MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous institution Affiliated to VTU, Belgaum)

Autonomous Programme

Bachelor of Engineering

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

SYLLABUS

V& VI Semester
(2022-23 Admitted Batch)

Academic Year 2024-25

Scheme & Syllabus for BE (E&C) V and VI semesters
2024-25 Academic Year

VISION OF THE DEPARTMENT

To produce industry ready, research oriented and socially responsible Electronics & Communication Engineers.

MISSION OF THE DEPARTMENT

- To create an ambience for learning.
- To conduct research, beneficial to the society.
- To promote industry-academic interaction at all levels.
- To be continuously agile to the needs of the stake holders.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates will:
PEO1: Design and test Electronics & Communication systems and be successful professional in the field of ECE and allied areas.
PEO2: Be a good leader, team worker with strong communication skills.
PEO3: Possess capability to pursue higher education and be involved in research in the core and allied areas of E&C engineering and be a lifelong learner.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: An ability to understand the basic concepts in Electronics and Communication Engineering and to apply them to various areas, like Signal and image processing, VLSI, Embedded systems, photonics, networks, MEMS, antennas etc., in the design and implementation of complex systems.

PSO2: Possess the skills to analyze and solve problems, using the latest software tools and hardware available in E & C Engineering along with analytical skills for real-time applications.

PROGRAM OUTCOMES

The program is targeted at developing the following competencies, skills and abilities amongst students of E & C Engineering:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis: Identify, formulate**, reviewer search literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage: Create, select, and** apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Scheme of Evaluation (Theory Courses)

Assessment	Marks
THREE CIEs conducted for a total of 30 marks	30
Activities as decided by course faculty/Lab component for IPCC	20
SEE	50
Total	100

Scheme of Evaluation (Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the Course coordinator	10
Record Writing	20
Laboratory CIE conducted by the Course coordinator	20
SEE	50
Total	100

Scheme of Evaluation (Integrated Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the Course coordinator	05
Record Writing	05
Laboratory CIE conducted by the Course coordinator	10
Total	20

Examination	Maximum Marks	Minimum Marks to Qualify
CIE	50	20
SEE	50	20

FIFTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	22EC501	Digital System Design Using Verilog	3-0-0	3	3
PCC	22EC502	Control Systems	3-0-0	3	3
PCC	22EC503	Antenna and Wave Propagation	3-0-0	3	3
IPCC	22EC504	Digital Communication	3-0-2	4	5
PCCL	22EC505	Hardware Description Language Laboratory	0-0-2	1	2
PEC	22EC5XX	Professional Elective Course -I	3-0-0	3	3
AEC	22RIP	Research Methodology and IPR	2-2-0	3	4
HSMC	22EVS	Environmental Studies	0-0-2	1	2
Total				**21**	**24**

Professional Elective Course –I		
PEC	22EC511	Operating Systems
PEC	22EC512	Data Structures using C
PEC	22EC513	Object Oriented Programming using C++
PEC	22EC514	Artificial Intelligence

SIXTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
IPCC	22EC601	VLSI Circuits	3-0-2	4	5
PCC	22EC602	Digital Signal Processing	3-0-0	3	3
PCC	22EC603	Optical Fiber Communication	3-0-0	3	3
PI	22EC604	Main Project Phase-1	0-0-4	2	4
PCCL	22EC605	Digital Signal Processing Laboratory	0-0-2	1	2
PEC	22EC6XX	Professional Elective Course-II	3-0-0	3	3
OEC	22OEEC6X	Open Elective Course -1(Institution level)	3-0-0	3	3
OEC	22SWY	*Swayam (NPTEL only)		Audit	-
AEC/SDC	22ASK	Analytical ability & soft skills	0-0-2	1	2
			Total	**20**	**25**

Professional Elective Course -II

PEC	22EC651	Machine Learning
PEC	22EC652	Information theory and Cryptography
PEC	22EC653	Object Oriented Programming using JAVA
PEC	22EC654	5G and Satellite Communication

Open Elective Course

OEC	22OEEC61	MEMS
OEC	22OEEC62	Embedded System Design
OEC	22OEEC63	Wireless Communication
OEC	22OEEC64	Neural Networks and Fuzzy Logic

Note: Analytical ability & soft skills will be conducted during 5th semester vacation by the TAP office.

DIGITAL SYSTEM DESIGN USING VERILOG

Course Code : 22EC501	**LTPC: 3-0-0-3**
Exam Hours : 3	Hours / Week : 3
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.	1, 2, 3, 5
4.	Develop the programs more effectively using directives, Verilog tasks and constructs.	3, 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.	**10 Hours**
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.	**10 Hours**
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, Multiway branching, loops, sequential and parallel blocks. Tasks and functions: Differences between tasks and functions.	**10 Hours**
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.	**10 Hours**

Activity Number	**Activity Name**	**Description**	**Marks**	**POs**
1	Simulation	At different abstract levels , simulation of circuits by applying test bench.	**10**	**1,2,5**
2	Flipped Class	Group Discussion followed by Pre-quiz and Post-quiz.	**10**	**1,2,9**

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.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	3	2			2								3	
CO2	3	2			2								3	2
CO3	3	2	1		2				2	2			3	3
CO4	3	2	2		2				2	2			3	3

CONTROL SYSTEMS

Course Code: 22EC502	**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.	1, 2,3,5,9
CO2	Apply the knowledge of time domain analysis for first and second order systems.	1, 2,3,5,9
CO3	Analyze the stability of closed loop control system using Routh-Hurwitz criterion and Root-locus technique.	1, 2,3,5,9
CO4	Analyze the stability of a system in the frequency domain using Nyquist and bode plots and the concept of state variables.	1, 2,3,5,9

Course Contents:

MODULE1	Lecture Hours
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 Hours**
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 Hours**
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 criterion, (Systems with transportation lag excluded).	**10 Hours**
MODULE4	
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.	**10Hours**

Activity Number	Activity Name	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	3	2	1		2				2				3	2
CO2	3	2	1		2				2				3	2
CO3	3	2	1		2				2				3	2
CO4	3	2	1		2				2				3	2

ANTENNAS AND WAVE PROPAGATION

Course Code: 22EC503	**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, 2,5,9
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, 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	**10 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, 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 ", 4^{th}edition,2013.
2. **GSN Raju,** "Antennas and wave propagations", Pearson education, 3^{rd} Edition, 2009.

REFERENCE BOOKS:

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

MOOC Course Link:

1. https://onlinecourses.nptel.ac.in/noc20_ee20/preview
2. https://www.udemy.com/course/rf-antenna-fundamentals/
3. Antennas and Propagation | Short courses - UCL – University College London

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	2	3			1				1				2	1
CO2	2	3			1				1				2	1
CO3	2	3			1				1				2	1
CO4	2	3			1				1				2	1

DIGITAL COMMUNICATION

Course Code: 22EC504	**LTPC: 3-0-2-4**
Exam Hours: 3	Hours / Week: 5
SEE: **50 Marks**	Total hours : 40+12=52

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.	Illustrate the basic concepts of digital communication system.	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, 2,3
4.	Analyze the security and performance in digital communication system.	1, 2

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**

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.

Laboratory Component

Exp. No.	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.	Conduction of experiments in hardware and Multisim / MATLAB

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	3	2											3	2
CO2	2	3											3	2
CO3	3	2											3	2
CO4	3	2											3	2

Hardware Description Language Laboratory

Course Code: 22EC505	LTPC: 0-0-2-1
Exam Hours: 3	Hours / Week: 2
SEE: **50 Marks**	

Course Objective: The students will have hands-on experience to simulate and debug combinational and sequential circuits using Xilinx.

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 ISE simulator to simulate combinational and sequential circuit.	1,2
2.	Simulate codes of the designed circuits and execute on CPLD/FPGA chips.	2
3.	Design and develop the programming skills for place and route the simulated code on to the chip area.	3, 4

Course Contents:

Exp No.	Experiment 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.
10.	Modeling of Universal shift registers.
II	**Interfacing**
1.	Stepper Motor.
2.	DC Motor.
3.	DAC interface.

Reference Books:

1. **Nazeih M. Botors**–"HDL Programming (VHDL and Verilog)", Dream tech publication New Delhi.
2. **J Bhaskar**, "VHDL Primer", Pearson/PHI, New Delhi 2003.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	3	2	2		3				2				3	
CO2	3	2	2		3				2				3	3
CO3	3	2	2		3				2				3	3

Professional Electives Course-I

OPERATING SYSTEMS

Course Code :22EC511	LTPC: 3-0-0-3
Exam Hours :**3**	Hours / Week: 3
SEE : **50 Marks**	Total hours :**40**

Course Objective: To enable the students to understand the fundamentals of operatingsystems, scheduling, memory management techniquesandorganization of file 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.	Apply the fundamentals of various concepts in operating system.	1, 2,5,9
2.	Distinguish different styles of operating system design.	1, 2, 3,5,9
3.	Apply principles and techniques to implement processes and threads as well as the different algorithms for process scheduling and design memory management concept along with issues of main memory.	1, 2, 3,5,9
4.	Apply the concepts of deadlock in operating systems and how they can be managed and build the structure and organization of file systems.	1, 2, 3,5,9

Course Contents:

MODULE-1	Teaching Hours
Introduction to Operating Systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and security; Distributed system; Open-Source Operating Systems. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System structure; Virtual machines; System boot. **Process Management:** Process concept; Process scheduling; Operations on processes; Inter-process communication, Threads**:** Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms;	**10 Hours**
MODULE-2	
Process Scheduling continued.: Thread scheduling; Multiple-Processor scheduling; **Process Synchronization:** Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors. **Deadlocks:** Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock	**10 Hours**
MODULE-3	
Memory Management: Main Memory: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. **File System Interface, File System Implementation:** FileSystem:File concept; Access	**10 Hours**

methods; Directory and Disk structure; File system mounting; file sharing; Protection, Implementing File System: File system structure; File system implementation; Directory implementation; Allocation methods; free space management; Recovery; NFS.	
MODULE-4	
BASICS OF REAL-TIME CONCEPTS: Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel	**10 Hours**

Text Book:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8th edition, Wiley-India, 2012.
2. Philips A. Laplante, "Real-Time System Design and Analysis", 3rd Edition, John Wley& Sons, 2004

Reference Books:

1. D.M Dhamdhere: Operating systems - A concept based Approach, 2nd Edition, Tata McGraw- Hill, 2002.
2. P.C.P. Bhatt: Operating Systems, 2nd Edition, PHI, 2006.
3. Harvey M Deital: Operating systems, 3rd Edition, Pearson Education, 1990.

Activity Number	Activity Name	Description	Marks	POs
1	**Case Study**	The Linux Operating System	10	1,2,9,10
2	**Presentation**	Presentation on Case study	10	1,2,9,10

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2			2				1					
CO2	3	2	3		2				1					
CO3	3	2	3		2				1					
CO4	3	2	3		2				1					

DATA STRUCTURES USING C

Course Code : 22EC512	**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	Activity Name	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	3	2			2				1				1	3
CO2	3	2	3		2				1				1	3
CO3	3	2	3		2				1				1	3
CO4	3	2	3		2				1				1	3

OBJECT ORIENTED PROGRAMMING using C++

Course Code: 22EC513	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	3	2	2		2				1				1	3
CO2	3	2	2		2				1				1	2
CO3	2	3	3		2				1				1	3
CO4	3	2	2		2				1				1	2

ARTIFICIAL INTELLIGENCE

Course Code: 22EC514	**LTPC: 3-0-0-3**
Exam Hours: **3**	Hours / Week: **3**
SEE: **100 Marks**	Total hours: **40**

Course Objective: The student should be made to Study the concepts of Artificial Intelligence and learn the methods of solving problems using Artificial Intelligence

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	Identify problems that are amenable to solution by AI methods.	1, 2,12
2	Identify appropriate AI methods to solve a given problem	1, 2
3	Formalize a given problem in the language/framework of different AI methods	1,2,4, 5
4	Implement basic AI algorithms	1, 2

Course Contents:

MODULE-1	**Teaching Hours**
INTRODUCTION History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents PROBLEM SOLVING: Solving problems by searching, Informed search and exploration, Constraint satisfaction problems, Adversarial search, Knowledge and reasoning, Knowledge representation, first order logic. (**Text Book 1:** 1.1,1.3,1.4,2.1,2.4, 3.1,3.2, 4.1,5.1,6.1,6.2, 8.2,10.1,10.2)	**10 Hrs**
MODULE-2	
PLANNING: Planning with forward and backward State space search, Partial order planning, Planning graphs, Planning with propositional logic, Planning and acting in real world (**Text Book 1:** 11.2,11.3,11.4,11.5,12.1,12.2,12.3,12.4).	**10 Hrs**
MODULE-3	
REASONING: Uncertainty Probabilistic reasoning, Filtering and prediction, Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions (**Text Book 1:** 13.1,13.2,13.6, 14.1,14.2,14.3, 15.2,15.3,15.4,15.5,15.6).	**10 Hrs**
MODULE-4	
LEARNING: Forms of learning, Knowledge in learning, Statistical learning methods, Reinforcement learning, Communication, perceiving and acting, Probabilistic language processing, Perception. (**Text Book 1:** 18.1, 19.1, 19.2, 20.1, 20.2, 20.5, 21.1, 21.2, 21.3, 21.4, 22.1, 23.1, 24.1, 24.2).	**10 Hrs**

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India2003.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: Addison-Wesley, 2002.

REFERENCE:

1.David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1882.

Activity Number	Activity Name	Description	Marks	POs
1	**Problem Solving**	Different Problems should be solved using various algorithms.	**10**	**3,5,9**
2	**Demo presentation on different Algorithms**	Presentation / Seminar of different algorithms should be given.	**10**	**2,9,10**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	3	2										2	1	1
CO2	2	3											1	1
CO3	2	3										2	1	
CO4	3	2								2			1	

Course Title	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS		
Course Code	22RIP	**L-T-P**	(3-0-0) 3
CIE	50	**Hours/Week**	3
SEE	50	**Total Hours**	40

Course Objective: To give an overview of technical research activities and patenting methodology.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Carry out Literature Review and write technical paper	2,3,4,8,12	-
2.	Describe the fundamentals of patent laws and the patent Drafting procedure.	6,8,10,12	-
3.	Elucidate the copyright laws and subject matters of copyright	6,8, 10,12	-

MODULE-1	10 Hrs.

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research. Ethics in Engineering Research: Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art ,Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: TheWay Forward, Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading.

MODULE-2	10 Hrs.

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Stylesfor Citations, Acknowledgments and Attributions.

Technical Writing and Publishing : Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Patent or Technical Paper?—The Choice, Writing, Journal Paper: Structure and Approach: Title, Abstract, and Introduction, Methods, Results, and Discussions, Table, Figures, Acknowledgments, and Closures

MODULE-3	10 Hrs.

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, Major Amendments inIP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements.

Process of Patenting: Prior Art Search. Choice of Application to be Filed. Patent Application Forms.Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Do I Need First to File a Patent in India.Patent Related Forms. Fee Structure. Types of Patent Applications.

MODULE-4	10 Hrs

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright.
Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transferof Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC).
Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration.
Self study: Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, IP Organizations In India.

Text Books:

Dipankar Deb, Rajeeb Dey, Valentina E, Balas, "Engineering Research Methodology",Springer, 2019.

Prof. Rupinder Tewari, Ms. Mamta Bhardwa, "Intellectual Property" , Professor GurpalSingh Sandhu Honorary Director, Publication Bureau, Panjab University, 2021.

Reference Books:

David V. Thiel, "Research Methods for Engineers", Cambridge University Press, 2014.

N.K.Acharya, "Intellectual Property Rights", Asia Law House, 8th Edition, 2021.

MOOC:

https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	2	3				2				3		
CO2						3		2		3		3		
CO3						3		2		3		3		

Course Title	Environmental Studies		
Course Code	22EVS	L-T-P	(0-0-2) 1
Exam	3 Hrs.	Hours/Week	2
CIE	100 Marks	Total Hours	20

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

#	Course Outcomes (CO)	Mapping to POs
1.	Acquire an awareness of sensitivity to the total environment and its allied problems.	7, 9,12
2.	Develop strong feelings of concern, sense of ethical responsibility for the environment and the motivation to act in protecting and improving it.	6,8
3.	Analyze and evaluate environmental measures in real world situations in terms of ecological, political, economical, societal and aesthetic factors.	6, 7,8, 9

MODULE- 1	5 Hrs

Environment: Definition, Ecosystem, Balanced ecosystem, Effects of human activities on environment
Agriculture Housing Industry Mining and Transportation.

MODULE-2	5 Hrs

Natural Resources: Water resources, Availability and Quality, Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources - Forest Resources - Material Cycles
- Carbon, Nitrogen and Sulphur Cycles.

MODULE-3	5 Hrs

Pollution: Effects of pollution - Water pollution - Air pollution Land pollution - Noise pollution.

MODULE-4	5 Hrs

Current Environmental issues of importance: Acid Rain, Ozone layer depletion - Population Growth, Climate change and Global warming. Environmental Impact Assessment and Sustainable
Development Environmental Protection - Legal aspects. Water Act and Air Act.

Text Books:
Environmental Studies - Dr. D.L Manjunath, Pearson Education -2006
Environmental Studies - Dr. S. M. Prakash - Elite Publishers - 2006

Reference Books:
Environmental Studies - Benny Joseph - Tata McGraw ill- 2005
Principles of Environmental Science and Engineering P. Venugopala Rao, Prentice Hall of India.
Environmental Science and Engineering - Meenakshi, Prentice Hall India.

Assessment Strategy

CIE	Schedule	Assessment Method	Marks	Duration (Min.)
CIE I	At the end of 8 weeks	Objective Questions	25	60
CIE II	At the end of 11 weeks	Objective Questions	25	60
Project	At the end of 14 weeks	Project/Presentation/ Prototype development/Plantation	50	-

Course Articulation Matrix

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	3	-	-	-	-	-
CO2	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	3	2	-	-	-	-	-

VI Semester

VLSI CIRCUITS

Course Code :22EC601	**LTPC: 3-0-2-4**
Exam Hours :**3**	Hours / Week :**5**
SEE : **50 Marks**	Total hours :**40+12=52**

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, 2,5,9
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	1, 2,5,9
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).	1,3, 2,5,9
4.	Ability to implement the designs of various types of combinational logic and arithmetic circuits.	1, 3, 2,5,9

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**

PRACTICAL COMPONENT OF VLSI CIRCUITS (Integrated Lab)

Conduct the following experiments using suitable simulation software

Exp No.	Experiments Title
1	Simulation of Half Adder and Half Subtractor using DSCH
2	Simulation of Full Adder and Full Subtractor using DSCH
3	Simulation of CMOS NOT, NAND, and NOR gates.
4	Simulation of 1, 2 bit magnitude comparator.
5	Simulation of Parallel Adder / Subtractor using Ex-OR gates.
6	Simulation of 2:1 Multiplexer and construct 4:1 multiplexer using 2:1 MUX.
7	Simulation of 2: 4 decoder and construct 3: 8 decoder using 2:4 decoder
8	Simulation of Flip Flops and Counters.
9	Simulation of Adders and Multipliers.

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.

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	3	2			2				1				1	1
CO2	3	2			2				1				1	1
CO3	3	2	1		2				1				2	2
CO4	3	2	1		2				1				2	2

DIGITAL SIGNAL PROCESSING

Course Code : 22EC602	**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, 2,3,5,9
3.	Design and implement FIR Filters using different types of window techniques and implement different types of IIR filters using analog filters.	1, 2,3,5,9
4.	Implementation and Realization of Digital **Filters** and architectural features of a digital signal processor.	1, 2,3,5,9

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**. (Textbook 1)** **Properties of DFT**, multiplication of two DFTs – the circular convolution, additional DFT properties, **(Textbook 1)**	**10 Hours**
MODULE-2	
Fast Fourier Transform (FFT) algorithms: Overlap save, and overlap add method**,** 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**. (Textbook 1)** **A linear filtering** approach to Computation of the DFT: The Goertzen algorithm, the Chirp –z transform algorithm.**(Textbook 1)**	**10 Hours**
MODULE-3	
FIR filter design: Introduction to FIR filters using – Rectangular, Hanning and Hamming windows, FIR filter design using frequency sampling technique.**(Textbook 1).** **IIR filter design:** Characteristics of analog filter- Butterworth filter, Impulse invariance method, mapping of transfer functions, Bilinear transforms. **(Textbook 1).**	**10 Hours**
MODULE-4	
Realization of Digital filters: Structures for the realization of FIR and IIR filters using Direct form I and II **(Textbook 1).** **Digital Signal Processors:** Architectural features of a Digital Signal Processor, generations of DSPs, fixed point and floating-point arithmetic format, Discussion on Architectural features of TMS 320C67X processors. **(Textbook 3).**	**10 Hours**

Activity Number	**Activity Name**	**Description**	**Marks**	**POs**
1	Activity 1	✓ Signal Generation and Visualization. ✓ Fourier Transform ✓ Applying Window Functions ✓ Spectrogram Analysis	10	1,2,3,5,9

		✓ Audio Signal Generation and Playback ✓ Spectral Analysis of an Audio Signal ✓ Audio Filtering (Low-Pass, High-Pass, and Band-Pass) ✓ Echo and Reverb Effects ✓ Noise Reduction using Spectral Subtraction ✓ Audio Compression using Mu-Law Companding		
2	Activity 2	Poster presentation	10	1,2,3,5,9

TEXTBOOKS:

1. **Proakis and Monalakis,** "Digital signal processing--- Principles algorithms and applications", Pearson education, 4th edition, 2007.
2. **P Ramesh Babu,** "Digital Signal Processing", Scitech Publications Pvt. Ltd., 2nd edition,2006.
3. **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. **Ganesh Rao, ,** "Digital signal processing", Pearson Education India, 2010.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	2	3											1	2
CO2	2	3	1		1	2			2				1	2
CO3	2	3	1		1	2			2				1	2
CO4	2	3	1		1	2			2				1	2

OPTICAL FIBER COMMUNICATION

CourseCode:22EC603	**LTPC:3-0-0-3**
Exam Hours :3	**Hours /Week:3**
SEE:50Marks	**Total hours :40**

Course Objective: In this course students will obtain the knowledge needed to perform fiber Optic 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
4	Demonstrate fiber couplers, connectors, WDM concepts, and components and be familiar with optical amplifiers	1, 2

Course Contents:

Module-1	Teaching Hours
OVERVIEW OF OPTICAL FIBER COMMUNICATION: Introduction, general system, cylindrical fiber (no derivations in article 2.4.4), single mode fiber, cut-off wavelength, and mode filed diameter optical fiber wave guides: Ray theory. (Text2) **TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS:** Introduction, Attenuation, absorption, scattering losses, bendingloss, dispersion, Intramodal dispersion, Intermodal dispersion. (Text2)	**10 Hours**
Module-2	
OPTICAL SOURCES AND DETECTORS: Introduction, LED's, double hetero junctionstructure,LASERdiodes,Photodetectors:PinPhotodetector,AvalanchePhotodiodes.(Text1)**OPTICALRECEIVERSANDDIGITALLINKS:**Introduction,OpticalReceiverOperation,receiversensitivity,quantumlimit,eyediagrams,coherentdetection,burstmodereceiver, Analog receivers. (Text1)	**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(Text2**).** **WDMCONCEPTS:** WDM concepts, overview of WDM operation principles, WDM standards, Mach- Zehender interferometer, multiplexer, Isolators and circulators, direct thin film filters.(Text1). [**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(Text1). **OPTICAL AMPLIFIERS :**Optical amplifiers, basic applications and types, semiconductor Optical amplifiers, EDFA.(Text1).**[Self-learning:** Tunable light sources]	**10 Hours**

Text Books:

1. **GerdKeiser,**"OpticalFiberCommunication",5thEd.,MGH,2017.
2. **JohnM.Senior,**"OpticalFiberCommunications",PearsonEducation.,3rdEdition,2009.

Reference Book:

1.**JosephC Palais**,—FiberOpticCommunication",4thEdition,2004.

ACTIVITY

Activity Number	Activity Name	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**	**PO 10**	**PO 11**	**PO 12**	**PS01**	**PSO 2**
CO1	3	2											2	1
CO2	2	3											2	1
CO3	3	2											2	1
CO4	3	2											2	1

DIGITAL SIGNAL PROCESSING LABORATORY

Course Code: 22EC605	LTPC:0-0-2-1
Exam Hours: 3	Hours / Week: 2
CIE: 50 Marks	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	1, 2, 3,4, 5, 9
2	Analyze the responses of FIR and IIR filters using different windowing techniques and response curves.	1, 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.

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	1	2	3	3	2				2				1	2
CO2	1	2	3	3	2				2				1	2
CO3					3				2				1	2

Professional Elective Course-I

MACHINE LEARNING

Course Code :22EC651	**L-T-P-C: (3-0-0)**
Exam Hrs.:3	**Hours/Week: 3**
SEE50Marks	**Total Hours: 40**

Course Objective: The objective of this course is to introduce the concepts of Machine Learning and Artificial Neural Networks.

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

COs	Statements	Pos
1.	Understand the core concepts of Machine learning to apply on real world problems.	1, 2
2.	Illustrate the underlying mathematical relationships within and across Machine Learning algorithms.	1, 2
3.	Apply the various algorithms of supervised and unsupervised learning	1, 2
4.	Analyze and design the genetic algorithms for optimization engineering problems	2,3

Course Contents:

MODULE-1	Teaching Hours
Introduction: Learning, Types of Learning, Supervised Learning, The Machine Learning Process. Some Terminology, Testing Machine Learning Algorithms, Some Basic Statics **Neurons, Neural Networks, and Linear Discriminants**: Hebb's Rule, McCulloch and Pitts Neurons, Neural Networks, Perceptron: The Learning Rate, The Bias Input, The Perceptron Learning Algorithm, An Example of Perceptron Learning: Logic Functions, Linear Separability: The Perceptron Convergence Theorem, The Exclusive Or Function, Preprocessing, Linear Regression.	**10 Hrs**
MODULE-2	
Multi-Layer Perceptron: Going Forwards, Back Propagation of Error: Multi-Layer Perceptron Algorithm. Initialising the Weights, Different Output Activation Functions, Local Minima, Picking up Momentum, Multi-Layer Perceptron in Practice: Amount of Training Data, Number of Hidden Layers, When to stop learning. **Dimensionality Reduction:** Linear Discriminant Analysis(LDA), Principal Components Analysis (PCA), Independent Components Analysis (ICA), Locally Linear Embedding, ISOMAP.	**10 Hrs**
MODULE-3	
Radial Basis Functions: Receptive Fields, The RBF Networks, Interpolations and Basis Functions **Support Vector Machines:** Optimal Separation, Kernels, SVM Algorithm. **Evolutionary Learning:** The Genetic algorithm, Genetic Operators, Using genetic algorithm**,** Genetic Programming.	**10 Hrs**
MODULE-4	
Reinforcement Learning: Overview, Example: Getting Lost, Markov Decision Processes, Values, Back on Holiday: Using Reinforcement Learning, Difference Between SARSA and Q-Learning, Uses of Reinforcement Learning. **Learning with Trees:** Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees, Classification Example. **Unsupervised Learning:** The k-Means Algorithm, Vector Quantization, Self-Organizing Feature MAP.	**10 Hrs**

TEXT BOOKS:

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC.

REFERENCE BOOKS:

1. **Tom M. Mitchell**, "Machine Learning", McGraw-Hill Education, (INDIAN EDITION), 2013.
2. **Ethem Alpaydin**, "Introduction to Machine Learning", 2nd Edition, PHI Learning Pvt. Ltd., 2013.

Activity Number	Activity Name	Description	Marks	POs
1	Simulation	Building effective machine learning models	10	2,5,9,
2	Seminars	Presentations on different algorithms related to machine learning.	10	2,5,9,

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	PSO 2
CO1	3	2												
CO2	2	1												
CO3	3	2												
CO4	3	2	1											

INFORMATION CODING & CRYPTOGRAPHY

Course Code:22EC652	**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 memoryless 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 sources (memory and memory less) to perform source coding.	1, 2, 3
2.	Determine channel characteristics and channel capacity.	1, 2, 5, 9
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,	**10 Hours**
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 Hours**
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 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.	**10 Hours**
Module-4	
Introduction, Principles of security, Model of Network 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 Hours**

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	1, 2, 5, 9
2	Implementation using MATLAB	1. Taking Two prime numbers and then computing Public and Private key. Then encrypt the message using public key and	10	1, 2, 5, 9

		decrypted using Private key 2. AES Encryption Decryption, Use the Galois field array function, gf, to implement a public key cryptosystem 3. RSA and DES Applications Program.		

Textbooks:

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.

MOOC Course Link:

1. https://archive.nptel.ac.in/courses/108/102/108102117/
2. https://www.coursera.org/learn/basic-cryptography-and-crypto-api
3. https://www.coursera.org/learn/crypto-info-theory

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	2	3			2				1				2	1
CO2	2	3			2				1				2	1
CO3	2	3			2				1				2	1
CO4	2	3			2				1				2	1

Object Oriented Programming with Java

Course Code: 22EC653	LTPC: 3-0-0-3
Exam Hours: **3**	Hours / Week: **3**
SEE: **50 Marks**	Total hours: **40**

Course Objective: Design and develop java application programs using object-oriented concepts.
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 Java constructs for the development of object-oriented programs.	1, 2
2.	Analyze the given java program to make suitable changes.	1, 2
3.	Design a java program for the given problem.	1, 2, 3
4.	Conduct practical experiments for demonstrating object-oriented concepts through java using IDE.	1, 2,5

Course Contents:

MODULE-1	Teaching Hours
Object Oriented Concepts and Java: Concepts of Object-Oriented programming language: Object, Class, Message passing, inheritance, encapsulation, and polymorphism Difference between OOP and other conventional programming – advantages and disadvantages of OOP. **Java Programming Fundamentals**: Java and Java Applications, A first Simple program, handling syntax errors, The Java Keywords, Identifiers inJava. **DataTypesandOperators:**Java'sPrimitiveTypes,ACloserLookatVariables,Operators: Arithmetic, Bitwise, Relational, Boolean Logical, Assignment Operators, Arrays, and Strings.	**10 Hours**
MODULE-2	
ProgramControlStatements:InputcharactersfromtheKeyboard,ifstatement,Nestedifs,if-else-ifLadder,SwitchStatement,Nested switch statements, for Loop, Enhanced for Loop, While Loop, do-while Loop, Nested Loops, Use of break and continue. **Introducing Classes, Objects and Methods:** Class Fundamentals, Declaring Objects, Object Reference Variables, Methods, Constructors, the "This" keyword, Garbage collection	**10 Hours**
MODULE-3	
Inheritance: Inheritance Basics, Member Access and Inheritance, Constructors and inheritance, Using super to C all Super class constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding.	**10 Hours**
MODULE-4	
Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Implementing Multiple Interfaces,and Interfacescanbeextended,NestedInterfaces. Packages: Package Fundamentals, Packages and Member Access, Importing Packages, Static import.	**10 Hours**

ACTIVITIES

Activity Number	Activity Name	Description	Marks	POs
1	Write an application Code using normal Java	Students should write a program for real time application using Java without using OOP concept	10	1,2,3,5 ,9
2	Write an application code in Java using OOP concept.	Students should write code using Java concept and compare the methods.	10	1,2,3,5 ,9

TEXT BOOKS:

1. JavaFundamentals,AcomprehensiveIntroductionbyHerbertSchildt,DaleSkrien.TataMcGrawHillEdition 2013 (Chapters1,2,3,4,5,6,7,8,9,10,12)
2. Java–The complete Reference, by Herbert Schildt Eight Edition Tata Mcgraw Hill Education (Chapter 19).

REFERENCE BOOKS:

1. ProgramminginJAVA2byDrKSomasundaram,Jaicopublications
2. JavaProgrammingbyHariMohanPandey,PearsonEducation,2012.
3. DeitelandDeitel–"JavaHowtoProgram"–6thEd.–Pearson.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	3	1	2		2				1				1	2
CO2	3	1	2		2				1				1	3
CO3	2	1	3		2				1				1	3
CO4	1	2	3		2				1				1	2

5G AND SATELLITE COMMUNICATION

Course Code: 22EC654	**LTPC: 3-0-0-3**
Exam Hours: 3	Hours / Week :3
SEE: **50 Marks**	Total hours :40

Course Objective: Overall knowledge gained in this course will enable the student to become familiar with satellite, and communication with the ground station. Gain the various advanced communication networks and 5G cellular networks.

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

COs	**Statement**	**POs**
1.	Analyse technologies for internet of things, applications in different areas and 5G requirements and initiatives.	1, 2, 3
2.	Inspect 5G architecture, its flexibility and deployment.	1, 2, 5, 9
3.	Comprehend the orbital mechanics and launch methodologies.	1, 2, 5, 9
4.	Understand the basic principles of radio and satellite navigation system	1, 2, 5, 9

Course Contents:

Module-1	**Teaching Hours**
Enabling Technologies for Internet of Everything: Introduction, Enabling Technologies for IoE, Cloud Computing, Fog Computing, Edge Computing, Machine to Machine, Machine Learning, Data Management and Security in Biosystem Management and Protection for IoE, Applications of IoE, Healthcare, Education System Smart Environment, Enabling IoE in Developing Countries. **5G Introduction:** Historical background, From ICT to the whole economy, Rationale of 5G: high data volume, twenty-five billion, connected devices and wide requirements, Global initiatives, Standardization activities.	**10**
Module-2	
5G use cases and system concept: Use cases and requirements, 5G system concepts. **The 5G architecture:** Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment.	**10**
Module-3	
Orbital Mechanics and Launchers: A brief History of Satellite Communication, Kepler's Three Laws of Planetary Motion, Describing the Orbit of a Satellite, Locating the Satellite in the Orbit, Locating the Satellite with Respect to the Earth, Orbital Elements, Look Angle Determination, Orbital Perturbations, Orbit Determination, Space Launch Vehicles and Rockets, Placing Satellites into Geostationary Orbit, Orbital Effects in Communications Systems Performance.	**10**
Module-4	
Satellite Sub-Systems: Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment. **Satellite Navigation & Global Positioning Systems:** The Global Positioning System, Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers, GPS C/A code accuracy, Differential GPS.	**10**

Text Books:

1. **Satellite Communications** – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003

2. **Satellite Communications Engineering** – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud Pearson Publications, 2nd Edition, 2003.

3. **Usman, M., Wajid, M., & Ansari, M.D.** (Eds.). (2020). Enabling Technologies for Next Generation Wireless Communications (1st ed.). CRC Press. https://doi.org/10.1201/9781003003472.

4. **5G and Beyond Wireless Systems Book:** 2021 in Springer Series in Wireless TechnologyEditors: Manish Mandloi, Devendra Gurjar, PrabinaPattanayak, Ha Nguyen

Activity-1	Visit to any unit or organization and submit a detailed report on 5G network architecture, subscription details, bandwidth, Satellite Communication requirements and working principle etc	**10 marks**
Activity-2	Poster Presentation emerging technologies in the current trend	**10 marks**

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**	**PO1 0**	**PO1 1**	**PO12**	**PS0 1**	**PSO2**
CO1	3	2											3	3
CO2	2	3											3	2
CO3	3	2											3	3
CO4	2	3											3	2

Open Elective Course
MEMS

Course Code: 22OEEC61	**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.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}

Upon completion of the course, students shall be able to:

COs	Statements	POs
1.	Demonstrate knowledge on fundamental principles and concepts of MEMS and Nano Technology	1, 2
2.	Apply Science and Engineering Mechanics for microsystems design	1, 2
3.	Apply different fabrication methodology used in MEMS devices.	2, 3
4.	Analyze micro-systems technology for technical feasibility as well as practicality using modern tools 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, Thermo mechanics, 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 – ,Electro-chemistry, 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, revalent Nanoscale Products and Applications, Nanoscale Engineering Analysis, Challenges in Nanoscale Engineering	**10 Hrs**

TEXTBOOKS:

1. Tai Ran Hsu,MEMS and Microsystems Design and Manufacture, TataMcraw Hill,2002.
2. Marc Madou,"Fundamentals of Microfabrication",CRCpress1997.

REFERENCES:

1. Stephen D.Senturia, Micro systemDesign,KluwerAcademicPublishers,2001

2. Chang Liu, “FoundationsofMEMS”,PearsoneducationIndialimited,2006
www.tutorialspoint.com

Activities:

Activities 1 and 2 depend on the presentation simulation and modeling MEMS device. The Opti wave, COMSOL, MEEP simulation tools can be used for the same.

Activity-1	Presentation of reputed journals related to sensors and actuators based. on the: • Displacement, • Force, • Pressure • Optical • Bio, • Chemical, etc.	10 Marks
Activity-2	Simulation and Modelling of sensors and actuators based on the: • Displacement, • Force, • Pressure • Optical • Bio, • Chemical, etc.	10 Marks

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	3	2		3										
CO2	2	3	3	2										
CO3	2	3	3	2										
CO4	2	2	2	2										

EMBEDDED SYSTEMS DESIGN

Course Code: 22OEEC62	**LTPC: 3-0-0-3**
Exam Hours: **3**	Hours / Week: **3**
SEE: **100 Marks**	Total hours: **40**

Course Objective: The objective of this course is to make the students understand the technologies behind the embedded computing systems technology, capabilities and limitations of the hardware & software components.

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.	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 applications of ARM processor.	2, 3
4.	Design and develop the programming skills for embedded devices.	1, 2,3

Course Contents:

MODULE-1	Teaching Hours
Introduction: Embedded system overview, Design challenges, Processor technology, IC technology. **Standard Single-Purpose Processors-Peripherals:** Introduction, Timers /counters and watch dog counters, UART, PWM, Stepper motor controller, ADC.	**10 Hrs.**
MODULE-2	
Memory: Introduction, Common memory types, Composing memory, Memory hierarchy and cache memory, **Communication Interfacing:** Communication basics, Microprocessor Interfacing: I/O addressing, interrupts, DMA. Serial, Parallel and Wireless communication/protocols.	**10 Hrs.**
MODULE-3	
ARM Processor: ARM design Philosophy, Embedded system hardware, embedded system Software. **ARM modes:** Registers, Current status program register, Pipelines, Exceptions, Interrupts and vector table, Core Extensions, Architecture revisions, ARM processor families.	**10 Hrs.**
MODULE-4	
ARM instruction set: Data processing instructions, Load- store instructions, Branch instructions, Software Interrupt instructions, Program status register instructions, Loading constants, ARMv5E Extensions, Conditional execution. **Thumb instruction set:** Thumb register usage, ARM-THUMB interworking, Branch instructions, Data processing instructions, Single register & Multiple register load-store instructions, Stack instructions, Software interrupt instruction.	**10 Hrs.**

TEXT BOOKS:

1.Frank Vahid, Tony Givargis,"Embedded System Design: A Unified Hardware/Software, Introduction", John Wiley & Sons, Inc.2012

2.Andrew N. Sloss, DomonicSymes and Chris Wright,"ARM System Developer's Guide", Elsevier, Morgan Kaufmann Publishers, 2008

REFERENCE BOOKS:

1. Raj Kamal,"Embedded Systems: Architecture and Programming", TMH. 2008

2. "ARM Processor manual", ISM, Bangalore, 2005.

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.

Activity Number	**Activity Name / Description**	**Marks**	**POs**
1	Execution of the ALP listed	10	1,2,3, 5,9
2.	Presentation and report writing	10	1,2,3, 5,9

Mapping of Course Outcomes [COs] and Program Outcomes [POs]:

Course Outcomes	**Program Outcomes [POs]**												**Program Specific Outcomes**	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3	2			2				1	1			2	1
CO2	3	2			2				1	1			2	1
CO3	3	2			2				1	1			2	1
CO4	3	2			2				1	1			2	1

WIRELESS COMMUNICATION

Course Code: 22OEEC63	**LTPC: 3-0-0-3**
Exam Hours: **3**	Hours / Week: **3**
SEE: **100 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: Evolution, 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, Three basic propagation mechanisms, reflection, Ground Reflection (Two-ray) Model, Diffraction, Scattering.	**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, Polarization, 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, Forward CDMA and Reverse CDMA Channels	**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.**

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.

Activity Number	Activity Name	Description	Marks	Pos
1	Report/Presentation	Prepare a report on recent trends in wireless Communication using Reputed Journals	10	2,5
2	Mini Project	Design and Simulate a fading models using suitable simulator	10	2,5,9

Mapping of Course Outcomes [COs] and Program Outcomes [POs]:

Course Outcomes	Program Outcomes [POs]												Program Specific Outcomes	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3	2		2	3								2	3
CO2	1	3	2	3	3								2	3
CO3	3	2		2	3								2	3
CO4	3	2											2	3

NEURAL NETWORKS AND FUZZY LOGIC

Course Code: 22OEEC64	**LTPC: 3-0-0-3**
Exam Hours: **3**	Hours / Week: **3**
SEE: **100 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	Activity Name	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	Conduction of experiments	The latest innovative works 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	3	2										1	1	1
CO2	2	3	1									1	1	1
CO3	3	2	2										1	
CO4	3	2	1										1	