discrete Fourier Transform.
- To learn the basic design and structure of FIR Filters
- To familiarize the design procedure of IIR filters with desired frequency responses
- To outline need of Multi-rate Processing.

Course Outcomes:

At the end of the course, the student will be able to

1. Illustrate the concept of discrete time signals and systems for Analysing the response of LTI system in Time domain and Frequency domain .(L4)
2. Construct the Decimation-in-Time Fast Fourier Transform and Decimation-in Frequency Fast Fourier Transform for reducing computational complexity of DFT .(L3)
3. Develop digital IIR filters and theirrealization structures using various transformation techniques.(L3)
4. Develop FIR digital filters using Windowing techniques for thegiven specifications and the irrealization structures.(L3)
5. Develop algorithms for performing various Multi-rate Digital Signal Operations.(L3)

UNIT-I

Discrete Time Signals, Systems and Discrete Fourier series

Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, LTI system Properties. Discrete time systems described by difference equations, Convolution of Discrete Time Signals and sequences.

Discrete Fourier series: DFS Representation of periodic sequences and Properties of Discrete Fourier Series.

Applications:

- Finding of frequency response of the given system
- Analysis of discrete time signals and systems

Learning Outcomes:

At the end of the unit, the student will be able to

- Explain importance of Digital Signal processing (L2)
- Outline LTI system Properties (L2)
- Summarize properties of Discrete time systems and Z-transforms (L2)

UNIT-II

Transforms

Discrete Fourier Transform (DFT):

Definition and Properties of Discrete Fourier Transforms, Convolution of sequences using DFT. **Fast Fourier Transforms (FFT):** Definition, Radix-2 decimation in time and decimation infrequency FFT Algorithms and Inverse FFT.

Applications

- The detection of the frequencies of a pair of sinusoidal signals, called tones, employed intelephone signaling
- Equalizer in audio and video signal processing.
- FFT algorithms in video and audio signal processing

Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the properties of DFT (L2)
- Make use of the convolution methods to compute DFT of a given sequence (L3)

- Solve the DFT computation problems using FFT and inverse FFT algorithms (L3)

UNIT-III

IIR Digital Filters

Structures of IIR –Discrete time IIR filter from analog filter using Butter worth and Chebyshev approximations. IIR filter design by Impulse Invariance and Bilinear transformation

Basic structures of IIR systems, Transposed forms.

Applications

- The applications of IIR filters include the removal of the noise or interference, passing of certainfrequency components.

1. an equalization of a small monitor loudspeaker

Learning Outcomes:

At the end of the unit, the student will be able to

- Build IIR filter from the given analog transfer function (L3)
- Illustrate the features of IIR Filter structures (L2)

UNIT-IV

FIR Digital Filters

Characteristics of FIR Digital Filters, Frequency Response, Design of Linear phase FIR Digital Filters using Fourier series and Window Techniques, Comparison of IIR & FIR filters, Realization of FIR filters.

Applications:

- Equalizer for audio and video processing

Learning Outcomes:

At the end of the unit, the student will be able to

- Build the FIR Digital Filter using windowing techniques for the given specifications (L3)
- Identify basic structures of given FIR systems (L3)

UNIT-V

Multirate Digital Signal Processing: Introduction, down sampling, Decimation, up sampling, Interpolation, Sampling Rate Conversion, Applications of Multi Rate Signal Processing.

Applications:

- Implementation of a narrow band low-pass filter
- Filter banks

Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the down sampled & Up sampled signal (L2)
- Outline the interpolation and decimation concepts (L2)
- Explain the sampling rate conversion (L2)

Text Books

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, andApplications, Pearson Education, 2007.
2. A.V.Oppenheim and R.W. Schaffer, Discrete Time Signal Processing ,PHI.

References

1. Andreas Antoniou, Digital Signal Processing, TATA McGraw Hill, 2006
2. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using Matlab,Thomson, 2007.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3203	VLSI Design	3	0	0	3

Course Objectives:

- To introduce the various steps involved in the MOS transistor fabrication of integrated circuits.
- To explain the electrical properties of MOS devices.
- To introduce design rules and scaling effects in CMOS technology.
- To study the behavior of inverters designed with various loads.
- To provide an overview of testing fundamentals and its testability design.

Course Outcomes:

At the end of the course, the student will be able to

1. Illustrate the electrical properties of MOS, CMOS, and BiCMOS with the steps involved in the fabrication of MOS transistor. (L2)
2. Utilize layout design rules during the design of layout diagrams. (L3)
3. Utilize scaling factors efficiently to estimate scaling of different parameters, and learn limitations of scaling. (L3)
4. Analyse digital logic circuits using dynamic CMOS logic and evaluate them using configurable devices.(L4)
5. Compare different testability models and different testing techniques.(L2)

UNIT-I

Introduction to MOSFETs: Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms ofpull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

Applications:

- Used for switching and amplifying electronics signals in the electronic devices
- Can be used in electronic DC relay

Learning Outcomes:

At the end of the unit, the student will be able to

- Outline CMOS fabrication process flow and λ-based design rules (L2)
- Explain the electrical parameters of MOS transistor (L2)
- Demonstrate the driving parameters of Inverters (L2)

UNIT-II

MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Sti..ck Diagrams, Design Rules and Layout, General observations on the Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal,Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams Translation to Mask Form.

Applications:

- Stick diagrams are useful for planning the layout and routing of integrated circuits
- CMOS used in microcontrollers, static RAM, registers, microchips and other digital circuits

Learning Outcomes:

At the end of the unit, the student will be able to

- Outline MOS design rules (L2)
- Draw stick diagrams and layouts for MOS gates (L3)

UNIT-III

Scaling of MOS Circuits: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, substrate doping, depletion width, limits of miniaturization, limits of interconnects
and contact resistances, Limits due to sub threshold currents, Limits on logic levels and supply voltage dueto noise and current density.

Applications:

- Scaling scenarios for wire capacitance
- Scaling results in the decrease of the dimensions of a MOS device
- Increases the device density and functional capacity of the chip.

Learning Outcomes:

At the end of the unit, the student will be able to

- Analyze scaling parameters on device (L4)
- Understand the factors effecting scaling on device (L2)
- Examine the various limitations occur while scaling of MOS devices (L4)

UNIT-IV

Digital circuits using CMOS: Pseudo NMOS, Pass transistor, transmission gates, Dynamic logic, Domino logic, Differential cascode voltage switch logic, design of combinational circuits, design of sequential circuits, timing requirements.

Programmable Logic Devices: Introduction to PLA, PAL, Standard Cells FPGAs, CPLDs.

Applications:

- Flash memory chip designing
- Used to design application-specific integrated circuits (ASICs)

Learning Outcomes:

At the end of the unit, the student will be able to

- Compare CMOS and pseudo-NMOS inverters with respect to area and speed (L2)
- Compare TG logic and Pass Transistor logic gates (L2)
- Compare static and dynamic logic styles (L2)
- Understand performance of simple arithmetic circuits designed using CMOS (L2)

UNIT-V

Basics of Testing: Fault models, Combinational logic and fault simulation, Test generation for Combinational Circuits. Current sensing based testing. Classification of sequential ATPG methods. Fault collapsing and simulation

Design for testability: Scan design, Partial scan, use of scan chains, boundary scan, built in self test (BIST), path sensitizing technique.

Applications:

- Ensure high yield and proper detection of faulty chips after manufacturing.
- Predictive study to make sure the produced version of the synthesised design will work to carry outthe specified I/O operation.

Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the significance of testable design (L2)
- Understand fabrication defects, errors and faults (L2)
- Compare combinational and sequential circuit test generation algorithms (L2)

Text Books

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. P. K. Lala: Digital circuit Testing and Testability, Academic Press. 1997.

Reference Books

1. Neil H.E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4thEdition, Pearson Education, 2015.
2. Jan M RABAEY, Digital Integrated Circuits, 2nd Edition, Pearson Education, 2003.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3201.1	Telecommunication Switching Systems & Networks **(Professional Elective-2)**	3	0	0	3

Course Objectives:

- To understand the basics of switching systems and design of different switching systems.
- To familiarize the multiplexing in switching networks.
- To demonstrate the different telephone networks and signalling techniques, organize the chargingand routing plans.
- To illustrate the different switching networks and its configurations.
- To explain the concepts of Digital Data Networks and different DSL technologies.

Course Outcomes:

At the end of the course, the student will be able to

1. Illustrate the knowledge about basics of switching system and different types of switching systems(L2)
2. Understand the switching systems such as Electronic space division switching and networks withvarious stages (L2)
3. Interpret the digital signal path in time and space, between two terminals with basic time divisionswitching, modes and combine switching (L2)
4. Demonstrate the routing hierarchy and different plans in Telecommunication Network (L2)
5. Illustrate the complete architecture of ISDN and various DSL technologies and cable networks (L2)

UNIT-I

Introduction: Evolution of Telecommunications, Simple Telephone Communication, Basics of Switching System, Manual Switching System, Major Telecommunication Networks.**Crossbar Switching:** Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Cross point Technology, Crossbar Exchange Organization.

Applications:

- Crossbar switches are commonly used in information processing applications such as telephony and circuit switching, but they are also used in applications such as mechanical sorting machines.
- The matrix layout of a crossbar switch is also used in some semiconductor memory devices whichenables the data transmission.

Learning outcomes:

At the end of the unit, the student will be able to

- Describe the fundamentals of telecommunication systems and associated technologies (L2).
- Understand the various types of connection links used by industry for telecommunication systemworldwide (L2).

UNIT-II

Electronic Space Division Switching and Time Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Two- Stage Networks, Three-Stage Networks, n- Stage Networks. Basic

Time Division Time Switching, Time Multiplexed Time Switching, Combination Switching, Three-Stage Combination Switching, n- Stage Combination Switching

Applications:

- The different types of switches which are widely used across industries such as Telecommunication, Industry control equipment, Commercial equipment, and Home appliances.

Learning outcomes:

At the end of the unit, the student will be able to

- Understand the common switching operations found in the telecommunications (L2).
- Distinguish the various Stored program controls and multiplexed switching systems (L2).

UNIT-III

Telephone Networks: Subscriber Loop System, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signalling Techniques, In-channel Signalling, Common Channel Signalling, CCITT Signalling System no.6, CCITT Signalling System no.7,

Packet Switching: Statistical Multiplexing, Local- Area and Wide- Area Networks, Large-scale Networks, Broadband Networks.

Applications:

- Packet switching is used in the Internet and most local area networks.
- Newer mobile phone technologies (e.g., GSM, LTE) also use packet switching.

Learning outcomes:

At the end of the unit, the student will be able to

- Demonstrate the performance of telecommunication networks (L2).
- Understand the various signalling techniques in tele communication systems (L2).

UNIT-IV

Switching Networks: Single- Stage Networks, Grading, Link Systems, Grades of service of link systems, Application of Graph Theory to link Systems, Use of Expansion, Call Packing, Rearrange-able Networks, Strict- Sense non-blocking Networks, Sectionalized Switching Networks Telecommunications Traffic: The Unit of Traffic, Congestion, Traffic Measurement, A Mathematical Model, Lost-call Systems, Queuing Systems. Problems

Applications:

- Switching networks are used in public telephone network.
- It is used for voice transmission.
- Fixed data can be transferred at a time in circuit switching technology.

Learning outcomes:

At the end of the unit, the student will be able to

- Understand the application of graph theory to link systems (L2).
- List various types of switching networks (L2).

UNIT-V

Integrated Services Digital Network: Motivation for ISDN, New Services, Network and Protocol Architecture, Transmission Channels, User- Network Interfaces, Signaling, Numbering and Addressing, Service Characterization, Interworking, ISDN Standards, Expert Systems in ISDN, Broadband ISDN, Voice Data Integration.

Applications:

- ISDN is also used as a smart-network technology intended to add new services to the publicswitched telephone network (PSTN).
- ISDN is also used for applications such as Telephone industry,Video conferencing, Broadcastindustry

Learning outcomes:

At the end of the unit, the student will be able to

- Interpret the concepts of Integrated Services Digital Networks, types of networks (L2).
- Understand the principles of the internal design and operation of ISDN network and its applications(L2).

Text Books

1. Telecommunication Switching Systems and Networks- Thiagarajan Viswanathan, 2000, PHI.
2. Telecommunications Switching, Traffic and Networks- J. E. Flood, 2006, Pearson Education.

References

1. Principles of Communication Systems- H. Taub & D. Schilling, 2nd Edition, 2003, TMH.
2. Data Communication & Networking- B. A. Forouzan, 3rd Edition, 2004, TMH.

Subject Code	Subject Name	L	T	P	C
R20ECE-PCE3201.2	Analog IC Design **(Professional Elective-2)**	3	0	0	3

Course Objectives:

- To educate that ICs are similar to discrete component circuits with special constraints.
- To expose to these constraints and make them design the ICs.
- To make them capable of arriving at a suitable architecture for a given function, realized in ICform.
- To compare and contrast the CMOS amplifiers based circuits for various applications.
- To familiarize the comparator functioning and characteristics.

Course Outcomes:

At the end of the Course, the Student will be able to

1. Apply mathematics and physics to derive first order and second order MOSFET models (L3)
2. Compare basic current mirror, and Wilson current mirror characteristics (L4)
3. Classify the simple CMOS amplifiers and analyze their performance (L4)
4. Identify the errors in a differential amplifier due to device mismatch (L3)
5. Compare performance of comparators (L4)

UNIT-I

MOS Devices and Modeling: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small Signal Model for the MOS Transistor, Computer Simulation Models, Sub-thresholdMOS Model.

Applications:

- Microprocessor designs.
- Flash memory chip designing.
- Used to design application-specific integrated circuits (ASICs)

Learning outcomes:

At the end of the unit, the student will be able to

- Relate resistors, capacitors, diodes and BJTs as MOS ICs (L2)
- Apply first order and second order mathematical models to MOSFETs (L3)
- Illustrate basic CMOS amplifier configurations with different types of loads (L2)

UNIT-II

Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

Applications:

- A precision current sink can be used to generate a voltage bias for sensors, amplifiers, and otheranalog circuits
- current mirror is used to provide bias currents and active loads to circuits.
- also used to model a more realistic current source

Learning outcomes:

At the end of the unit, the student will be able to

- Distinguish between the current source and current sink of a MOSFET (L4)
- Compare basic current mirror with Widlar and Wilson current mirrors (L2)
- Understand the performance of Zener and Band gap references (L2)

UNIT-III

CMOS Amplifiers : Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

Applications: CMOS amplifiers are used in computers, audio systems, smartphones, cameras, telecommunication systems, biomedical circuits, and many other systems.

Learning outcomes:

At the end of the unit, the student will be able to

1. Understand the CS amplifier with different types of loads and compare their gain and Zout (L2)
2. Understand the performance of a CMOS cascade amplifier and their architectures (L2)
3. Compare cascode and folded cascode amplifier performances (L4)

UNIT-IV

CMOS Operational Amplifiers : Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

Applications:

- Used extensively in signal conditioning, filtering or to perform mathematical operations such asadd, subtract, integration and differentiation.
- CMOS operational amplifier for wireless intraocular pressure recordings.

Learning outcomes: At the end of the unit, the student will be able to

- Find gain, BW and phase characteristics of two and three stage CMOS OPAMPS (L1)
- Calculate the gain and output impedance of an OPAMP by cascade technique (L3)
- Understand the process and temperature independent compensation techniques for CMOSOPAMPs (L2).

UNIT-V

Comparators : Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete- Time Comparators.

Applications:

- Used in Analog to Digital converter (ADC)

Learning outcomes:

At the end of the unit, the student will be able to

- Distinguish between different open loop comparators (L2)
- Analyze the performance of open loop comparators (L4)

Text Books

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press,International Second Edition/Indian Edition, 2010.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G.Meyer, Wiley India, Fifth Edition, 2010.

Reference Books

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2013.
2. Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition.

Subject Code	Subject Name	L	T	P	C
R20ECE-PE3201.3	Electronic Measurements & Instrumentation **(Professional Elective-2)**	3	0	0	3

Course Objectives:

- To familiarize the characteristics of the instruements used for voltage, current and resisitancemeasurements.
- To understand the operation of signal generators and various wave analyzers.
- To demonstrate the basic building blocks of an oscilloscope and its types, measurement ofparameters.
- To explain the procedure of finding unknown L, C, and Q values using bridges.
- To famialiarize various types of transducers used in electronic instrumentation.

Course Outcomes:

At the end of the course, the student will be able to

1. Select the instrument to be used based on the required measurement (L3).
2. Understand different signal generators and analyzers (L2).
3. Understand the design of oscilloscopes and probes for different measurement applications (L2).
4. Make use of different bridge circuits to measure R, L and C component values (L3).
5. Understand working principles of different transducers for measurement of physical quantities(L2).

UNIT- I

Performance characteristics of instruments, Static characteristics, Errors in Measurement, Dynamic Characteristics-speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters- Multi-range, Range extension/Solid state and differential voltmeters, AC voltmeters- multi-range, range extension, shunt.Thermocouple type RF ammeter, Ohmmeters series type, shunt type, Multi-meter for Voltage, Current and resistance measurements.

Applications:

- Voltmeter comes in handy for measuring the voltage and emf between the two points in the electriccircuit.
- Ammeter is used to measure the flow of current

Learning outcomes:

At the end of this unit, the student will be able to

- Understand the performance characteristics of instruments (L2)
- List different types of errors occurred in measurements (L1)
- Explain the operating principles of AC/DC Voltmeters and Ammeters (L2)
- Calculate the sensitivity, error and accuracy of an instrument (L3)

UNIT-II

Signal Generator- fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Arbitrary waveform. Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

Applications:

- Signal generators are used for testing components, receivers and test systems in a wide variety of applications including cellular communications, WiFi, WiMAX, GPS, audio and video broadcasting, satellite communications, radar and electronic warfare.
- Wave analyzers have very important applications in electrical measurements, Sound measurements, Vibration measurements, etc.

Learning outcomes:

At the end of this unit, the student will be able to

- Explain the operating functionality of a signal generator (L2)

- Demonstrate for obtaining various types of waveforms like square, pulse, traingualar, etc throughfunction generators (L2)
- Compare various types of wave analyzers (L2)

UNIT-III

Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, Dual beam CRO, Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope, Lissajou's method of frequency measurement, standard specifications of CRO, probes for CRO- Active & Passive, attenuator type.

Applications:

- Oscilloscopes can be used in wide variety of applications such as automotive test, protocol test, EMI precompliance analysis, signal analysis, conformance test, power measurements, jitter analysis and many more.
- Probe is used to make a physical and electrical connection between a test point or signal source andan oscilloscope

Learning outcomes:

At the end of this unit, the student will be able to

- Explain the key building blocks involved in an oscilloscope (L2)
- Demonstrate the procedure to measure frequency using Lissajou's method (L2)
- List the various types of probes used with CROs for testing procedures (L1)

UNIT-IV

AC Bridges Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance-Schearing Bridge. Wheat stone bridge. Wien Bridge, Errors and precautions in using bridges. Q-meter.

Applications:

1. AC bridges are used in the measurement of inductances, capacitances, frequency, dissipation factorand to provide phase-shifting, feedback path to the oscillator.
2. Wheatstone bridge is used for the precise measurement of low resistance, temperature, light, andstrain (Along with an operational amplifier)
3. Q-meter is used to measure the quality factor of the inductor.

Learning outcome:

At the end of this unit, the student will be able to

- Calculate the unknown impedance in a circuit using bridges (L3)
- Calculate the Q-factor of a circuit using Q-meter (l3)
- Explain the working principles of various bridges used in impedance measurements (L2)

UNIT-V

Transducers- active & passive transducers : Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Sensistors.

Applications:

- Transducers are important for detecting physical quantities such as temperature, pressure, air humidity, sound pressure or light, are transformed into normalized signals.

Learning Outcomes:

At the end of this unit, the student will be able to

- Define the transducer and its operation (L1)
- List the types of transducers used in measurements (L1)
- Summarize the applications of transducers used in electronic measurements (L2)

Text Books

1. Electronic instrumentation, second edition - H.S.Kalsi, Tata McGraw Hill, 2004.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D.Cooper, PHI, 5th Edition, 2002.

Reference Books

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition, 2003.
2. Electronic Measurements & Instrumentations by K. Lal Kishore, Pearson Education - 2005.

Subject Code	Subject Name	L	T	P	C
R20ECE-PCE3201.4	Microwave and Radar Engineering **(Professional Elective-2)**	3	0	0	3

Course Objectives

- To understand the theoretical principles underlying microwave devices and networks.
- To design microwave components such as power dividers, hybrid junctions, microwave filters,ferrite devices, and single-stage microwave transistor amplifiers.
- To summarize the basic operating principles of various Microwave semiconductor devices.
- To understand the basic knowledge on Radar range equation and various components of Radar.
- To quantify the various direction finders of microwave systems such as communication networks,radars, and antennas related in this design process.

Course Outcomes

At the end of the Course, the Student will be able to

1. Apply scattering parameters to analyze microwaves, waveguides, and microwave transmission lines. (L3)
2. Identify the performance analysis of various Microwave Components and their measurements.(L3)
3. Understand the operating principles of different Microwave Solid State Devices. (L2)
4. Apply knowledge of radar concepts to demonstrate the functionality of various radar types.(L3)
5. Compare the performance of direction-finding systems like ILS, LORAN, GPS,and Doppler navigation. (L2)

UNIT-I

Introduction to Microwaves- Characteristic features of Microwaves- Advantages and Applications- Wave guides- basic concepts and properties. Fundamentals of Microwave Transmission Lines, Scattering matrix- Concept of N port scattering matrix representation- Properties of S matrix- S matrix formulation of two- port junction. Passive microwave devices- T junctions- H plane, E plane and EH plane Tee junctions, its S matrix and properties.

Applications:

- They are extensively used in Microwave ovens.
- Waveguides are used for broadcasting and radar installations.
- These are used in space vehicles and aircrafts.
- Used in Reflectometer that provides measurement of forward power and reflected power
- Used in Levelled generator

Learning outcomes:

At the end of the unit, the Student will be able to

- List of various applications of microwaves (L1)
- Understand concepts of wave propagation and microwave transmission lines (L2)
- Understand various modes of propagation in the waveguides (L2)
- Understand properties of S –parameters (L2)

UNIT-II

Microwave Measurements- Frequency- power- VSWR- impedance. Applications of Hybrid junction. Directional coupler-Termination- Gyrator- Isolator- Circulator- Phase changer- Attenuator. Microwave tubes- High frequency limitations- Magnetron- Multicavity Klystron- Reflex Klystron- Traveling Wave Tube- principle of operation. Microwave Communication

Basic Principles of Microwave Links – Microwave relay Systems – block schematic of terminal transmitters and receivers – repeaters – basic principles of design of a microwave links.

Applications:

- Used in microwave receivers as a low noise RF amplifier
- Used in high power pulsed radars and ground based radars

Learning outcomes:

At the end of the unit, the Student will be able to

- Understand limitations of conventional devices at high frequencies (L2)
- Explain velocity modulation and bunching phenomenon in linear beam and cross field tubes (L2)
- Compute output power and efficiency of microwave tubes (L3)

UNIT-III

Microwave Semiconductor Devices- Principle of operation of Transistors and FETs. Transferred Electron Devices- Gunn diode- Gunn diode as an Oscillator and an amplifier- InP diode- Tunnel diode- principle of operation. Avalanche Transit time devices- IMPATT and TRAPATT devices- principle of operation.

Applications:

- Microwave solid state devices are primarly used in microwave links, continuous-wave radars, andelectronic countermeasures
- IMPATT diode, the BARITT is used in microwave signal generation, often in applicationsincluding burglar alarms

Learning outcomes:

At the end of the unit, the Student will be able to

- Understand the Transferred bulk electron effect (L2)
- Explain principle of operation of microwave semiconductor diodes and transistors (L2)
- Demonstrate the process of parametric amplification (L2)

UNIT-IV

Introduction to Radar-Radar range equation- Block schematic of pulse radar- Radar frequencies- Applications of radar- CW radar- applications of CW radar- CW radar with nonzero IF- FM CW radar-FM CW altimeter- MTI and Pulse Doppler radar.

Applications:

- Radars are used in safe landing and take-off of all the types of aircrafts.
- CW and MTI radars are used in enemy target identification and electronic countermeasures

Learning outcomes:

At the end of the unit, the Student will be able to

- Explain with relevant sketch functions of given component of the RADAR system (L2)
- Calculate the maximum RADAR range for the given data (L3).
- Explain the effect on the RADAR range for the given parameters (L2)
- Explain the type of scanning and tracking methods used for RADAR communication (L2).

UNIT-V

Direction finders- Instrument Landing System- Radio ranges. Navigation- Hyperbolic navigation- LORAN. Satellite navigation- Doppler navigation – Global positioning system- Different types of microwave antennas-basic principles.

Applications:

- Used in ground and space communication applications

- Used in GPS, satellite and military warfare.

Learning outcomes:

At the end of the unit, the Student will be able to

- Explain the working principle of given type of RADAR (L2)
- List the applications of direction finders (L1).
- Apply radar principles in positioning and navigation (L3)

Text Books

1. Microwave devices and circuits Samuel Liao, PHI.
2. Introduction to radar systems — Merrill I Skolnik, McGraw Hill.

Reference Books

1. Microwave and Radar Engg. — M Kulkarni.
2. Microwave and Radar Engineering — Gottapu Sasibhushana Rao, Pearson Education India, 2014.

Subject Code	Subject Name	L	T	P	C
R20ECE-PCE3201.5	Advanced Signal Processing **(Professional Elective-2)**	3	0	0	3

Course Objectives:

- To learn and understand the concepts of stationary and non-stationary random signals andanalysis & characterization of discrete-time random processes
- To enunciate the significance of estimation of power spectral density of random processes
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication engineering
- To introduce the concepts of multi-rate signal processing techniques

Course Outcomes:

At the end of the course, the student should be able to:

1. Apply the concepts of special random processes in practical applications (L3)
2. Choose appropriate spectrum estimation techniques for a given random process (L3)
3. Apply optimum filters appropriately for a given communication application (L3)
4. Apply appropriate adaptive algorithm for processing non-stationary signals (L3)
5. Apply the multirate signal processing techniques for signal and image processing basedapplications (L3)

UNIT-I

Discrete-Time Random Processes: Random variables - ensemble averages a review, random processes -ensemble averages, autocorrelation and autocovariance matrices, ergodic random process, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA

Learning outcomes:

At the end of this unit student will able to

- Apply Fourier transform to obtain frequency spectrum of periodic and aperiodic signals (L3)
- Understand the functions of a basic random processs (L2)
- Understand the DSP system with consideration of AR, MA, ARMA random processes (L2)

UNIT-II

Spectrum Estimation: Bias and consistency, Non-parametric methods - Periodogram, modified- Periodogram - performance analysis.Bartlett's method, Welch's method, Blackman-Tukey method.Performance comparison.Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

Learning outcomes:

At the end of this unit student will able to

- Understand the concepts of Non-parametric methods (L2).
- Apply various parmetric methods such as Auto regressive etc to spectral estimation of signal (L3).

UNIT-III

Optimum Filters: Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.

Learning outcomes:

At the end of this unit student will able to

- Explain the FIR and IIR filters are converted as optimum filters (L2).

- Develop the causal and non-causal filters (L3)

UNIT-IV

Adaptive Filters: Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms

- steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noisecancellation, channel equalization.

Learning outcomes:

At the end of this unit student will able to

- Apply the LMS algorithm for random signals filtering process. (L3).
- List the applications of adaptive filters (L1).
- Apply noise cancellation and channel equalization techniques in communication system (L3).

UNIT-V

Multirate Digital Signal Processing: Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion Multirate Digital Signal Processing Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Band pass Signals.

Learning outcomes:

At the end of this unit student will able to

- Analyze the importance of Rational factor (I/D) for given DSP system (L4).
- List the applications of Multirate signal processing (L2).

Text Books

1. John G. Proakis&Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications¦, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.

Reference Books

1. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993

Subject Code	Subject Name	L	T	P	C
R20CSE-OE3201	Computer Networks **(Open Elective-2)**	3	0	0	3

Course Objectives:

- To understand the network architecture and applications.
- To understand about the basic Networking Components and their functionality.
- To understand the functionalities of the Data Link Layer.
- To understand the protocols for data transfer.
- To analyse different protocols and architecture of IEEE 802.11

Course Outcomes:

At the end of this course, student will able to

1. Understand and Compare the Reference Models (L2).
2. Identify the Network Components and learn about their functionality (L3).
3. Analyze the services provided by the Data Link Layer to the Network Layer (L4).
4. Compare the MAC Layer protocols with respect to their performance (L4).
5. Understand the architecture of IEEE 802.11 (L2).

UNIT-I

Introduction: Components of a Data Communication system, Dataflow , Network Topologies LAN,MAN,WAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model

Applications:

- Conceptual Framework of a Network, ATM, Online reservation systems, reservation systems.

Learning Outcomes:

At the end of this unit student will able to

- Understand the components involved to form a Computer Network (L2).
- Understand the data flow in a Computer Network and the use of protocols (L2)
- Explain the importance of each layer in the reference models (L2).

UNIT-II

Physical Layer and overview of PL Switching: **Transmission Media**: Guided, Unguided. Bandwidth, throughput, Latency.

Multiplexing: frequency division multiplexing, wave length division multiplexing, synchronous timedivision multiplexing, statistical time division multiplexing.

Applications:

Identify the use of different devices in real time computer networks and data processing tasks.

Learning Outcomes:

At the end of this unit student will able to

1. Understand the Connecting Devices (L2).
2. List different types of Multiplexing (L2).
3. Understand the performance metrics of a Network (L2).

UNIT-III

Data Link Layer Design Issues: Data link layer: Design issues, Framing: fixed size framing, variable size framing, flow control, error control, error detection and correction, CRC, Elementary Data Link Layer protocols: simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. Sliding window protocol: One bit, Go back N, Selective repeat-Stop and wait protocol, Data link layer in HDLC: configuration and transfer modes, frames, control field, point to point protocol (PPP): framing transition phase, multiplexing.

Applications: Error correction and detecting procedures on binary data.

Learning Outcomes:

At the end of this unit student will able to

- Understand Data Link Layer Services to the Network Layer (L2)
- Compare various types of Error Correction and Detection techniques (L4)
- Apply Detecting Codes for sample data (L3)

UNIT-IV

Random Access: ALOHA, MAC addresses, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance Network Layer: Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing.

The Transport Layer: addressing, establishing a connection, releasing connection, flow control andBuffering and crash recovery, End to end protocols: UDP.

Applications: It is used to connect various types of networks.

Learning Outcomes:

At the end of this unit student will able to

- Understand the MAC layers with various types of protocols (L2).
- Compare various types of CSMA techniques. (L4)
- Distinguish between multi-cast and broadcast routing techniques. (L4)

UNIT-V

Application layer (WWW and HTTP): ARCHITECTURE: Client (Browser), Server, Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format.

Applications: Used to implement web developments based system.

Learning Outcomes:

At the end of this unit student will able to

- Understand the architecture of application layer (L2)
- Understand the concept of HTTP operation model and client/server communication (L2)

Text Books

1. Data Communications and Networking ,Behrouz A Forouzan,Fourth Edition.
2. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010

Reference Books

1. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGrawHill Education.
2. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5th ed),Morgan Kaufmann/ Elsevier, 2011

Subject Code	Subject Name	L	T	P	C
R20CSS-OE3201	Data Structures with Java **(Open Elective-2)**	3	0	0	3

Course Objectives:

- Understand and implement data structures using Java.
- Analyze the time and space complexity of data structures.
- Develop efficient solutions to real-world computational problems.
- Gain hands-on experience with Java-based data structures.

Course Outcomes:

The student will be able to

1. Explain and implement fundamental data structures in Java.
2. Apply appropriate data structures for problem-solving.
3. Compare different data structures in terms of efficiency.
4. Implement data structures using Java's Collection Framework.

UNIT-I

Introduction to Java and Data Structures

Introduction to Java programming: Object-oriented concepts, Exception handling, File handling, Java Collections Framework (Lists, Sets, Maps), Complexity Analysis (Big-O Notation), Time and Space Complexity, Importance of Data Structures.
Applications: Understanding the need for efficient data structures in real-world applications like search engines, databases, and AI.

Learning Outcomes:

At the end of the module, students will be able to:

- Explain the fundamentals of Java programming and object-oriented principles (L2).
- Identify the importance of data structures in software development (L2).
- Apply complexity analysis techniques to evaluate algorithm efficiency (L3).

UNIT-II

Arrays and Linked Lists

Arrays: Static vs Dynamic Arrays, Multi-dimensional Arrays, Array operations.
Linked Lists: Singly Linked List, Doubly Linked List, Circular Linked List, Java's ArrayList and Linked List implementations.
Applications: Implementing data structures in Java programs for handling large datasets efficiently.

Learning Outcomes:

At the end of the module, students will be able to:

- Differentiate between arrays and linked lists (L2).
- Implement various linked list operations using Java (L3).
- Analyze and compare the performance of arrays and linked lists in different scenarios (L4).

UNIT-III

Stacks and Queues

Stack: Stack operations, Implementation using arrays and linked lists, Applications (Expression evaluation, Parenthesis balancing).
Queue: Types of Queues (Simple, Circular, Priority, Deque), Implementation and Applications.
Java's Stack and Queue classes.
Applications: Implementing undo-redo functionality, job scheduling, and memory

management.

Learning Outcomes:

At the end of the module, students will be able to:

- Implement stack and queue operations in Java (L3).
- Apply stacks and queues for solving real-world problems (L3).
- Compare different queue implementations and their use cases (L4).

UNIT-IV

Trees and Graphs

Trees: Binary Tree, Binary Search Tree (BST), Tree Traversal (Inorder, Preorder, Postorder), Balanced Trees (AVL, B-Trees).

Graphs: Representation (Adjacency Matrix & List), Graph Traversal (BFS, DFS), Shortest Path Algorithms (Dijkstra's, Floyd-Warshall).

Applications: Designing hierarchical structures like file systems, social networks, and web crawlers.

Learning Outcomes:

At the end of the module, students will be able to:

- Construct binary search trees and perform traversals (L3).
- Implement graph algorithms using Java (L3).
- Analyze the efficiency of various tree and graph operations (L4).

UNIT-V

Sorting, Searching, and Hashing

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort.

Searching: Linear Search, Binary Search, Interpolation Search.

Hashing: Hash Tables, Hash Functions, Collision Handling (Chaining, Probing).

Applications: Efficient searching and sorting in databases, caching, and indexing.

Learning Outcomes:

At the end of the module, students will be able to:

- Implement and compare different sorting techniques in Java (L3).
- Apply searching algorithms to optimize data retrieval (L3).
- Utilize hashing techniques for efficient data storage and retrieval (L3).

Text Books:

1. **Robert Lafore**, *Data Structures and Algorithms in Java*, Pearson Education.
2. **Mark Allen Weiss**, *Data Structures and Algorithm Analysis in Java*, Pearson Education.

Reference Books:

1. **Herbert Schildt**, *Java: The Complete Reference*, McGraw-Hill.
2. **Robert Sedgewick & Kevin Wayne**, *Algorithms, 4th Edition*, Addison-Wesley.

Subject Code	Subject Name	L	T	P	C
R20CIT-OE3201	Introduction to Artificial Intelligence **(Open Elective-2)**	3	0	0	3

Course Objectives:

- To familiarize with basic principles of AI towards problem solving, inference, perception,knowledge representation, and learning.
- To elucidate the basic knowledge representation, problem solving, and learning methods ofArtificial Intelligence.
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving particular engineering problems
- To familiarize the importance of AI and planning in solving the problems.
- To introduce various Machine learning techniques in Artificial Intelligence.

Course Outcomes:

At the end of the module, students will be able to:

1. Understand the history of Artificial Intelligence (AI) and various AI environments (L2).
2. Apply basic principles of AI in solutions that require problem solving, perception, knowledgerepresentation, and learning (L3).
3. Explain the knowledge based representation and reasoning in AI agents (L2)
4. Illustrate the importance of artificial intelligence and planning in solving real world problems(L2).
5. Compare various types of Machine learning techniques with the inclusion of applications (L2).

UNIT-I

Introduction: Philosophy of artificial intelligence, Definitions - Evolution of AI - Applications of AI, Classification of AI- Intelligent Agents: Agents and Environment-Nature of Environment-Structure Environment.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the importance of AI. (L2)
- Illustrate the applications of AI (L2)

UNIT-II

Searching Based Problem Solving: Problem Solving Agent - Blind Search- Performance measures - Informed Search: Introduction to Heuristics-Variants of heuristic search-uniform cost, A*, Greedy - Overview of Hill Climbing –Simulated Annealing – Genetic Algorithms – Adversarial Search – Minimax, Alpha beta pruning

Learning Outcomes:

At the end of this unit, the student will be able to

- Apply mathematics and science in engineering applications. (L3)
- Apply various algorithms for digital image processing and computer vision. (L3)

UNIT-III

Knowledge Representation and Reasoning: Logical systems – Knowledge Based systems, Propositional Logic – Constraints, Predicate Logic– First Order Logic, Inference in First Order Logic, Ontological Representations and applications Knowledge representation and reasoning through logic

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the subject related concepts and contemporary issues in AI. (L2)
- Illustrate the applications of Knowledge representation. (L2)

UNIT-IV

Planning: Planning Problem – Planning with State Space Search – Partial order Planning – Planning and Acting in the Real World: Conditional Planning – Re-planning Agents, Robotics-Action

Learning Outcomes:

At the end of this unit, the student will be able to

- List the techniques and modern engineering tools for engineering practice (L1).
- Understand the problem solving techniques using Planning in real world (L2)

UNIT-V

Learning Systems: Machine learning, Forms of Learning – Types - Supervised, unsupervised, reinforcement Learning, Learning Decision Trees, soft computing- Artificial Neural Network.

Learning Outcomes:

At the end of this unit, the student will be able to

- Distinguish various Machine Learning algorithms and their limitations. (L4)
- Understand the application of Artificial Neural Networks (L2)

Text Books

1. David L. Poole and Alan K. Mack worth, "Artificial Intelligence: Foundations of ComputationalAgents", Second Edition, Cambridge University Press, 2017
2. Authors, book title, year of publication, edition number, press, place
3. Tom Mickiewicz & Josh Zheng,Getting started with Artificial Intelligence, Published byO'Reilly Media,2017

Reference Books

1. Aurelian Géron, Hands on Machine Learning with Scikit-Learn and Tensor Flow [Concepts,Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media, 2017.
2. Elaine Rich, Kevin Knight and Shiv Shankar B. Nair, Artificial Intelligence, 3rd edition, TataMcGraw Hill, 2009.

Subject Code	Subject Name	L	T	P	C
R20EEE–OE3201	Power Electronics **(Open Elective-2)**	3	0	0	3

Course Objectives:

- To study the characteristics of power semiconductor devices and the TURN ON and TURN OFFprocess of the switches.
- To study the process of converting fixed AC to variable DC using thyristor as a switch.
- To analyze the process for step down and step up the DC voltage.
- To study and analyze the operation of 1-Φ and 3-Φ voltage source inverter.
- To analyze the operation of AC-AC converters.

Course Outcomes:

After completion of the course, the student will be able to

1. Analyze the characteristics of power semiconductor devices and the process of Turn-on andTurn-off semiconductor switches. (L4)
2. Design the controlled rectifier circuits with R and RL-Loads. (L3)
3. Design the DC to DC choppers. (L3)
4. Analyze the operation of AC-AC converters. (L4)
5. Explain the operation of single and their phase voltage source inverters. (L2)

UNIT-I

Power Semiconductor Switching Devices: Silicon controlled rectifiers (SCR), Static and Dynamic characteristics of SCR; Gate characteristics of SCR; SCR Turn-on and Turn-off methods; Snubber CircuitTransistor Family: Power MOSFET, Power IGBT

Learning outcomes:

After completion of the unit, the student will be able to

- Examine the characteristics of power semiconductor switching devices. (L3)
- Design the gating circuits for thyristors, MOSFET and IGBT. (L3)

UNIT-II

AC-DC Controlled rectifiers: Single-phase half-wave controlled rectifier with R and RL load with and without freewheeling diode; Single-phase full-wave controlled rectifiers: center tapped and Bridge configurations with R, RL and RLE load with and without freewheeling diode; Single phase semi controlled rectifier with R, RL and RLE load; Effect of source inductance in single phase fully controlled bridge rectifier with continuous conduction; Dual Converters; Three phase controller rectifiers-Three phase half wave and full wave-controlled rectifiers with R and RL loads, Three phase semi-converter
;Numerical Problems.

Learning outcomes:

After completion of the unit, the student will be able to

- Understand the operation of single-phase controlled rectifiers (L2)
- Understand the operation of three phase-controlled rectifiers (L2)

UNIT-III

DC-DC Choppers: Elementary chopper-Duty ratio-control strategies: time ratio control and current limit control-Analysis of Buck, Boost, and Buck-Boost converters in continuous and discontinuous conduction modes of operation-output voltage equations-inductor current and output voltage ripple-Critical inductance and capacitances-Numerical Problems

Learning outcomes:

After completion of the unit, the student will be able to

- Understand the operation of different types of DC-DC converters (L2)
- Explain the operation of buck, boost and Buck-Boost converters (L3)

UNIT-IV

AC Voltage Controllers and Cycle Converters: Single-phase AC-AC regulator-phase angle control and integrated cycle control with R and RL load – For continuous and discontinuous conduction- 3-Phase AC- AC regulators with R load only-single phase cyclo-converter with R load.

Learning outcomes:

After completion of the unit, the student will be able to

- Analyze the operation of the voltage regulator (L4).
- Understand the concept of cyclo-converter (L2).

UNIT-V

Inverters: Single-phase voltage source inverter-single phase half bridge and full bridge inverters with R and RL load-Fourier Analysis of single-phase inverter output voltage-Three phase square wave inverters-120^0 conduction and 180^0 conduction modes of operation-PWM inverters-modulation index- Multi-level Inverter: Five Level Diode Clamped Inverter only; Numerical Problems

Learning outcomes:

After completion of the unit, the student will be able to

- Understand the operation of single-phase inverter with square wave modulation. (L2)
- Explain the operation of voltage source inverter with sinusoidal modulation. (L2)
- Compare the voltage waveforms at different switching states of the VSI inverter. (L2)

Text Books

1 Power Electronics – by P.S.Bhimbra, Khanna Publishers.

2 M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

Reference Books

1 R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2007.

2 N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", JohnWiley & Sons, 2007.

Web Resources:

1 https://swayam.gov.in/nd1_noc20_ee97/preview

2 https://nptel.ac.in/courses/108/105/108105066/

Subject Code	Subject Name	L	T	P	C
R20MEC–OE3201	3D Printing **(Open Elective-2)**	3	0	0	3

Course Objectives:

- To exploit the technology used in 3D prinitng.
- To introduce liquid based 3D printing systems
- To understand importance of 3D printing in advanced manufacturing process.
- To acquire knowledge, techniques and skills to select relevant 3D Printing process.
- To explore the potential of 3D Prinitng in different industrial sectors.

Course Outcomes

After completion of the Course, the student will be able to

1 Illustrate the importance of 3D printing in Manufacturing (L2)
2 Understand the liquid-based 3D printing systems(L2)
3 Illustrate the solid-based 3D printing systems (L2)
4 Explain the powder based 3D printing systems (L2)
5 Summarize the application 3D printing in various fields (L2)

UNIT – I

Introduction: 3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Other Related Technologies Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology, Other Associated Technologies, The Use of Layers, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World.

Learning outcomes:

At the end of the unit, the student will be able to:

- Compare between 3D printing and CNC Machining (L2)
- Explain the various 3D printing Processes (L2)

UNIT-II

Liquid-Based 3D Printing Systems: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Learning outcomes:

At the end of the unit, the student will be able to:

- Understand the Basic Principle of Liquid based systems.(L2)
- Explain the working process of Stereo lithography .(L2)
- Explain the working process of Solid Ground Curing (L2)

UNIT-III

Solid-Based 3D Printing Systems: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Learning outcomes:

At the end of the unit, the student will be able to:

- Elucidate the Basic Principle of Solid based systems.(L2)
- Explain the working process of Laminated object manufacturing. (L2)
- Explain the working process of Fused deposition modelling. (L2)

UNIT – IV

Powder Based 3D Printing Systems: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Learning outcomes:

At the end of the unit, the student will be able to:

- Illustrate the working principle of 3D printing machine.(L2)
- Explain the working principle of Selective laser sintering.(L2)
- Explain the working principle of Three dimensional printing.(L2)

UNIT-V

Medical Applications & Future Direction For 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions

Learning outcomes:

At the end of the unit, the student will be able to:

- Outline various real-life applications of 3D printing (L2)
- Summarize the suitable types of materials used in 3D printing (L2)

Text Books

1 Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.

2 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.

Reference Books

1 Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.

2 Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.

Online resources:

1 https://www.nist.gov/additive-manufacturing
2 https://www.metal-am.com/
3 http://additivemanufacturing.com/basics/
4 https://www.3dprintingindustry.com/
5 https://www.thingiverse.com/
6 https://reprap.org/wiki/RepRap

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3204	Microprocessors And Microcontrollers Lab	0	0	3	1.5

Course Objectives:

- To impart the basic instructions of 8086 microprocessor for implementation of arithmetic,logical, BCD and ASCII operations.
- To demonstrate various string, branching and process control instructions for implementation ofdifferent array-based operations.
- To explain the mechanism of DOS based interrupt handling service and interfacing peripheralcontrol ICs like 8255 and 8259 with demonstrated examples.
- To explain the procedure of interfacing 8051 microcontroller with timers, parallel ports.
- To demonstrate the usage of 8051 as embedded controller with real world applications like trafficlight, LCD etc.

Course Outcomes:

At the end of the course, the student will be able to:

1. Use the knowledge of Assembly language and assembler directives for programming in 8086 and 8051 with focus towards their limited arithmetic operations. (L3)
2. Experiment with the knowledge of 8086 string operations towards different data structures applications.(L3)
3. Apply DOS/BIOS services and Peripheral Control ICs in utilizing different input and output feature of a 8086 based microcomputer system.(L3)
4. Use the 8051 feature stop roduce Delay and Interrupt functions needed for a embedded system design.(L3)
5. Demonstrate real world applications with peripherals interfacing to a 8051 microcontroller.(L3)

List of Experiments

Intel 8086 (16-bit Microprocessor)-

Assembly Language Programming using MASM/TASM.

1 Perform simple arithmetic operations.
2 Construct program for Addition of an array of BCD numbers stored in packed form.
3 Implement Sorting an array of random 8-bit binary numbers.
4 Produce the reverse of the given string.
5 Show the logic work of Deleting a Character from a String.
6 Convert ASCII code to packed BCD code.
7 Make use of DOS/BIOS functions to convert BCD code to 7-Segment Display code.
8 Demonstrate the DOS/BIOS functions in reading the key strokes with echo.
9 Utilize 8255 to program the working of Stepper Motor.
10 Interfacing with a 8259 interrupt controller.
11 Implementation of A/D and D/A Converters

Intel 8051 (8-bit Microcontroller)-

Assembly Language and C Programming experiments usingKeil uvision IDE.

1 Demonstrate Delay generation Methods.
2 Utilize the timer function and interrupts to count external events.
3 Demonstrate the working of Elevator model using 8051 microcontroller.
4 Implement the function of traffic signal model using 8051 microcontroller.
5 Display the given message on LCD.

Text Books

1 K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition,McGraw HillEducation, 2017.
2 Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System

Design,2nd edition, Pearson, 2012.

References

1 D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition.

2 Microcontrollers and application, Ajay. V. Deshmukh, TMGH,2005.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3205	Digital Signal Processing Lab	0	0	3	1.5

Course Objectives:

- Explain the DSP processor architecture and signal processing tools
- Study the linear and circular convolution methods for discrete time LTI systems.
- Demonstrate the analog and digital filters (IIR, FIR)based on the modes (Low pass, High pass) ofoperations.
- Examine the spectral analysis of a signal using N-point Fast Fourier Transform (FFT) algorithmand power spectral density.
- Study of various DSP Processors.

Course Outcomes:

At the end of the course, student will be able to:

1 Outline the TMS 320C 5X/6X processor architecture & its instructions and demonstrate the working environment of MATLAB & CC Studio for signal processing applications (L2)

2 Understand the handling of discrete/digital signals using MATLAB and analyze the response ofdiscrete time LTI systems using linear and circular convolution methods (L2).

3 Make use of windowing techniques such as Rectangular, Triangular and Kaiser to develop FIRfilters (L3).

4 Build analog and IIR low pass and high pass filters (L3).

5 Apply the N-point Fast Fourier Transform (FFT) algorithm on one dimensional signals andanalyze the power spectral density of a given signals (L3).

List of Experiments

Minimum of Ten Experiments has to be implemented in software Using MATLAB / CC Studio

1 To study the architecture of DSP chips – TMS 320C 5X/6X Instructions.

2 To generate basic elementary signals like unit impulse, unit step, unit ramp signal andExponential signals using MATLAB

3 To find Impulse response of first order and second order systems

4 To verify linear convolution

5 To find frequency response of a given system given in (Transfer Function/ Differential equationform).

6 To verify the circular convolution.

7 To design FIR filter (LP/HP) using windowing technique
   - Using rectangular window
   - Using triangular window
   - Using Kaiser Window

8 To design IIR filter using butter worth technique.

9 To find DFT / IDFT of given Discrete Time signal

10 MATLAB program to generate sum of sinusoidal signals

11 MATLAB program to find frequency response of analog LP/HP filters

12 Determination of Power Spectrum of a given signal(s)

13 Implementation of Decimation, Interpolation Process

14 Implementation of I/D sampling rate converters.

Text Books

1 Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis,DimitrisG.Manolakis, Pearson Education / PHI, 2007.

2 Fundamentals of Digital Signal Processing using Matlab – Robert J.Schilling, Sandra L. Harris,Thomson, 2007

Reference Books

1 Digital Signal Processors – Architecture, Programming and Applications, B.Venkataramani,M.Bhaskar, TATA McGraw Hill, 2002.

2 Digital Signal Processing – K Raja Rajeswari, I.K. International Publishing House.

Subject Code	Subject Name	L	T	P	C
R20ECE-PC3206	VLSI Design Lab	0	0	3	1.5

Course Objectives:

- To Train on mentor graphics environment for design of VLSI circuits
- To design different VLSI circuits using Mentor Graphics Tool.
- To draw corresponding layout to perform simulation and verification of designed circuits.
- To familiarize the design rules in layout drawing in tool.
- To perform LVS and analyze the performance metrics of designed circuits.

Course Outcomes:

At the end of the course, student will be able to:

1 Understand the environment of mentor graphics and its design flow (L2)
2 Design of CMOS logic circuits and analyze the parameters (L3)
3 Design of the layout of digital circuits (L3)
4 Apply the design rules and analyze their significance on MOS circuits (L3)
5 Develop custom logic circuits/systems (L3)

List of Experiments

Minimum of Ten Experiments has to be conducted

1 Design and Implementation of an Inverter
2 Design and Implementation of Universal logic Gates
3 Design and Implementation of XOR Gate using NAND/NOR logic
4 Design and Implementation of Half Adder and Half Subtractor
5 Design and Implementation of Full Adder
6 Design and Implementation of Full Subtractor
7 Design and Implementation of multiplexer
8 Design and Implementation of Decoder
9 Design and Implementation of RS-Latch
10 Design and Implementation of JK Flip-flop
11 Design and Implementation of D Flip-flop
12 Design and Implementation of Static RAM Cell
13 Design and Implementation of Asynchronous counter
14 Design and Implementation of Shift Register

Subject Code	Subject Name	L	T	P	C
R20ECE-SC3201	High Frequency and Antenna Engineering Lab **(Skill Oriented Course)**	0	1	2	2

Course Objectives:

- To familiarize the design and simulation various antennas and microwave components using anEM solver.
- To estimate the antenna performance using various metrics in the EM solver.
- To understand various microwave sources and components involved in Microwave Bench setupfor Microwave measurements.
- To utilize Electromagnetic solver for the functional verification of various microwave components.
- To identify suitable microwave component for wave propagation.

.Course Outcomes:

At the end of the course, student will be able to:

1 Design the experimental setup to measure the signal conditioning/controlling characteristics ofvarious microwave devices using bench setup (L3).
2 Design the microwave components and analyze the wave propagation modes (L3).
3 Design various antennas andanalyze the performanceof the antenna model as per the requiredoperating characteristics (L3).
4 Design of wire type, miniaturized printed antennasfor the given specifications, to measure itsparameters through simulation (L3).
5 Design of printed antennas and wire monopoles (helical) Circular Polarized radiation and Highgain applications (L3).

List of Experiments:

Minimum of Ten Experiments has to be performed

Part-A Microwave Engineering (Any Five experiments)

1 Reflex Klystron Characteristics.
2 V-I characteristics of Gunn Diode
3 Directional Coupler Characteristics.
4 Attenuation Measurement
5 Scattering parameters of Circulator.
6 Scattering parameters and study of power division in Magic Tee.
7 Design of Microstrip Power divider (with EM Solver).
8 Design of Rectangular and Circular waveguides for X-band (with EM Solver).

Part-B Antenna Design and Simulation (with EM Solver). (Any Five experiments)

1 Design and Study of Ultra-High Frequency (UHF) Dipole Antenna.
2 Design of Rectangular Patch Antenna with Probe feed for 2.4 GHz WLAN application.
3 Design of Meander line antenna for 2.4 GHz.
4 Design of Circularly Polarized Patch Antenna with Microstrip Line Feed.
5 Design and analysis of a Monofilar Helical Antenna
6 Design and Study of broadside & endfire UHF dipole antenna array.
7 Design and Analysis of Conical Horn Antenna

Equipment required for Laboratories:

1 Regulated Klystron Power Supply, Klystron mount
2 VSWR Meter
3 Micro Ammeter
4 Multi meter
5 CRO
6 GUNN Power Supply, Pin Modulator

7 Crystal Diode detector
8 Microwave components (Attenuation)
9 Frequency Meter
10 Slotted line carriage
11 Probe detector
12 Wave guide shorts
13 SS Tuner
14 Directional Coupler
15 E, H, Magic Tees
16 Circulators, Isolator
17 Matched Loads
18 Ansys HFSS Software

Subject Code	Subject Name	L	T	P	C
R20BSH-MC3201	Intellectual Property Rights & Patents **(Mandatory Course)**	2	0	0	0

Course Objectives:

- To impart knowledge of Intellectual property rights on trademarks, copyrights and patents andalso agencies responsible for IPR
- To create the awareness of copyright law and various rights acquired by the owner or originalcreators.
- To illustrate the patent law, registration process and grants, protects in India and abroad.
- To explain the significance of trademark and service mark in business Organisations and itsinfringement.
- To assess and maintain the protection of trade secret in the organisation and also emerging trendsin cyber security and cybercrimes.

Course Outcomes:

At the end of the course, student will be able to:

1. Elaborately discussed basics of Intellectual Property Law(L2)
2. Evaluate rights ,principles and infringement of Copy rights(L2)
3. Analyse requirements for registration and International laws of Patents (L4)
4. Determine Trade mark registration process and global factors (L3)
5. Discuss confidentiality agreement,litigation related to Tradesecret (L2)

UNIT-I

Introduction to Intellectual Property Rights (IPR): Introduction to IPRs, Basic concepts and need for Intellectual Property – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR. IPR Tool Kit - Agencies for IPR Registration – Emerging trends in IPR - Use and Misuse of IntellectualProperty Rights

Application: Applicability and relativity between elements of Intellectual property rights and creatinginnovative ideas.

Learning Outcomes:

At the end of this unit student will be able to:

- Understand the knowledge about the elements of IPR (L2)
- Learn International Instruments and emerging areas of IPR (L1)
- List the Agencies responsible for Registration and laws related to IPR (L1)

UNIT-II

Copyrights and Neighboring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to CopyrightsSubject Matters of Copyright – Copyright Ownership – Transfer and Duration. Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Semiconductor Chip Protection Act.

Application: Practice of copyrights case and Identification of the infringement to the owner of the copyright.

Learning Outcomes:

At the end of this unit student will be able to:

- Understand how one can generate economic wealth through copyrights (L2)
- Understand the importance of protection, promotion and enforcement of copy rights (L2)
- List the limitations and Infringement of Copyrights (L2)

UNIT-III

Patents: Introduction to Patents - Laws Relating to Patents in India – Patent

Requirements – PatentSearch - Patent Registration and Granting of Patent - Ownership and Transfer — Infringement of Patent -Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – SoftwareProtection and Computer related Innovations.

Application: Checking the eligibility for several patents and suggest remedies for problems through casestudy.

Learning Outcomes:

At the end of this unit student will be able to:

- Demonstrate the registration process of Patents (L2)
- Understand the infringement of patents and their remedies (L2)
- Contrast Patents, Software protection and Computer related Innovations (L2)

UNIT-IV

Trademarks: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies- Case study.

Application: Compare and contrast different trademarks and know how to register trademark

Learning Outcomes:

At the end of this unit student will be able to:

- Demonstrate registration and maintenance of trademarks (L2)
- Illustrate procedure for trademark claims (L2)
- Understand transfer of rights in Trademarks (L2)

UNIT-V

Trade Secrets & Cyber Law: Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Confidentiality Agreements – Breach of Contract – Trade Secret Litigation .

Cyber Law and Cyber Crime: Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - Cyber Crimes - Prevention and Punishment - Case study.

Application:

- Adapt how to protect trade secret physically and from the employees of the organization.
- Choose and exhibit various securities to access like biometrics, login passwords, facialrecognition, UID number, which protects the individual properties

Learning Outcomes:

At the end of this unit student will be able to:

- Understand the level of physical security (L2)
- Outline Employee Confidentiality Agreements (L2)
- Explain about the prevention and punishment of cybercrimes (L2)
- Understand the various levels of liability of network providers (L2)

Text Books:

1 Fundamentals of IPR for Engineers- Kompal Bansal &Parishit Bansal, B. S. Publications,2013

2 Intellectual Property -Deborah E.Bouchoux ,Cengage Learning, New Delhi.,2012

References Books:

1 Intellectual property rights- PrabuddhaGanuli., Tata Mcgraw hill, 2012.

2 V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

Web links:

1 http://www.ipindia.gov.in/patents.htm

2 http://www.ipindia.gov.in/trade-marks.htm

3 https://copyright.gov.in/
4 http://www.wipo.int/portal/en/index.html
5 https://indiankanoon.org/