Complete Scheme for 2021-22 Admitted batch of students for 160 credits

First Semester

Course Category	Course Code	Course Title	L-T-P	Credits	Contact hours
BSC	22PH101	Engineering Physics	4-0-0	4	4
BSC	22MA102	Calculus and Numerical Methods	3-1-0	4	5
ESC	22EE103	Basic Electrical Engineering	3-0-0	3	3
ESC	22MD104A/B	Engineering Drawing	1-0-2	3	6
ESC	22CV105	Engineering Mechanics	3-0-0	3	3
BSC	22PH106	Engineering Physics Laboratory	0-0-1	1	2
HSMC	22PE107	Physical Education Activity (PEA)	0-0-1	1	2
AEC	21DT208	Design Thinking Laboratory	0-0-1	1	2
		Total		20	27

Second Semester

Course Category	Course Code	Course Title	L-T-P	Credits	Contact hours
BSC	22CH201	Engineering Chemistry	4-0-0	4	4
BSC	22MA202	Differential Equations & Vector calculus	3-1-0	4	5
ESC	22EC203	Basic Electronics Engineering	3-0-0	3	3
ESC	22ME204	Elements of Mechanical Engineering	3-0-0	3	3
ESC	22CS205	Programming for Problem Solving	4-0-0	4	4
BSC	22CH206	Engineering Chemistry Laboratory	0-0-1	1	2
ESC	21CS207	Computer Programming Laboratory	0-0-1	1	2
		Total		20	23

THIRD SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
BSC	**21MA301**	**Linear Algebra and Integral Transforms**	**2-1-0**	**3**	**4**
PC	21EC302	Analog Electronic Circuits	3-0-0	3	3
PC	21EC303	Digital Electronics	3-0-0	3	3
PC	21EC304	Network Analysis(Integrated)	3-0-1	4	5
PC	21EC305	Linear ICs and Applications	3-0-0	3	3
PC	21EC306	Analog and Linear Integrated Circuits Laboratory	0-0-1	1	2
PC	21EC307	Digital Electronics Laboratory	0-0-1	1	2
HSMC	**21KNS/ KNB**	**Samskrutika Kannada/ Balake Kannada (Group A)**	**1-0-0**	**1**	**2**
			Total	**19**	**24**

FOURTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
BSC	21MA401	**Statistics and Probability**	**2-1-0**	**3**	**4**
PC	21EC402	Analog Communication and Switching Systems	3-0-0	3	3
PC	21EC403	Signals and systems(integrated)	3-0-1	4	5
PC	21EC404	Microcontroller and applications	3-0-0	3	3
PC	21EC405	Electromagnetic Field Theory and Transmission lines	3-0-0	3	3
PC	21EC406	Microcontroller Laboratory	0-0-1	1	2
PC	21EC407	Communication Laboratory	0-0-1	1	2
AEC	**21BEEC408**	**Biology for Engineers**	**1-0-0**	**1**	**2**
UHV	**21UHV**	**Universal Human Values (Group A)**	**1-0-0**	**1**	**2**
PI	**21ECINT1**	**Summer Internship –I**	**0-0-1**	**2**	**15**
			Total	**22**	**41**

FIFTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PC	21EC501	Hardware Description Language (Integrated)	3-0-1	4	5
PC	21EC502	Internet of Things (Integrated)	3-0-1	4	5
PC	21EC503	Antenna and Propagation	3-0-0	3	3
PC	21EC504	Digital Communication	3-0-0	3	3
PC	21EC505	Information theory and Cryptography	3-0-0	3	3
PC	21EC506	Advanced Communication Laboratory	0-0-1	1	2
PI	**21INT2**	**Summer Internship -II**	**0-0-1**	**3**	15
UHV	**21SCR**	**Social Connect and Responsibility**		**1**	
HSMC	**21EVS**	**Environmental Studies (Mandate non-credit course) (Group – A)**	**0-1(A)-0**	**AUDIT**	**2**
			Total	**22**	**40**

SIXTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
HS	21EC601	Entrepreneurship and Management	3-0-0	3	3
PC	21EC602	VLSI Circuits	3-0-0	3	3
PC	21EC603	Digital Signal Processing	3-0-0	3	3
PC	21EC604	Optical Fiber Communication	3-0-0	3	3
PE	**21EC6XX**	**Professional Elective-I**	3-0-0	3	3
OEC	**21OEXX**	**Open Elective –I**	**3-0-0**	**3**	3
PC	21EC605	Digital Signal Processing Laboratory	0-0-1	1	2
PC	21EC606	VLSI Circuits Laboratory	0-0-1	1	2
OEC	**21SWY**	**SWAYAM (NPTEL only)**	**0-1(A)-0**	**AUDIT**	
AEC	**21ASK**	**Analytical Ability and Soft Skills**	**0-1-0**	**1**	**2**
HSMC	**21CIP**	**Constitution of India and Professional Ethics (Mandate non-credit course) (Group-A)**	**0-1(A)-0**	**AUDIT**	2
			Total	**21**	26

Professional Electives - I

PE	21EC651	Artificial Intelligence	3-0-0	3
PE	21EC652	Control Systems	3-0-0	3
PE	21EC653	Object Oriented Programming using Python	3-0-0	3
PE	21EC654	Data structures using C	3-0-0	3

Open Elective-I

OE	21OEEC61	MEMS & Nano Technology	3-0-0	3
OE	21OEEC62	Embedded System Design	3-0-0	3
OE	21OEEC63	Wireless Communication	3-0-0	3
OE	21OEEC64	Neural Networks and Fuzzy Logic	3-0-0	3

SEVENTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PC	21EC701	Embedded System Design	3-0-0	3	3
PC	21EC702	Wireless Communication (Integrated)	3-0-1	4	5
PC	21EC703	Embedded System Design Laboratory	0-0-1	1	2
PE	21EC7XX	Professional Electives-II	3-0-0	3	3
PE	21EC7XX	Professional Electives-III	3-0-0	3	3
OEC	**21OEXX**	**Open Elective -II**	**3-0-0**	**3**	**3**
AEC	**21RIP**	**Research Methodology & Intellectual Property rights (Mandatory non-credit)**	**0-1-0**	**AUDIT**	**2**
		Total		**17**	**21**

Professional Electives II

PE	21EC751	MEMS	3-0-0	3
PE	21EC752	Nanotechnology	3-0-0	3
PE	21EC753	Network Security	3-0-0	3
PE	21EC754	Internet Protocol Engineering	3-0-0	3

Professional Electives III

PE	21EC755	Digital Image Processing	3-0-0	3
PE	21EC756	Automotive Electronics	3-0-0	3
PE	21EC757	Microwave and Radar	3-0-0	3
PE	21EC758	Satellite Communication	3-0-0	3

Open Elective-II

OE	21OEEC71	Sensors and Actuators	3-0-0	3
OE	21OEEC72	Quantum Information Theory	3-0-0	3
OE	21OEEC73	Digital Image Processing	3-0-0	3
OE	21OEEC74	Big Data Analysis	3-0-0	3

EIGHTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PI	**21PROJ**	**Project work**	**0-0-10**	**10**	**20**
PI	**21INT3**	**Research / Industry Internship -III**	**0-0-09**	**09**	**18**
		Total		**19**	38

Year	Semester	Credits
BE 2nd year	III	19
	IV	22
BE 3rd Year	V	22
	VI	21
BE 4th year	VII	17
	VIII	19
	Total	120

Note :- 1. Total number of credits from 3rd semester to 8th semester = 120

MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous UG Program

Syllabus
of
V and VI Semester (THIRD YEAR 2021 ADMITTED BATCH)

Academic Year 2023-24

DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING

Hardware Description Language (Integrated)

Course Code : 21EC501 **LTPC: 3-0-1-4**

Exam Hours : 3 Hours / Week : 5

SEE: **50 Marks** Total hours : 40

Course Objective: The ability to code and simulate any digital function in Verilog HDL. Know the difference between synthesizable and non-synthesizable code. Understand library modeling, behavioral code and the differences between simulator algorithms and logic verification using Verilog simulation. Learn good coding techniques required for current industrial practices.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Apply the acquired knowledge of digital circuits in different levels of modeling using Verilog HDL.	1, 2
2.	Analyze the abstraction level, timing, and delay simulation for a digital system design.	1, 2
3.	Design and verify the functionality of digital circuit/system using test benches.	3, 5
4.	Develop the programs more effectively using directives, Verilog tasks and constructs taught in the classroom through experiments using suitable simulation software in the laboratory	1, 2 3,5,9

Course Contents:

MODULE-1	Teaching Hours
Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL? Trends in HDLs). Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. Lexical conventions, data types, system tasks, compiler directives.	**10Hours**
MODULE-2	
Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays.	**10Hours**
MODULE-3	
Modeling: Dataflow Modeling- Continuous assignments, delay specification, expressions, operators, operands, operator types. Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks. Tasks and functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.	**10Hours**
MODULE-4	
Useful Modeling Techniques: Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks. Timing and Delays- Distributed,lumped and pin-to-pin delays, specify blocks, parallel and full connection, timing checks, delay back-annotation.	**10Hours**

Text Books:

1. **Samir Palnitkar**, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.
2. **Kevin Skahill,** "VHDL for Programmable Logic", PHI/Pearson education, 2006.

Reference Books:

1. **Donald E. Thomas, Philip R. Moorby**, "The Verilog Hardware Description Language", Springer Science+Business Media, LLC, Fifth edition.
2. **Michael D. Ciletti**, "Advanced Digital Design with the Verilog HDL" Pearson (Prentice Hall), Second edition.
3. **Padmanabhan, Tripura Sundari,** "Design through Verilog HDL", Wiley, 2016 or earlier.

PRACTICAL COMPONENT OF HARDWARE DESCRIPTION LANGUAGE (Integrated Lab)

Conduct the following experiments using suitable simulation software

Exp No.	Experiments Title
I	**Programming**
1.	Verilog code to realize all the logic gates.
2.	Verilog program for Encoder without priority and with priority.
3.	Verilog code for Multiplexer, Demultiplexer, Comparator, Code converters.
4.	Verilog code to describe a Half Adder/Half Subtractor using different Modeling styles.
5.	Verilog code to describe a Full adder/Full Subtractor using different modeling styles.
6.	Verilog code for a) 4-bit parallel adder b)4-bit ALU/8-bit ALU.
7.	Verilog codes for SR, D, JK, T-flip-flops.
8.	Designing 4-bit Binary counter, BCD counter (Synchronous reset) and any arbitrary sequence counter.
9.	Designing 4-bit Binary counter, BCD counter (Asynchronous reset) and any arbitrary sequence counter.

ACTIVITIES

1. **Continuous Evaluation (Max. Marks:10):**
   a. **Objective:** To record and document the results of experiments conducted
   b. **Plan of Action:**
      - Each student must maintain observation and record for documenting the results.
      - Each experiment documented in the record must contain aim of the experiments, circuit, theory related to the experiment, theoretical calculation and results obtained.
      - Each experiment will be evaluated and will be averaged to 10 marks.

2. **Lab CIE (Max. Marks:10)**
   a. **Objective:** To conduct the experiments on the theoretical problems in the lab.
   b. **Plan of Action:**
      - Each student will be given an experiment to conduct.
      - Students must perform practical conduction of the experiment after getting approval from the concerned course faculty.
      - Document the results obtained and compare the theoretical and practical results.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√												
CO2	√	√												
CO3			√		√									
CO4	√	√	√		√				√					

•

INTERNET OF THINGS (integrated)

Course Code: 21EC502 **LTPC: 3-0-1-4**
Exam Hours : 3 Hours / Week : 5
SEE : **50 Marks** Lecture hours : 40 hours

Course Objective: Understanding of internet of things for several applications.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Explain the significance and application areas of the Internet of Things.	1
2.	Analyze different Protocols, key wireless technologies used in IOT systems, IOT system management.	1,2
3.	Perform logical design using python and use of Raspberry Pi in design of IOT systems.	1,2, 3 5
4.	Design and Implement IOT systems in the area of home automation, Agriculture, Cities, industries , pollution control etc.	3,5, 7

Course Contents:

MODULE-1	Teaching Hours
Introduction & Concepts- Introduction of IoT; Physical Design of IoT; Logical Design of IoT; IoT Enabling Technologies, IoT Levels & Deployment Templates . **Domain Specific IoTs**- Introduction, Home Automation; Cities; Environment; Energy; Retail; Logistics; Agriculture; Industry; Health & Lifestyle.	**10 Hours**
MODULE-2	
IoT and M2M, IoT System management with NETCONF-YANG -Introduction; M2M; Difference between IoT and M2M; SDN and NFV for IoT, Need for IoT Systems management; SNMP; Network Operator Requirements; NETCONF; YANG; IoT Systems management with NETCONF-YANF; NETOPEER. **IoT Developing Internet of Things: - IoT Platforms Design Methodology Systems-Logical Design using Python I** - Introduction; IoT Design Methodology; Case Study on IoT System for Weather Monitoring. Introduction; Installing Python; Python Data Types & Data structures; Control Flow.	**10 Hours**
MODULE-3	
IoT Systems- Logical Design using Python II and IoT Physical Devices - Functions, Modules, Packages, File Handling, Date/Time Operations ,Classes, Python Packages of Interest of IoT.What is an IoT device; Exemplary Device- Raspberry Pi; Linux on Raspberry Pi; Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Other IOT Devices. **IOT Physical Devices and Cloud Offerings -**, Introduction to cloud storage models and Communication APIs, WAMP, Xively cloud, Python web application framework	**10 Hours**

Designing RESTful Web APIs.	
MODULE-4	
Case Studies Illustrating IOT Design I: Introduction, Home Automation, Cities, Parking, Cities. **Case Studies Illustrating IOT Design II and Data Analytics for IOT:** Environment, Agriculture, Productivity Applications.	**10 Hours**

TEXT BOOK:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands on Approach",Universities Press, 2015

REFERENCE BOOK:

1. **Olivier Hersent, David Boswarthick, Omar Elloumi**, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.

PRACTICAL COMPONENT OF INTERNET OF THINGS (integrated)

Exp No.	Experiment Title
1.	Introduction to Microcontroller based IoT boards(Arduino, Rasberry Pi, TI-MSP-430).
2.	Working with Arduino using push Button switch, potentiometer, thermistor and other sensors.
3.	Using DHT-11 temperature and humidity sensor.
4.	Connecting 16x2 LCD display to Arduino.
5.	Using IR sensor with Arduino and its applications
6.	Ultrasonic distance measurement and servomotor control using Arduino.
7.	Joystick based controlling using Arduino.
8.	Android based Bluetooth Integration to Arduino.
9.	Wifi integration and cloud controlling of devices using Arduino.
10.	Working with Node MCU and its applications.
11.	Rasberry Pi- Introduction, Pin Configuration, working with sensors using Rasberry Pi.
12.	Using camera with Rasberry Pi.

TEXT BOOK:

1. **ArshdeepBahga and Vijay Madisetti**, "Internet of Things - A Hands on Approach",Universities Press, 2015

REFERENCE BOOK:

2. **Olivier Hersent, David Boswarthick, Omar Elloumi**, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√												
CO2	√	√												
CO3	√				√									
CO4	√				√									

ANTENNAS AND WAVE PROPAGATION

Course Code: 21EC503 **LTPC: 3-0-0-3**
Exam Hours: 3 Hours / Week:3
SEE:**50 Marks** Total Hours:40

Course Objective: To make the students understand the knowledge of different radiation mechanisms, antenna designing techniques, antenna applications and different modes of wave propagation

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Apply the knowledge of electromagnetic; determine the field, phase, and power patterns for different types of point sources and their arrays.	1, 2
2.	Apply the knowledge of electromagnetics to find the field equations and radiation resistance of various types of antennas.	1,2,5,9
3.	Design different types of frequency independent antennas, HF, VHF, UHF and microwave antennas	1,2,5,9
4.	Analyze different losses involved in three basic modes of wave propagation and their impact on antenna transceivers selection and construction.	1,2,5,9

Course Contents:

MODULE-1	Teaching Hours
Antenna Basics : Introduction, Basic Antenna parameters, Patterns, radiation intensity, Beam efficiency, Directivity, Gain, resolution, antenna aperture, effective height, antenna field zones, SNR, antenna temperature, antenna impedance, front-to-back ration. **Point Source and their Arrays :**Introduction, point source definition, power patterns, power theorem and its application to an isotropic source, examples of power patterns, field patterns, phase patterns, arrays of two isotropic point sources, pattern multiplication.	**10 Hours**
MODULE-2	
ELECTRIC DIPOLES AND THIN LINEAR ANTENNAS: Introduction, short electric dipole, fields of a short dipole(no derivation of field components), radiation resistance of short dipole, radiation resistances of lambda/2 Antenna, thin linear antenna, broadside and end-fire arrays. **Loop, Slot and Horn antennas:** Introduction, small loop, comparison of far fields of small loop and short dipole, loop antenna general case, far field patterns of circular loop, radiation resistance, directivity, slot antenna, Babinet's principle and complementary antennas, impedance of complementary screens	**13 Hours**
MODULE-3	
HF, VHF and UHF antennas: Isotropic radiators, resonant antenna, non-resonant antennas, antennas for HF, VHF, and UHF, Rhombic antenna, Yagi-Uda antenna, log-periodic, loop, Helical, whip, ferrite, turnstile, notch antenna **Microwave antennas** – Plane, corner, parabolic, type of parabolic reflectors, feed system for parabolic reflectors, shaped beam antenna, horn antenna, micro strip patch antennas.	**10 Hours**
MODULE-4	
Basics of wave propagation and Ground wave propagation: Introduction, classification based on modes of operation, Ground wave propagation: introduction, plane earth reflection, space wave and surface wave, transition between surface and space waves, tilt of waves front due to ground losses, impact of imperfect earth, Reduction factor. Curved earth reflections**. Space Wave Propagation:** Introduction, field strength relation, effect of imperfect earth, effect of curvature of earth, troposphere propagation, fading, path loss calculations, **Sky Wave Propagation:** Introduction, structural details of the ionosphere	**10 Hours**

Activity Number	Activity Name	Description	Marks	POs
1	Design using SCILAB	1. To design a 6-element Yagi-Uda antenna operating at 500 MHz. 2. Compute the field strength of the incident wave of square loop antenna. 3. To design a pyramidal horn antenna in E-plane and H-plane. 4. Compute the parameter (power) of the receiving antenna for polarization match Condition. 5. Design a lossless horn antenna with directivity 20dB at a frequency of 10 GHz	10	1,2,5, 9
2	Design using MATLAB/HFSS	1. To design a broadside array. 2. Design a five turn helical antenna in the normal mode at 400MHz. 3. Compute the minimum transmitter power of microwave repeater operating at 10 GHz. 4. Design a rectangular microstrip antenna whose centre frequency is 2.4GHz. 5. To find the radiation efficiency in percentage of a single turn and 8 turns of small circular loop antenna.	10	1,2,5, 9

TEXT BOOKS:

1. **John D Kraus, Ronald J Marhefka and Ahmad S Khan,** "Antennas and Wave Propagation ", 4th edition,2013.
2. **GSN Raju,** "Antennas and wave propagations", Pearson education, 3rd Edition, 2009.

REFERENCE BOOKS:

1. **John D Kraus et. al.** "Antennas for all applications", TMH, 3rd,2006.
2. **Balanis,** "Antenna Theory and Design", John Wiley, 3rdEd, 2013 reprint.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√											√	√
CO2	√	√			√				√				√	√
CO3	√	√			√				√				√	√
CO4	√	√			√				√				√	√

DIGITAL COMMUNICATION

Course Code : 21EC504 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week : 3
SEE :**50 Marks** Total hours :40

Course Objective: The students will be able to analyze mathematical background required for communication system and understands the concepts of building blocks of digital communication systems.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Acquire the concepts of digital communication systems.	1, 2
2.	Apply the knowledge of various signal processing operations and coding techniques for efficient and reliable digital transmission	1, 2
3.	Analyze the performance of different forms of digital communication techniques.	1, 2
4.	Analyze the security and performance in digital communication system.	1, 2, 3

Course Contents:

MODULE-1	Teaching Hours
Introduction to Digital communication, Sources and Signals, Basic signal processing operations in Digital communication, Channels for Digital communication, **Sampling process,** Sampling theorem, Quadrature sampling of band pass signals, reconstruction of a message from its samples, signal distortion in sampling, practical aspects of sampling and signal recovery, TDM.	**10 Hours**
MODULE-2	
Waveform Coding Techniques, PCM, Quantization noise and SNR, Robust quantization, DPCM, DM. **Base-Band Transmission**, Base-Band Shaping For Data Transmission, Discrete PAM signals, Power spectra of PAM signals, ISI, Nyquist's criterion for distortion less base band binary transmission, Correlative coding.	**10 Hours**
MODULE-3	
Digital Modulation Techniques, Introduction **,** Digital modulation formats, Coherent binary modulation techniques, Coherent Quadrature modulation techniques, Non-Coherent binary modulation Techniques, Comparison of binary and quaternary modulation techniques	**10 Hours**
MODULE-4	
Spread Spectrum Modulation: PN sequences, notation of spread spectrum, Direct sequence spread coherent binary PSK, Signal space dimensionality and processing gain, frequency hop spread spectrum.	**10 Hours**

Activity Number	Activity Name	Description	Marks	POs
1	Implementation using SCILAB	Basic Digital Modulation techniques	10	1,2,5,9
2	Demonstration	Hybrid and advance modulation.	10	1,2,5,9

TEXT BOOKS:

1. **Simon Haykin**, "Digital Communication", John Wiley and sons, 2nd Edition, 2004.
2. **Theodore S. Rappaport** – "Wireless Communications: Principles and Practice" Pearson Education, Second Edition, Eleventh Impression 2013

REFERENCE BOOKS:

1. **K. Sam Shanmugham**"Digital and analog Communication System", John Wiley and sons 2nd Edition, 2008.

2. **Simon Haykin**, "Introduction to Analog and Digital Communication System", John Wiley and sons, 2004.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√											√	
CO2	√	√											√	
CO3	√	√											√	
CO4	√	√	√										√	√

INFORMATION CODING & CRYPTOGRAPHY

Course Code:21EC505 **LTPC: 3-0-0-3**

Exam Hours: 3 Hours / Week :3

SEE:**50 Marks** Total hours :40

Course Objective: The student will design memory and memory less sources and quantify the information content to design channel codes and apply crypt algorithms for data security.

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Quantify information rate and determine information rate of analog sources and discrete source (memory and memoryless) to perform source coding.	1, 2 ,3
2.	Determine channel characteristics and channel capacity.	1, 2 ,3
3.	Determine block and convolution channel codes, determine error detection and correction capability of codes.	1,2,5,9
4.	identify different types of attacks and perform encryption and decryption.	1,2,5,9

Course Contents:

Module-1	Teaching Hours
Information theory: Introduction to information theory, Measure of information, Average and mutual information, Source entropy, Properties of entropy, source efficiency and extension Entropy of a source with memory. **Source Coding I:**Types of codes, Source Coding theorem, Huffman Coding, The Lempel Ziv Algorithm, arithmetic coding, Shannon's First Encoding Theorem Shannon-Fano Encoding Algorithm	**10**
Module-2	
Source Coding I: Shannon's First Encoding Theorem, Shannon-Fano Encoding Algorithm, Run Length Encoding, Information Channels, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, Shannon Limit, Introduction to error correcting codes, Linear block codes,Hamming Codes,Encoding and Decoding of Linear Block Code using matrix method and circuits, Syndrome Decoding.	**10**
Module-3	
Introduction to cyclic codes, Polynomials, The Division, Encoding and Decoding of cyclic codes using division method and shift register circuits, Matrix Description of Cyclic	**10**

Codes.**Introduction to Convolutional codes,** Polynomial Description of Convolutional Codes, Matrix Description of Convolutional Codes, Tree Codes and Trellis Codes, Viterbi Decoding of Convolutional Codes.	
Module-4	
Introduction, Principles of security, Passive and Active attacks, Substitution and Transposition techniques, Symmetric and Asymmetric key cryptography, Diffie Hellman key exchange algorithm, Data Encryption Standard, RSA algorithm.	**10**

Activity Number	Activity Name	Description	Marks	POs
1	Implementation using SCILAB	Huffman coding, Arithmetic Coding, hamming distance between two code words, Determine code words and the minimum weight of the code using Cyclic coding	10	6,9,12
2	Implementation using MATLAB	1. Taking Two prime numbers and then computes Public and Private key. Then encrypt the message using public key and decrypted using Private key 2. AES Encryption Decryption, Use the Galois field array function, gf, to implement a public key cryptosystem	10	6,9,12

Text Books:

1. **Ranjan Bose**, "Information Theory Coding and Cryptography", Tata McGraw-Hill Education, 2nd Edition, 2008.
2. **Murlidhar Kulkarni, K.S.Shivaprakasha, "Information Theory and Coding",** Wiley India Pvt. Ltd. 1st Edition, 2015.
3. **Atul Kahathe, "**Cryptography and Network Security", Tata McGraw-Hill Fourth edition 2008

Reference Books:

1. **Sam Shanmugam**, "Introduction to Analog and Digital Communication", John Wiley &Sons,1996.
2. Cryptography and Network Security- **Behrouz A Forouzan, Debdeep Mukhopadhyay**, Mc-GrawHill, 3rd Edition, 2015.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√	√											
CO2	√	√	√											
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

ADVANCED COMMUNICATION LABORATORY

Course Code : 21EC506 **LTPC:0-0-2-1**
Exam Hours : 3 Hours / Week : 2
SEE :50 Marks

Course Objective: Students are exposed practically on digital modulation techniques and microwave communication.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Conduct an experiments to demonstrate the concepts related to digital communication system	1, 2
2.	Conduct microwave experiments to measure losses, power, wavelength, VSWR, coupling coefficient, gain and directivity using microwave bench.	1, 2
3.	Work as an individual and in a team and thereby conduct experiments for a given problem statement and maintain the record.	5, 9, 10

Course Contents:

Exp No.	Hardware experiments
1.	Verification of sampling theorem using Flat-top samples
2.	ASK generation and Detection
3.	FSK generation and Detection
4.	PSK generation and Detection
5.	DPSK encoder and decoder
6.	QPSK modulator and demodulator
7.	Determination of Frequency, Guide wavelength and VSWR using Microwave bench
8.	Measurement of Directivity, Beam width and gain of Horn antenna
9.	Determination of modes, Transit time, Electronic tuning range and Sensitivity of Reflex Klystron
10.	Determination of V – I Characteristic curve of a Gunn Diode
11.	Determination of Characteristic of Directional Coupler
12.	Experiments on Microstrip antennas

TEXT BOOKS:

1. **Simon Haykin**, "Introduction to Analog and Digital Communication System", John Wiley and sons, 2004.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√											√	
CO2	√	√											√	
CO3					√				√	√				√

VI Semester
ENTREPRENEURSHIP AND MANAGEMENT

CourseCode:**21EC601** **LTPC:3-0-0-3**
Exam Hours: **3** Hours/Week:3
SEE:**50Marks** Total hours: 40

Course Objective: To make the students understand the various plans for a new business idea and think on the ways and means of organizing and launching an enterprise.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Define entrepreneurship and its intricacies and Ponder over the Feasibility of adventure.	6,8,11, 12
2	Develop plan for a new business idea.	8, 11
3	Organize and launch an enterprise	7, 8, 11
4	Identify options in managing the process involved in business by Considering various factors affecting human resource management.	7, 10, 11

Course Contents:

MODULE-1	Teaching Hours
Entrepreneurs & Entrepreneurship: Introduction, what is Entrepreneurship? Who are Entrepreneurs and what do they do? **The Context of Entrepreneurship**: Issues affectingentrepreneurshipinaction,identifyingenvironmentalopportunities,Understanding Competitive advantage.	**10 Hrs.**
MODULE-2	
Researching the Venture's Feasibility: Generating and evaluating business ideas, researching competitors, Researching finance options. **Planning the Venture:** Developing organizational vision and mission, Organizational culture issues, Developing and writing the business plan.	**10 Hrs.**
MODULE-3	
Organizing the Venture: Legal forms of business organization, other legal issues, Organizational design issues. **Launching the Venture:** Establishing the organizational goals and strategies, designing the venture's production & operations management function, establishing the Venture's marketing function, designing the venture's information systems and establishing the venture's financial and accounting systems.	**10 Hrs.**
MODULE-4	
Managing Processes: Making decisions, Measuring and evaluating organizational performance, Stimulating and making changes – Being a change agent and Contemporary issues in managing the venture. **Managing People:** Human resource management issues, Motivating employees, Employee work teams and leadership and other people issues.	**10 Hrs.**

Activities:

Activity Number	Activity Name	Description	Marks	POs
1	Problem Identification	Empathize the problems of customers to explore entrepreneurial context.	10	6,9,12
2	Ideation	Find an entrepreneurial solution to the identified problem through brainstorming sessions and conduct feasibility test	10	6,9,12

TEXTBOOKS:

1. **Entrepreneurship in Action**, MaryCoulter, PHI2nd Edition.

REFERENCES:

1. **Entrepreneurship Development,** E.Gordon &K.Natarajan, Himalaya publishers,2008.

2. **Entrepreneurship Development**, SSKhanka, SChand&Co.,NewDelhi.
3. **EntrepreneurshipDevelopmentandManagement,**A.K.Singh,JBApublishers,NewDelhi.
4. **Principles of Management** –P.C.Tripathi,P.N.Reddy–TataMcGrawHill

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1						√		√			√	√		
CO2								√			√			
CO3							√	√			√			
CO4							√			√	√			

VLSI CIRCUITS

Course Code :21EC602 **LTPC: 3-0-0-3**
Exam Hours :**3** Hours / Week :**3**
SEE : **50 Marks** Total hours :**40**

Course Objective: The students will learn to design and analyze digital circuits used in VLSI chips.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Ability to understand the basic Physics and Modeling of MOSFETs and to create models of moderately sized CMOS circuits that realize specified digital functions.	1, 2
2.	Ability to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects	2,3
3.	Ability to understand the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes, inherent trade-offs involved in system design. (i.e. power vs. speed).	1,2, 3
4.	Ability to implement the designs of various types of combinational logic and arithmetic circuits.	2,3

Course Contents:

MODULE-1	Teaching Hours
An overview of VLSI: Complexity and Design, Basic concepts, Logic Design with MOSFETs: Ideal switches, Boolean operations, MOSFETs, Switches, Basic, Complex gates in CMOS, Transmission Gate Circuits, Clocking and Data flow control. **Structure of CMOS Integrated Circuits:** IC Layers, MOSFETs, CMOS Layers, Designing FET Array.	**10 Hours**
MODULE-2	
Elements of Physical Design: Concepts, Layout of structures, Cell Concepts, FET Sizing and Unit Transistor, Physical Design of Logic Gates, Design Hierarchies**.** Electronic Analysis of CMOS Logic Gates: DC Characteristics of the CMOS Inverter, Inverter Switching characteristics, Power dissipation, DC Characteristics, Transient response of NAND and NOR Gates, Analysis of Complex Logic Gates, Gates Design for Transient Performance, Transmission Gates and Pass Transistors.	**10 Hours**
MODULE-3	
Designing High Speed CMOS Logic Networks: Gate Delays, Driving Large Capacitive loads, Logic Effort, BiCMOS Drivers **Advanced Techniques in CMOS Logic Circuits:** Mirrors Circuits, Pseudo-nMOS, Tri-State Circuits, Clocked CMOS, and Dynamic CMOS Logic Circuits, Dual Rail Logic networks.	**10 Hours**

MODULE-4	
VLSI System Components: Multiplexers, Binary decoders, Equality Detectors and comparators, priority encoders, shift and rotation operations, latches, DFlip-Flop. [**Self learning:** latches] **Arithmetic Circuits in CMOS VLSI:** 1 bit adder circuits, ripple carry adders, carry Look ahead adders, Other high speed adders, Multipliers.	**10 Hours**

Activity Number	Activity Name	Description	Marks	POs
1	Simulation	Basic VLSI Circuits using Microwind	**10**	**1,2,3, 5,9**
2	Delay Calculation	Calculation of resistance and capacitance using SPICE and its verification	**10**	**1,2,3, 5,9**

TEXT BOOK:

1. **John P. Uyemura**, "Introduction to VLSI Circuits and Systems"- John Wiley, 3rd Edition, 2002.

REFERENCE BOOKS:

1. **Neil H E Weste, David Harris, Ayan Banerjee,** "CMOS VLSI Design – A circuits and Systems perspective", Pearson Education, III Ed., 2006.
2. **A.Albert Raj and T.Latha**"VLSI Design" PHI,2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√	√		√				√					
CO2	√	√	√		√				√					
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

DIGITAL SIGNAL PROCESSING

Course Code : 21EC603 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week : 3
SEE : **50 Marks** Total hours : 40

Course Objective: The objective of this course is to make the students to design and simulate digital filters and analyze by comparing different signal processing strategies.
Course Outcomes (COs) with mapping shown against the Program Outcomes (POs)
Upon completion of the course, students shall be able to:

COs	Statement	Pos
1.	Apply various basic aspects of Digital Signal Processing and implement the properties of DFT and IDFT and also long data sequence	1, 2
2.	Implement DFT and IDFT using Fast Fourier transform and linear computation of DFT using Goertzel and Chirp- Z algorithm.	1, 2
3.	Design and implement FIR Filters using different types of window techniques and implement different types of IIR filters using analog filters and digital frequency transformation.	1, 2, 3
4.	Understand the applications of digital signal processing in communication system, speech/image processing and architectural features of a digital signal processor.	1, 2

Course Contents:

MODULE-1	Teaching Hours
Discrete Fourier Transform: Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, relationship of the DFT to other transforms**.(Text1)** **Properties of DFT**, multiplication of two DFTs – the circular convolution, additional DFT properties, Overlap saves and overlap add method**.(Text1)**	**10 Hours**
MODULE-2	
Fast Fourier Transform (FFT) algorithms: Direct computation of DFT, Radix -2 FFT algorithms for the computation of DFT and IDFT –decimation in time (DIT) and decimation in frequency (DIF) algorithms**. (Text1)** **A linear filtering** approach to Computation of the DFT: The Goertzel algorithm, the Chirp –z transform algorithm.(**Text1**)	**10 Hours**
MODULE-3	
FIR filter design: Introduction to FIR filters using – Rectangular, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique.**(Text1)** **IIR filter design:** Characteristics of analog filter- Butterworth filter, Impulse invariance method, mapping of transfer functions, Bilinear transforms. (**Text1**)	**10 Hours**
MODULE-4	
Implementation of Discrete Time Systems: Structures for the realizations of discrete time systems, Structures for FIR and IIR systems **(Text1)**. **Digital Signal Processors:** Architectural features of a Digital Signal Processor, fixed point and floating point processors, different generations of DSPs, discussion on TMS 320C67X processors.**(Text2)**	**10 Hours**

Activity Number	Activity Name	Description	Marks	POs
1	SCILAB experiments	Signal processing applications	10	1,2,3,5,9
2	MATLAB experiments	Speech Processing application	10	1,2,3,5,9

TEXT BOOKS:

1. **Proakis and Monalakis,** "Digital signal processing--- Principles algorithms and applications", Pearson education, 4th edition, 2007.
2. **Monsoon H Hayes**, "Digital signal processing", Tata McGraw-Hill, New Delhi, 3rdedition, 2008.

REFERENCE BOOKS:

1. **S.Salivahanan,** "Digital signal processing", TMH, New Delhi, 2nd Edition,2000.
2. **P Ramesh Babu,** "Digital Signal Processing", Scitech Publications Pvt. Ltd., 2nd edition,2006.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√	√		√				√					
CO2	√	√	√		√				√					
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

Optical Fiber Communication

Course Code : 21EC604 LTPC: **3-0-0-3**
Exam Hours : **3** Hours / Week : **3**
SEE : **50 Marks** Total hours : **40**

Course Objective: In this course students will obtain the knowledge needed to perform fiberOptic communication system engineering calculations and apply this knowledge to modern fiber optic systems.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}Upon completion of the course, students shall be able to:

COs	Statement	Pos
1	Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber	1, 2
2	Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers	1, 2
3	Analyze the principles of optical sources and the characteristics of fiber optic receivers	1, 2,3
4	Demonstrate fiber couplers, connectors, WDM concepts, and components and be familiar with optical amplifiers	1, 2,3

Course Contents:

Module-1	Teachingg Hours
OVERVIEW OF OPTICAL FIBER COMMUNICATION: Introduction, general system, cylindrical fiber (no derivations in article 2.4.4), single mode fiber, cut-off wave length, and mode filed diameter optical fiber waveguides: Ray theory. (Text 2) **TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS:** Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intramodal dispersion, Intermodal dispersion. (Text 2)	**10 Hours**
Module-2	

OPTICAL SOURCES AND DETECTORS: Introduction, LED's, double hetero junction structure, LASER diodes, Photo detectors: Pin Photo detector, Avalanche Photodiodes. (Text 1)**OPTICAL RECEIVERS AND DIGITAL LINKS:** Introduction, Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, burst mode receiver, Analog receivers, Point to Point link, Link power budget, Rise time budget. (Text 1)	**10 Hours**
Module-3	
FIBER COUPLERS AND CONNECTORS: Introduction, fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers (Text 2)**.** **WDM CONCEPTS:** WDM concepts, overview of WDM operation principles, WDM standards, Mach-Zehender interferometer, multiplexer, Isolators and circulators, direct thin filmfilters. (Text 1). [**Self-learning:** Fiber splices].	**10 Hours**
Module-4	
WDM COMPONENTS: Variable optical attenuators, tunable optical filters, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators, tunable light sources (Text 1). **OPTICAL AMPLIFIERS:** Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA. (Text 1). **[Self-learning:** Tunable light sources]	**10 Hours**

Text Books:

1. **Gerd Keiser,** "Optical Fiber Communication", 5th Ed., MGH, 2017.
2. **John M. Senior,**"Optical Fiber Communications", Pearson Education., 3rd Edition, 2009.

Reference Book:

1. **Joseph C Palais**, —Fiber Optic Communication", 4th Edition, 2004.

ACTIVITY

Activity Number	ActivityName	Description	Marks	POs
1	Characteristics of optical fibers	Finding of the attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion.	**10**	**2,5,9**
2	Technical Talk on current trends in the field of optical fiber communication	Quiz will be conducted on the topic explained.	**10**	**1,2**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√												
CO2	√	√												
CO3	√	√	√											
CO4	√	√	√											

DIGITAL SIGNAL PROCESSING LABORATORY

Course Code: 21EC605 **LTPC:0-0-1-1**

Exam Hours : 3 Hours / Week: 2

SEE: 50 Marks

Course Objective: The student will have hands-on experience of MATLAB or SCILAB modern tool on Digital Signal Processing operations.

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

COs	Statement	POs
1	Apply the Discrete Fourier Transform for efficient computation and implantation of the DFT and its applications	2, 3,4, 5, 9
2	Analyze the responses of FIR and IIR filters using different windowing techniques and response curves.	2, 3,4, 5, 9
3	Work as an individual and in a team and thereby conduct experiments for a given problem statement and maintain the record.	5, 9

EXPERIMENTS USING MATLAB or SCILAB

1. Verification of Sampling Theorem for three different cases.
2. Linear Convolution of two given sequences.
3. Circular Convolution of two given sequences.
4. Computation of N point DFT of a given sequence and to plot magnitude and phases spectrum and computation of N point IDFT.
5. Computation of 4 and 8-point DFT and IDFT of a given sequence using standard equation.
6. Computation of 4 and 8-point DFT using FFT / IIFT function.
7. Linear and Circular convolution using DFT and IDFT method.
8. Finding DFT for a long data sequence using overlaps save and overlap add methods.
9. Autocorrelation and Cross correlation of a given sequence and verification of its properties.
10. Finding Impulse response of a given system.
11. Solving a given difference equation with and without initial conditions.
12. Design and implementation of FIR Digital filters using Rectangular, Chebyshev, Hamming windows.
13. Design and implementation of Low pass, High Pass, Band Pass and Band rejection Butterworth IIR Digital filters.
14. Implementation of Decimation and Interpolation Process.
15. Implementation of Sampling rate conversion by a factor I/D.

E-Books:

1. https://www.scilab.org/about/community/books
2. https://www.mathworks.com/academia/books.html
3. https://www.electronicsforu.com/resources/cool-stuff-misc/15-helpful-ebooks-matlab
4. http://www.freebookcentre.net/Language/Matlab-Books.html

MOOCs (Courses Link):

1. https://www.udemy.com/course/scilab-an-open-source-alternative-of-matlab/
2. https://matlabacademy.mathworks.com/
3. https://www.coursera.org/learn/matlab
4. https://www.edx.org/learn/matlab
5. https://www.udemy.com
6. https://www.eckovation.com/course/matlab-course

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1		√	√	√	√				√				√	√
CO2		√	√	√	√				√				√	√
CO3					√				√				√	√

VLSI CIRCUITS LABORATORY

Course Code: 21EC606 **LTPC: 0-0-1-1**
Exam Hours: 3 Hours / Week: 2
SEE: **50 Marks**

Course Objective: The students will have hands-on experience on design concepts underlying VLSIs chips.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Simulate combinational and sequential circuits using MOSFET'a and logic gates.	2,3,4,5,9
2.	To build higher level combinational and sequential blocks using user defined structural model	2, 3 4,5,9
3.	To learn physical design, Lambda design rule or micron-based design and layout making of VLSI circuits.	2, 3, 4,5 ,9
4.	Optimize the logic gate area using modern tools.	2, 3, 4,5,9

Course Contents:

Exp No.	Experiment Title
I	**Simulation of schematic and layout using DSCH 2.6c and Microwind tools**
1.	Logic inverter
2.	Two input logic gates- AND, OR, NAND, NOR, EXOR, EXNOR
3.	Half adder and Full adder
4.	2-Bit parallel adder
5.	Magnitude comparator
6.	D Flip – Flop with reset
7.	T Flip – Flop with reset
8.	J-K Flip Flop
9.	Ring Oscillator
10.	Clock divider (by 4)
11.	4 –bit Shift Register with enable
12.	Schmitt trigger
13.	4:1 Multiplexer and 1:4 Demultiplexer

TEXT BOOK:

1. John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley, 3rd Edition, 2002.

REFERENCE BOOKS:

1. Neil H E Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design – A circuits

and Systems perspective", Pearson Education, III Ed., 2006.
2. A.Albert Raj and T.Latha, "VLSI Design", PHI, 2008.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1		√	√	√	√				√				√	√
CO2		√	√	√	√				√				√	√
CO3		√	√	√	√				√				√	√
CO4		√	√	√	√				√				√	√

Professional Electives – I

ARTIFICIAL INTELLIGENCE

Course Code:21EC651 **LTPC: 3-0-0-3**

Exam Hours:**3** Hours / Week:**3**

SEE: **50 Marks** Total hours: 40

Course Objective: The objective of this course is to introduce the concepts of Artificial Intelligence.

COs	Statement	POs
1	ApplytheknowledgeofArtificialIntelligencetowritesimplealgorithmforagents.	1, 2
2	Apply the AI knowledge to solve problem on search algorithm.	1,2
3	Develop knowledge based sentences using propositional logic and first order logic.	2,3
4	Apply first order logic to solve knowledge engineering processes.	1,5

Course Contents:

Module– 1	Hours
INTRODUCTION: INTELLIGENT AGENTS: What is AI? Foundation of AI, State of Art, Agents of Environment, Structure of agents. **PROBLEM SOLVING:** Problem solving agents, Example Problems, searching for solutions	10
Module– 2	
PROBLEM SOLVING: Uniformed and Informed search strategies, Heuristic Functions. **UNCERTIAN KNOWLEDGE AND REASONING:** Acting under uncertainty, Basic Probability Notation,	10
Module– 3	
UNCERTIAN KNOWLEDGE AND REASONING: Inference using full joint distributions, Bayes Rule and its use. **PROBABILISTIC REASONING OVER TIME:** Time uncertainty, Temporal Models, Hidden Markov Models.	10
Module– 4	
REINFORCEMENT LEARNING: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Applications of Reinforcement Learning.	10

Activity Number	Activity Name	Description	Marks	POs
1	Programming using Python	Machine learning Applications.	10	1,2,3, 5,9
2	Implement the AI concepts and algorithms.	AI application for society	10	1,2,3, 5,9

Textbooks:

1. Stuart Russel and Peter Norvig , "Artificial Intelligence A Modern Approach", Pearson 3rd Edition , 2016

REFERENCE BOOKS:

1. DAN W PATTERSON," Introduction to Artificial Intelligence and Expert Systems", PEARSON, 1st edition 2015.
2. Tom. M. Mitche, "Machine Learning", McGraw Higher Ed, 1st edition 2013.
3. Elaine Rich, "Artificial Intelligence", Mc Graw Hill 3rd Edition, 2017.
4. Er. Rajiv Chopra, "Artificial Intelligence – A practical approach", Chandpublication, 1st edition 2012

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√												
CO2	√	√	√											
CO3		√	√		√				√					
CO4	√				√				√					

CONTROL SYSTEMS

Course Code: 21EC652 **LTPC: 3-0-0-3**

Exam Hours: 3 Hours / Week :3

SEE: **50 Marks** Total hours :40

Course Objective: Understanding of control system, stability of systems.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

COs	Statement	POs
CO1	Formulate and interpret the results of practical problems of physical systems using mathematical modeling, block diagram and signal flow graph methods in control systems.	PO1, PO2,PO3,PO5,PO9
CO2	Apply the knowledge of time domain analysis for first and second order systems.	PO1, PO2,PO3,PO5,PO9
CO3	Analyze the stability of closed loop control system using Routh-Hurwitz criterion and Root-locus technique.	PO1, PO2,PO3,PO5,PO9
CO4	Analyze the stability of a system in the frequency domain using Nyquist and bode plots and the concept of state variables.	PO1, PO2,PO3,PO5,PO9

Course Contents:

Topic	Lecture Hours
MODULE1: **Introduction:** Types of Control Systems, Effect of Feedback System s, Differential equation of Physical Systems –Mechanical Systems, Electrical Systems, Electromechanical systems, Analogous Systems. **Block diagrams:** Transfer functions, Block diagram algebra.	10
Module-2 **Signal flow graphs:** Signal Flow graphs, Masons gain formula (State variable formulation excluded).Signal Flow graphs for block diagrams, electric networks and algebraic equations. **Time Response of feedback control systems & Stability analysis:** Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants**,** criterion.	10
Module-3 **Concepts of stability:** Necessary conditions for Stability, Routh- stability criterion. **Root–Locus Techniques**: Introduction, The root locus concepts, Construction of root loci **Stability in the frequency domain:** Mathematical preliminaries, Nyquist Stability criterion, (Inverse polar plots excluded), Assessment of relative stability using Nyquist	10

criterion, (Systems with transportation lag excluded).	
Module-4 **Frequency domain analyses:** Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function, Assessment of relative stability using Bode Plots. **Introduction to State variable analysis**: Concepts of state, state variable and state models for electrical systems, Solution of state equations.	10

Activity Number	ActivityName	Description	Marks	POs
1	Simulation of electrical and mechanical systems using open source tool.	• Use of open source tool for simulation • Group of 4 students should solve assigned simulation • Demonstration of the result	10	1,2,3, 5,9
2	Simulation of root locus, nyquist and bode plot using open source tool.	• Use of open source tool for simulation • Group of 4 students should solve assigned simulation • Demonstration of the result	10	1,2,3, 5,9

TEXT BOOK :

1. I.J. Nagarath and M.Gopal, ―Control Systems Engineering‖, New Age International (P) Limited, Publishers, Sixth edition – 2019

2. Dhanesh.N.Malik "Control Systems‖,Cengage Learning India Pvt.Ltd 2017

REFERENCE BOOKS:

1. **K. Ogata, "Modern Control Engineering ",**Pearson Education Asia/ PHI, 4th Edition, 2010.

2. **M. Gopal, "Control Systems – Principles and Design",** TMH, **5th edition** 2012

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√	√		√				√					
CO2	√	√	√		√				√					
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

OBJECT ORIENTED PROGRAMMING USING PYTHON

Course Code: 21EC653 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **3**
SEE: **50 Marks** Total hours: **40**

Course Objective: The objective of this course is to make the students to learn object-oriented programming to develop solutions to problems demonstrating usage of control structures, functions, classes, objects, and templates.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Apply the concepts of object-oriented programming using classes and objects.	1, 2
2.	Describe syntax, functions and OOP concepts using C++.	1, 2
3.	Develop C++ Programs using inheritance, Classes and pointers.	1, 2
4.	Illustrate the process of console I/O and file stream operations using C++.	1, 2, 3

Course Contents:

MODULE-1	Teaching Hours
Introduction: Object oriented programming, Basic concepts of OOP. **Basics of C++:** C++ Statements, Structure of C++ program, type compatibility, declaration of variables, dynamic initialization of variables, Reference variables, Special assignment expressions, implicit conversions, Operator overloading, operator precedence, control structures, Main function, function prototyping, call by reference, return by reference, inline functions, default arguments, const arguments, function overloading, math library functions.	10 **Hours**
MODULE-2	
Classes and objects: Specifying a class, defining member functions, static data members, friend functions, pointers to members. **Constructors and destructors:** Constructors, parameterized constructors, constructors with default arguments, copy constructor, destructors. **Operator overloading and type conversions:** Defining operator overloading, overloading unary operators, overloading binary operators, type conversions.	10 **Hours**
MODULE-3	
Inheritance: Defining derived classes, single inheritance, making a private member inheritable, multilevel inheritance, multiple inheritance, hierarchical inheritance, hybrid inheritance. **Classes and pointers:** Virtual base classes, abstract classes, constructors in derived classes, nesting of classes. pointers to objects, this pointer, pointers to derived classes.	10 **Hours**
MODULE-4	
Managing Console I/O Operations: C++ streams, C++ stream classes, unformatted I/O operations, formatted console I/O operations. **Working with files:** Classes for file stream operations, opening and closing a file, detecting end-of-file, sequential input and output operations.	10 **Hours**

Activity Number	Activity Name	Description	Marks	POs
1	Write an application Code using normal C++	Students has to write a program for real time application using C++ without using OOP concept	10	1,2,3,5 ,9
2	Write an application code in C++ using OOP concept.	For same application they have to write code using OOP concept and compare the methods.	10	1,2,3,5 ,9

TEXT BOOKS:

1. E. Balagurusamy. "Object Oriented Programming with C++", 6th edition, McGraw Hill Education (India) Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

1. **Robert Lafore**, "Object Oriented Programming using C++", Golgotha publications, 2004.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√											√	
CO2	√	√											√	
CO3	√	√	√										√	√
CO4	√	√											√	√

DATA STRUCTURES USING C

Course Code : 21EC654 **LTPC:3-0-0-3**
Exam Hours : **3** Hours / Week :3
SEE : **50 Marks** Total hours : **40**

Course Objective: To understand the fundamental techniques of Abstract Data types and to learn about the data structures with a comparative perspective so as to make use of most appropriate data structures in a program to enhance the efficiency or for better memory utilization based on the priority of the implementation.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Analyze various types of data structures and implement stack operations	1, 2,5,9
2.	Design and implement the operations on trees and various types of queues.	1, 2, 3,5,9
3.	Design and implement the Hash Table and operations on linked list	1, 2, 3,5,9
4.	Design applications using stacks and implement various searching and sorting techniques	1, 2, 3,5,9

Course Contents:

Module -1	Teaching Hours
Introduction to Data Structures and Algorithms: Basic terminology, Classification of Data Structure, Operations on Data structures, **Arrays:** Introduction, Declaration of Arrays, Storing values in Arrays, Operations on Arrays, **Stacks:** Introduction, Array representation of stacks, Operations on a stack. (Text 1)	**10 Hours**
Module -2	
Applications of Stacks: Reversing a list, Implementing Parentheses checker, Evaluation of Arithmetic Expressions, Recursion, **Queues:** Introduction, Array representation of Queues, Types of Queues. (Text 1)	**10 Hours**
Module -3	
Lists, Stacks and Queues: The List ADT, Linked Lists, Programming Details, Common Errors, Doubly Linked Lists, Circularly Linked Lists, Cursor Implementation of Linked Lists, **Hashing:** General Idea, Hash Function, Separate Chaining, Double Hashing, Rehashing. (Text 2)	**10 Hours**
Module -4	

Trees: Introduction, Types of Trees, Creating a Binary Tree from a General Tree, Traversing a Binary Tree, **Searching and Sorting**- Introduction to Searching, Linear Search, Binary Search, Insertion sort, Selection sort, Merge sort.(Text 1)	**10 Hours**

ACTIVITIES

Activity Number	ActivityName	Description	Marks	POs
1	Write, and execute C program to solve the problems	To write the C code to solve the problems and execute the same using Code-Block software	**10**	**1,2,3, 5,9**
2	Write, and execute C program using data structures	Recognizing the suitable data structure and to write and execute the C code using software.	**10**	**1,2,3, 5,9**

List of experiments for the activity 1:

1. To read radius of a circle and to find area and circumference
2. To read three numbers and find the biggest of three
3. To check whether the number is prime or not
4. To read a number, find the sum of the digits, reverse the number and check it for palindrome
5. To Swap Two Numbers
6. To find the roots of quadratic equation
7. To read marks scored by n students and find the average of marks
8. To perform addition and subtraction of Matrices
9. To remove Duplicate Element in a single dimensional Array

List of experiments for the activity 2:

1. To find GCD using recursive function
2. To generate n Fibonacci numbers using recursive function.
3. To implement dynamic array, find smallest and largest element of the array
4. To implement Stack.
5. To convert an infix expression to postfix.
6. To implement simple queue.
7. To implement linear linked list.
8. To sort the given list using insertion sort technique.
9. To sort the given list using merge sort technique.
10. To search an element using linear search technique.
11. To search an element using binary search technique.

TEXT BOOKS:

1. **ReemaThereja**, "Data Structures using C", Oxford Press, Second edition, 2014.
2. **Mark Allen Weis**, "Data Structures and Algorithm Analysis in C", Pearson Education, Second Edition,2003.

REFERENCE BOOK:

1. **Y. Langsam, M. J. Augenstein, A.M. Tanenbaum**, "Data structures using C and C++", 2nd Edition,2002.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√			√				√					
CO2	√	√	√		√				√					
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

Open Elective-I

MEMS & Nano Technology

Course Code: 20OEEC61 **LTPC: 3-0-0-3**
Exam Hours: 3 **Hours / Week: 3**
SEE: 50 Marks **Total hours: 40**

Course Objective: The objective of this course is to introduce the concepts of MEMS and Nanotechnology, and its design and fabrication methods.

COs	Statements	POs
1.	Understand the working principles of MEMS and Nanosystems and their applications.	1, 2
2.	Apply Science and Engineering Mechanics for Microsystem Design and fabrication	1, 2
3.	Apply appropriate miniaturization, fabrication and manufacturing techniques for MEMS and microsystems	2, 3
4.	Analyze various simulation FEM techniques for the design of MEMS and microsystems	3,5

Course Contents:

MODULE-1	Teaching Hours
OVERVIEW OF MEMS & MICROSYSTEMS: MEMS & Microsystems, Microsystems and Microelectronics, The multidisciplinary nature of Microsystems design and manufacture, Applications of MEMS and microsystems, **Materials for MEMS, and Microsystems: S**ubstrates and Wafers, Active Substrate Materials, Silicon as a Substrate Material. **WORKING PRINCIPLES OF MICROSYSTEMS:** Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics	**10 Hrs**
MODULE-2	
ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN: Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin-Film Mechanics **SCALING LAWS IN MINIATURIZATION:** Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity, scaling in fluid mechanics & heat transfer.	**10 Hrs**
MODULE-3	
MICROSYSTEM FABRICATION PROCESSES: Introduction, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition – Plasma, Sputtering **MICRO MANUFACTURING.** Bulk micro manufacturing, Surface Micromachining, The LIGA Process.	**10 Hrs**
MODULE-4	
MICROSYSTEMS DESIGN: Introduction, Design Considerations, Process Design, Mechanical Design, Mechanical Design Using Finite Element Method, Design of a Silicon Die for a Micro pressure Sensor. **Introduction to Nanoscale Engineering:** Overview of Nanotechnology, Overview of Nanofabrication Techniques, Prevalent Nanoscale Products and Applications, Nanoscale Engineering Analysis, Challenges in Nanoscale Engineering	**10 Hrs**

Activity Number	Activity Name	Description	Marks	POs
1	Design sensors using Opti wave	Displacement, Force, Pressure, Optical Bio, Chemical etc	**10**	**1,2,3, 5,9**
2	Design sensor using COMSOL, MEEP	Displacement, Force, Pressure, Optical Bio, Chemical etc.	**10**	**1,2,3, 5,9**

TEXTBOOKS:

1. TaiRanHsu,"MEMSandMicrosystemsDesignandManufacture",TataMcrawHill,2002.
2. Marc Madou,"Fundamentalsof Microfabrication",CRCpress1997.

REFERENCES:

1. Stephen D.Senturia,"Micro systemDesign",KluwerAcademicPublishers,2001
2. ChangLiu,"FoundationsofMEMS",PearsoneducationIndialimited,2006

www.tutorialspoint.com

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√												
CO2	√	√												
CO3		√	√		√				√					
CO4			√		√				√					

EMBEDDED SYSTEMS DESIGN

Course Code : 21OEEC62 **LTPC: 3-0-0-3**
Exam Hours : **3** Hours / Week : **3**
SEE : **50 Marks** Total hours : 40

Course objective: To make students familiar with the basic concepts and terminology of the target area, the embedded systems design flow. – To give students an understanding of the embedded system architecture

Course Outcomes: At the end of the course the student will be able to:

COs	Statements	POs
1.	Comprehend the requirements for embedded systems to design an embedded system using microprocessor/microcontrollers	1,2
2.	Analyse how the memory, peripheral components and buses interact in an embedded system	1, 2
3.	Develop the code to implement the Embedded firmware.	2, 3
4.	Design and develop the programming skills for embedded devices using RTOS.	1, 2,3

Course Contents:

MODULE-1	Teaching Hours
Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	10 Hrs
MODULE-2	
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces	10 Hrs
MODULE-3	

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	10 Hrs
MODULE-4	
RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and multitasking, Task Scheduling.	10 Hrs

Activity Number	Activity Name	Description	Marks	POs
1	Execution of the ALP	Execute the above listed programs	10	1,2,3, 5,9
2	Presentation and report writing	Identify the applications of embedded systems and present any one application providing its functionality, working principle, components utilized etc. Prepare the report for the same.	10	1,2,3, 5,9

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Processors using an evaluation simulator and the required software tool.

1. Write an ALP to find the sum of 10 integer numbers.
2. Write an ALP to multiply two 16-bit binary numbers.
3. Write an ALP to find factorial of a number.
4. Write an ALP to arrange an array of numbers in ascending/descending order.
5. Write an ALP to find the square of a number (1 to 10) using look-up table.
6. Write an ALP to find the largest/smallest number in an array of 32 numbers.

TEXT BOOKS:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√												
CO2	√	√												
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

WIRELESS COMMUNICATION

Course Code: 21OEEC63 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Objective: To make the students understand the various wireless architectures from a design and performance perspective

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Acquire the basics of Wireless Communication and Networks.	1
2.	Realize the complicated nature of wireless propagation and use of simple models to determine power requirements.	2,3
3.	Classify multipath channel models and analyze the operational principles of the various components of diversity techniques.	3
4.	Describe some of the existing and emerging Cellular and Non-Cellular Wireless Networks.	2

Course Contents:

MODULE-1	Teaching Hours
Introduction to Wireless Communication and Cellular Concept: 2G, 2.5G, 3G,4G,5G Networks, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Coverage and Capacity in Cellular systems. **Mobile Radio Propagation: Large scale path loss-** Free Space Propagation model, Ground Reflection Model(No Derivation only final expression), Diffraction	**10 Hrs.**
MODULE-2	
Mobile Radio Propagation: Small scale path loss- Small scale multipath propagation, Parameters of Mobile Multipath Channels, Types of Small-scale fading **Diversity Techniques**: Selection diversity Improvement, Maximal ratio Combining Improvement, Selection Diversity, Scanning Diversity, Maximal and Equal Gain Combining, Time, Frequency diversity, RAKE Receiver	**10 Hrs.**
MODULE-3	
Non-Cellular Networks: LoRA technology, Zigbee, ZWave, SIGFOX Wireless Systems and Standards-I: AMPS-Overview, Call Handling, CDMA Digital Cellular Standard (IS-85)-Frequency and Channel Specification.	**10 Hrs.**
MODULE-4	
Wireless Systems and Standards-II: Global System for Mobile (GSM)-Services, Features, System Architecture, Radio Subsystem, Channel Types, Frame Structure, Signal Processing. Wireless Systems and Standards-III: DECT- Features and Specifications, Architecture, Functional Concept, Radio Link, PACS-System Architecture, Radio Interface.	**10 Hrs.**

Activities:

Activity Number	Activity Name	Description	Marks	POs
1	Design of Path Loss Models	Design any path loss model to determine the free space loss and power received.	10	1,2,3,5,9
2	Simulation of Diversity Models	Simulation of any diversity model to calculate SNR using open source software	10	1,2,3,5,9

TEXT BOOKS:

1. Theodore S. Rappaport– "Wireless Communications: Principles and Practice" Pearson Education, Second Edition, Eleventh Impression 2013

REFERENCE BOOKS:

1. **S.S Manvi,** "Wireless and Mobile Networks, Concepts and Protocols", Second Edition, 2010.
2. **William C Y LEE**, "Mobile Communications Engineering" McGraw Hill Second Edition, 2010.
3. **D.P.Agarwal**, "Wireless communication" Thomson learning, 2nd Edition 2007Second edition, 2010.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√													
CO2		√	√		√									
CO3			√		√									
CO4		√	√											

Neural Networks and Fuzzy Logic

Course Code: **21OEEC64** **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Objective: To introduce the concepts and understanding of Neural networks and Fuzzy Logic

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}upon completion of the course, students shall be able to:

COs	Statement	POs
1	Acquire the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations.	1,2
2	Acquire the basic features of membership functions, fuzzification process and defuzzification process.	1,2
3	Classify the concepts of biological neurons and artificial neurons	1,2
4	Analyze the feed-forward and feedback neural networks and their learning algorithms.	1,2

Course Contents:

MODULE-1	Teaching Hours
Supervised Learning Neural Networks:-Perceptron – Single Layer, Multilayer and their architecture, Error back propagation algorithm, Generalized delta rule, Concept of Training, Testing and Cross-validation data sets for design and validation of networks. Over-fitting. Stopping criterion for training.	**10 Hrs.**
MODULE-2	
: Unsupervised Learning Neural Networks-Competitive Learning Networks – Maxnet, Mexican Hat Net, Kohonen Self-Organizing Networks – architecture, training algorithm, K-means and LMS algorithms, Radial Basis Function (RBF) neural network -architecture and algorithm, and Discrete Hopfield networks. Introduction to the concept of Support Vector Machine based classifier.	**10 Hrs.**

MODULE-3	
Classical sets : Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.	**10 Hrs.**
MODULE-4	
Fuzzification and Defuzzification : Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation.	**10 Hrs.**

TEXT BOOKS:

1. Hagan, Demuth, and Beale, Neural Network Design, Thomson Learning.
2. Timothy J.Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010.
3. George J.KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995.

REFERENCES:

1. Christopher M Bishop, Neural Networks For Pattern Recognition, Oxford University Press
2. Simon Haykin, Neural Network- A Comprehensive Foundation, Pearson Education
3. S.Rajasekaran, G.A.Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003.

WEB RESOURCES: http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=111106048

Activities:

Activity Number	ActivityName	Description	Marks	POs
1	Neural Network Problem Simulation	You can create a handwriting recognition tool using the MNIST dataset as input. MNIST is a manageable, beginner-friendly data source that can be used to generate images of handwritten numbers. Since these images are noisy, they need a noise removal filter to classify and read the digits properly. And auto encoders can learn this noise removal feature for a particular dataset. Students can try this project yourself by downloading freely available code from online repositories.	10	1,2,3,5,9
2	Mini Projects based on Fuzzy Logic	The latest innovative mini projects which can be built by students to develop programs in areas related to/ using fuzzy logic.	10	1,2,3,5,9

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√	√		√				√					
CO2	√	√	√		√				√					
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					