MALNAD COLLEGE OF ENGINEERING,HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous Programme

Bachelor of Engineering

Department of Electronics and Communication Engineering

V and VI Semester
SCHEME and SYLLABUS
(2024-25 Admitted Batch)

Academic Year 2026-27

VISION OF THE INSTITUTE

To be an institute of excellence in engineering education and research, producing socially responsible professionals.

MISSION OF THE INSTITUTE

1. Create conducive environment for learning and research
2. Establish industry and academia collaborations
3. Ensure professional and ethical values in all institutional endeavors

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.

PROGRAMOUTCOMES(POs)

1. **Engineering knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **Design/Development of solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
4. **Conduct investigations of complex problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
5. **Engineering tool usage**: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **The engineer and the world**: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PROGRAMOUTCOMES(POs)

7. **Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

8. **Individual and collaborative team work**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary settings.

9. **Communication**: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

10. **Project management and finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

11. **Life-long learning**: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES

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, in the design and implementation of complex systems.

PSO2: An ability to solve problems using latest hardware and software tools available in E&C Engineering along with analytical skills to arrive at appropriate, cost effective solution.

Scheme of Evaluation(Theory Courses)

Assessment	Marks
CIE1	**10**
CIE2	**10**
CIE3	**10**
Activities as decided by course faculty	**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**

Examination	Maximum Marks	Minimum marks to qualify
CIE	50	20
SEE	50	20

COURSETYPES

Basic Science Course	BSC
Applied Science Course	ASC
Engineering Science Course	ESC
Emerging Technology Course	ETC
Programming Language Course	PLC
Professional Core Course	PCC
Integrated Professional Core Course	IPCC
Professional Core Course Laboratory	PCCL
Professional Elective Course	PEC
Open Elective Course	OEC
Project/MiniProject/Internship	PI
Humanities and Social Sciences, Management Course	HSMC
Ability Enhancement Course	AEC
Skill Enhancement Course	SEC
Skill Development Course	SDC
Universal Human Value Course	UHV
Non-credit Mandatory Course	MC

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FIFTH SEMESTER												
Sl. No	Course Category	Course Code	Course Title	Teaching & Learning scheme (Hours per Semester)					Exam Marks			Credits
				L (Lecture)	T (Tutorial)	P (Practical/Drawing)	TW (Term Work) + SL (Self-Learning)	Total	CIE	SEE	Total	
1.	PCC	24EC501	Digital System Design Using Verilog	42	0	0	48	90	50	50	100	3
2.	PCC	24EC502	Machine Learning	52	0	28	40	120	50	50	100	4
3.	PCC	24EC503	Antenna and Wave Propagation	42	0	0	48	90	50	50	100	3
4.	IPCC	24EC504	Digital Communication	52	0	28	40	120	50	50	100	4
5.	PCCL	24EC505	Hardware Description Language Laboratory	0	0	28	2	30	50	50	100	1
6.	HSMC	24EVS	Environmental Studies	0	28	0	2	30	50	50	100	1
7.	PEC	24PECXXX	Professional Elective Course -I	42	0	0	48	90	50	50	100	3
8.	MC	24NYP3	NSS, YOGA, PE	0	0	28	2	30	100	-	100	A
9.	AEC	24RIP	Research Methodology and IPR	42	0	0	48	90	50	50	100	3
Total												22

Professional Elective Course I	
Course Code	Course Name
24EC511	Operating Systems
24EC512	Data Structures using C
24EC513	Object Oriented Programming using C++
24EC514	Introduction to AI

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SIXTH SEMESTER												
Sl. No	Course Category	Course Code	Course Title	Teaching & Learning scheme (Hours per Semester)					Exam Marks			Credits
				L (Lecture)	T (Tutorial)	P (Practical/Drawing)	TW (Term Work) + SL (Self-Learning)	Total	CIE	SEE	Total	
1.	PCC	24EC601	VLSI Circuits and design	42	0	0	48	90	50	50	100	3
2.	PCC	24EC602	Digital Signal Processing	42	0	0	48	90	50	50	100	3
3.	PCC	24EC603	Optical Fiber Communication	42	0	0	48	90	50	50	100	3
4.	PCCL	24EC604	VLSI Laboratory	0	0	28	2	30	50	50	100	1
5.	PCCL	24EC605	DSP Laboratory	0	0	28	2	30	50	50	100	1
6.	PI	24EC606	Main Project Phase - I	0	0	4	2	4	50	50	100	2
7.	PEC	24EC6XX	Professional Elective Course – II	42	0	0	48	90	50	50	100	3
8.	OEC	24OEEC6X	Open Elective Course - I	42	0	0	48	90	50	50	100	3
9.	MC	24NYP4	NSS,YOGA,PE	0	0	28	0		100	-	100	A
10.	AEC	24ASK	Analytical Ability and Soft Skills	0	0	28	2	30	50	50	100	1
Total												**20**

Open Elective Course – I	
Course Code	**Course Name**
24OEEC61	Sensors and Actuators
24OEEC62	Embedded System Design
24OEEC63	Wireless Communication
24OEEC64	Introduction to Communication Engineering
24OEEC65	E-waste management
24OEEC66	Entrepreneurship and Management
24OEEC67	Electronic Instrumentation and Measurement
24OEEC68	Automotive Electronics

Professional Elective Course – II	
Course Code	**Course Name**
24EC621	Quantum Computation and information
24EC622	Information Coding and Cryptography
24EC623	Object Oriented Programming using JAVA
24EC624	5G Technologies and Beyond

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V Semester

Course Title	DIGITAL SYSTEM DESIGN USING VERILOG		
Course Code	24EC501	(L-T-P) C	LTPC: (3-0-0)3
Exam	3	Hours/Week	3
SEE	50 Marks	Total Hours	42L+38ABL+10EV

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the basic concepts of digital circuits in different levels of modeling using Verilog HDL.	1,2	1
2	Implement abstraction-level, timing, and delay simulations for digital system design.	1, 2,5,8	1, 2
3	Design and verify the functionality of digital circuit/system using test benches.	1, 2, 3, 5,8,9	1,2
4	Develop the programs more effectively using directives, Verilog tasks and constructs.	3, 5, 8,9	1,2

MODULE-1	No. of Hrs. 11

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.

MODULE-2	No. of Hrs. 10

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 buffer/not type gates, rise, fall and turn-off delays, min, max, and typical delays.

MODULE-3	No. of Hrs. 11

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.

MODULE-4	No. of Hrs. 10

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.

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	"Verilog HDL: A Guide to Digital Design and Synthesis"	Samir Palnitkar	Second Edition	Pearson Education	-

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	"The Verilog Hardware Description Language"	Donald E. Thomas, Philip R. Moorby	Fifth edition.	Springer	-
2.	"Advanced Digital Design with the Verilog HDL"	Michael D. Ciletti	Second edition	Pearson	-
3.	"Design through Verilog HDL"	T.R. Padmanabhan, B. Bala Tripura Sundari	-	Wiley Publication	2003

Online Courses and Video Lectures:

1. **https:// nptel.ac.in/courses/106/105/106105165/**
2. **https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs61**
3. **https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee180**

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Class Room Teaching &Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)	-	-	38
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to10 marks	30
Activity Details	Details of activities to be conducted Activity1-Simulation-based activity involves using software tools to create and test digital circuits in a virtual environment (10 Marks). Activity2- Real-World Digital Design Activity Using Verilog**:**The activity involves designing and implementing a real-world digital system using the Verilog Hardware Description Language (HDL). (10 Marks).	20
Total		**50**

Activity Based Learning (38Hours)

ABL1-Simulation-Based Activity:A simulation-based activity involves using software tools to design and test digital circuits in a virtual environment

Component	Description	Hours	Marks
Simulation	Simulation of digital systems using Verilog HDL concepts	6	10
Preparation	Preparation and planning for simulation activities	4	
Execution	Execution and verification of	4	

CO	PO	PSO	Hours
1,3	**1,2,3,5,8**	**1,2**	**18**

	simulation results						
Report Preparation	Documentation of simulation outcomes	4					
ABL2- Real-World Digital Design Activity Using Verilog**:**The activity involves designing and implementing a real-world digital system using the Verilog Hardware Description Language (HDL).				**2,4**	**1,2,3,5,8**	**1,2**	**20**
Component	Description	Hours	Marks				
Problem Identification	Identification of real-world problems	4	10				
Design and Planning	Design planning using Verilog modeling and verification concepts	5					
Implementation	Development and verification of digital systems	7					
Documentation	Preparation of technical reports and presentations	4					
Total Learning Hours/Semester							**38**

Evaluation of Learning Process (10Hours)

Type of Evaluation	**Hours**
CIE (1,2and3)	3
Demonstration of activity and report submission	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

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

Course Title	**MACHINE LEARNING**

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Course Code	24EC502	(L-T-P) C	(4-0-0)-4
Exam	3 hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	52L +68ABL=120

Course Objective: This course will enable students toapply machine learning algorithms for analyzing data and developing solutions to real-world problems.

Course Outcomes: The students should be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply data preprocessing, feature engineering, and supervised and unsupervised machine learning algorithms to solve real-world problems.	1	2
2	Analyze a given problem, identify suitable data models, and select appropriate machine learning algorithms for effective solution development.	2	2
3	Design and implement machine learning models using appropriate algorithms to address real-world engineering applications.	3	2
4	Develop and evaluate machine learning solutions for real-world problems, and effectively communicate the results through technical reports and presentations.	4,5,6,9,10, 11	2

MODULE-1	No. of Hrs.
Introduction to Machine Learning: Introduction, what is Human Learning, Types of Human Learning, what is Machine Learning, Types of Machine Learning,Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields,Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications, State of the art languages/tools in Machine Learning, Issues in Machine Learning. **Preparing to Model:** Machine Learning Activities, Basic Types of Data in Machine Learning. Exploring Structure of Data Self-Study: Problems ML can solve and problems that ML cannot solve.	**13 Hours**
MODULE-2	
ModelingandEvaluation: Introduction,selectingaModel,TrainingaModel,ModelRepresentationandInterpretability**.**Evaluating Performance of a Model. **Learning Problems and Concept Learning:** Find-S, Version Space and Candidate Elimination Algorithm. **Supervised Learning-Classification:** Example of Supervised Learning, Classification Model, Classification Learning Steps. **Self study:**Improving Performance of a Model.	**13 Hours**
MODULE-3	
Supervised Learning-Classification: Common Classification Algorithms- KNN, decision tree, Random Forest model, Support vector machines. **Bayesian Concept Learning:** Why Bayesian Methods are Important, Bayes' Theorem, Bayes' Theorem and Concept Learning. **Regression**: Introduction of regression, Regression algorithms: Simple linear regression, Multiple linear regression.	**13 Hours**
MODULE-4	
Regression: Polynomial regression model, Logistic regression **Unsupervised Learning**: Unsupervised VS Supervised Learning, Application of Unsupervised Learning, Clustering, Finding Patterns using Association Rules. **Other Types of Learning:** Representation Learning, Active Learning, Instance-based Learning	**13 Hours**

Prescribed Textbook:

Sl. No	Book Title	Authors	Publisher	Year
1.	Machine Learning	S Sridhar and M Vijayalakshmi -	Oxford University Press	2021
2.	Introduction to Machine Learning with Python	Andreas C Muller & Sarah Guido	O'Reilly Publication,	2019
3.	Machine Learning	Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das	1st Pearson	2023

Reference Books:

Sl. No	Book Title	Authors	Publisher	Year
1	Machine Learning: Theory and Practice	M N Murty and Ananthanarayana V S	Universities Press (India) Pvt. Limited	2024.
2	Machine Learning	Tom M. Mitchell	McGraw-Hill Education	2013
3	An Introduction to Machine Learning	Miroslav Kubat	Springer	2017

E-Books and online course materials:

1. https://www.cs.cmu.edu/~tom/files/MachineLearningTomMitchell.pdf
2. https://ai.stanford.edu/~nilsson/MLBOOK.pdf
3. https://www.geeksforgeeks.org/ml-machine-learning/
4. https://tinyurl.com/46yeuw4a
5. https://www.javatpoint.com/machine-learning

Web links and Video Lectures (e-Resources):

1. **https://swayam.gov.in/nd1_noc19_cs52/preview**
2. **https://www.coursera.org/learn/machine-learninghttps://tinyurl.com/2n848a96**
3. **nptel.ac.in/courses/106106139**
4. **Mathematical Foundations for Machine Learning - YouTube**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs will be conducted for 20 marks each and reduced to 10 marks	30
Activity Based Learning Details	1. Practical-based learning 2. Mini Project	20
Total		**50**

Activities

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DEPARTMENTOFELECTRONICS AND COMMUNICATIONENGINEERING

PRACTICAL COMPONENT OF MACHINE LEARNING

Teaching-Learning–Evaluation Scheme:

Sl.No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Class Room Teaching & Learning	1	14	14
2.	Activity Based Learning	-	-	40
3.	Evaluation of Learning Process	-	-	14
Total Learning Hours/Semester				68

1. Class Room Teaching &Learning (14 Hours)

Sl. No	Demonstration of algorithms	Hours
1.	Data Preprocessing and Exploratory Data Analysis	5
2.	Machine Learning Algorithms	9
	Total	14

1. Activity Based Learning (40 Hours)

Sl. No	Activity	Hours
1.	Mini Project: Develop a simple machine learning application using real-world data to solve a basic classification or prediction problem.	35
2.	Documentation & Reporting: Prepare a mini-project report containing: problem statement, dataset summary, preprocessing steps, model performance, and conclusions.	05
	Total	40

3. Evaluation of Learning Process (14Hours)

Continuous Evaluation (Max. Marks: 10)

a. Objective:

To evaluate the students' understanding of machine learning concepts, implementation of algorithms, documentation, and interpretation of results obtained through laboratory experiments and mini-project activities.

b. Plan of Action:

- Each student must maintain a laboratory record documenting all experiments and observations.
- Every experiment documented in the record shall include the objective, dataset description, preprocessing steps, algorithm implemented, code, output, performance evaluation, and conclusions.
- Students must demonstrate successful execution of the program and explain the working of the implemented algorithm.

- Evaluation shall be based on program execution, correctness of output, interpretation of results, and maintenance of the laboratory record.
- Continuous evaluation marks will be averaged to a maximum of 10 marks.

Assessment (Max. Marks: 10)

a. Objective:
To assess the students' ability to independently implement machine learning algorithms and develop a mini-project using real-world datasets.

b. Plan of Action:

- Each student will be assigned a laboratory experiment or a mini-project task.
- Students must perform data preprocessing, implement the selected machine learning algorithm, and evaluate the model using appropriate performance metrics.
- Students shall explain the methodology adopted, justify the algorithm selection, and interpret the obtained results.
- Students must submit a mini-project report containing the problem statement, dataset description, preprocessing techniques, model implementation, performance analysis, and conclusions.
- Assessment will be carried out through program demonstration, viva-voce, documentation, and project presentation.

Suggested Rubrics

Component	**Marks**
Laboratory Record & Documentation	4
Program Execution & Correctness	6
Viva-Voce / Understanding of Algorithm	4
Mini Project Implementation & Demonstration	4
Project Report & Result Analysis	2
Total	**20**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3											1	1
CO2		2										1	1
CO3			2									2	2
CO4				3	3	2			3	3	3	2	2

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DEPARTMENTOFELECTRONICS AND COMMUNICATIONENGINEERING

Course Title	Antenna and Wave Propagation		
Course Code	24EC503	(L-T-P) C	(3-0-0)3
Exam	3Hours	Hours/Week	3
SEE	50Marks	Total Hours	42L+38ABL+10E=90

Course Objective: To understand radiation mechanisms, antenna parameters, antenna design techniques, applications of antennas, and modes of wave propagation in communication systems.

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

#	Course Outcomes	Mapping to PO's	Mapping toPSO's
1	Understand the fundamentals of antennas, antenna parameters, radiation mechanisms, and point source arrays used in communication systems.	1, 2,	1,2
2	Analyze the characteristics and performance of electric dipole, loop, slot, and thin linear antennas with respect to radiation patterns, impedance, and efficiency.	1, 2, 4, 5, 8, 9, 11	1,2
3	Analyze the design, operating principles, and applications of HF, VHF, UHF, and microwave antennas.	1, 2, 3, 4, 5, 8, 9, 11	1,2
4	Apply the principles of ground, space, and sky wave propagation to analyze radio communication systems.	1, 2, 5, 8, 9, 11	1,2

MODULE-1	11Hrs.

Introduction to Antennas, Types of Antennas, 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 ratio, VSWR (Voltage Standing Wave Ratio), Return Loss, Bandwidth and Polarization.

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.

MODULE-2	10 Hrs.

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.

Loop and Slot 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, Slot antenna concept, Babinet's principle and complementary antennas,

MODULE-3	11 Hrs.

HF, VHF, and UHF antennas: Resonant antennas, non-resonant antennas, antennas, Rhombic antenna, Yagi-Uda antenna, log-periodic, Helical antenna, Smart-Antenna Analogy, Fractal Antennas

Microwave antennas –Parabolic reflectors and working principles, feed systems for parabolic reflectors, Horn Antenna and its types. Microstrip patch antenna.

MODULE-4	10Hrs

Basics of wave propagation: Introduction, classification based on modes of operation,

Ground wave propagation: Introduction, planeearth reflection, space wave and surface wave, transition between surface and space waves, tilt of wave front due to ground losses, impact of imperfect earth, curved earth reflections**.**

Space Wave Propagation: Introduction, field strength relation, troposphere propagation, fading, path loss calculations and

Sky Wave Propagation: Structural details of the Ionosphere

Prescribed Text Book:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Antennas and Wave Propagation	John D Kraus, Ronald J Marhefka and Ahmad S Khan,	5th	McGraw-Hill Education	2017 **ISBN:** 9789352606184
2	Antennas and wave propagations	GSN Raju	3rd	Pearson Education / Dorling Kindersley (India)	2018
3	Antenna Theory: Analysis and Design	Constantine A. Balanis	4th	John Wiley & Sons	2016

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Antennas for all applications	John D Kraus et. al.	3rd	Tata McGraw-Hill.	2006
2.	Antenna Theory and Design	Warren L. Stutzman, Gary A. Thiele	3rd	John Wiley & Sons	2012

E-Books and online course materials:

1. **https://www.amazon.in/Antennas-Wave-Propagation-John-Kraus/dp/0070671559**
2. **https://books.google.com/books?id=icy-_fN8vVsC&printsec=frontcover**
3. **https://www.udemy.com/course/antennas-and-wave-propagation-a-core-of-antenna-design/?srsltid=AfmBOorAbe6I4X6m5tLYm2pZO3WNc_8gXOxftnzHzjqt2OFQYm1oQZ_6&couponCode=NVDINCTA35TRT**
4. **https://online.vtu.ac.in/course-details/Microwave-and-Antennas**

Online Courses and Video Lectures:

1. **https://www.coursera.org/learn/microwave-antenna**
2. https://onlinecourses.nptel.ac.in/noc20_ee20/preview
3. https://www.udemy.com/course/rf-antenna-fundamentals/
4. https://www.ucl.ac.uk/short-courses/search-courses/antennas-and-propagation

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No.of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Classroom Teaching & Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)	-	-	38
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
Internals	Three CIEs will be conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Activity 1: Design and simulation of antennas (such as dipole, microstrip patch, or Yagi-Uda) using electromagnetic simulation software like ANSYS HFSS or CST. Students should analyze radiation pattern, gain, VSWR, and return loss and prepare a technical report. *(10 Marks)* Activity 2: Fabrication of a simple antenna on copper-clad substrate. *(10 Marks)*	20
Total		**50**

Activity Based Learning(38Hours)

ABL1(15Hours): Students will learn antenna design concepts and perform simulations using ANSYS HFSS. They will design basic antennas such as dipole or microstrip patch and analyze parameters like radiation pattern, gain, VSWR, return loss, and bandwidth. Theoretical results will be compared with simulation outcomes, and a technical report will be prepared.		**Hours**
1.	Study of radiation pattern of a half-wave dipole antenna	2
2.	Design and simulation of dipole antenna	2
3.	Design and simulation of microstrip patch antenna	2
4.	Analysis of antenna parameters (gain, directivity, VSWR, return loss)	2
5.	Study of antenna radiation patterns using polar plots	1
6.	Design and analysis of Yagi-Uda antenna	1
7.	Study of loop antenna characteristics and radiation pattern	1
8.	Measurement of resonant frequency and impedance of antenna using VSWR meter	1
9.	Study of ground wave, space wave and sky wave propagation characteristics	2
10.	Analysis of path loss and signal strength variation in free space propagation	1
Total		**15**
ABL2(23Hours): Students will fabricate simple antennas such as dipole or microstrip patch antenna using copper-clad substrate. They will follow proper design dimensions and construction procedures. Students will document the fabrication process, observations, and outcomes in a technical report.		**Hours**
Students will fabricate simple antennas such as half-wave dipole, quarter-wave monopole, microstrip patch antenna, Rhombic antenna, V antenna, Inverted V antenna, slot antenna, loop antenna, small loop antenna, folded dipole, sleeve dipole, a basic 3–5 element Yagi-Uda antenna, a simple horn antenna model, helical antenna, parabolic reflector antenna, log-periodic antenna, and fractal antenna using copper-clad substrate or wire setup.		23
Total Learning Hours/Semester		**38**

Evaluation of Learning Process(10Hours)

Type of Evaluation	**Hours**
Test(1,2and3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	**Program Outcomes[POs]**											**PSO's**	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2										2	2
CO2	3	3		2	2			1	1		1	3	2
CO3	2	3	3	2	2			1	1		1	3	3
CO4	2	3			2			1	1		1	2	3

MALNAD COLLEGE OF ENGINEERING, HASSAN
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Title	DIGITAL COMMUNICATION	
Course Code	24EC504	LTPC: (3-0-2)4
Exam	3	Hours/Week :5
SEE	50 marks	Total Hours: (42L +28P+50ABL)=120

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: With mapping shown against the Program Outcomes (POs)

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Comprehend the basics of digital communication, sampling and waveform coding techniques such as PCM, DPCM, and DM.	1, 2,5,8	1,2
2	Analyze the various sampling techniues, baseband transmission, pulse shaping, PAM signals, ISI, and Nyquist criterion for distortion less transmission.	2,3,5,8	1,2
3	Analyze different digital modulation techniques and compare binary and quaternary modulation methods.	2,3,5,8	1,2
4	Understand spread spectrum techniques, PN sequences, DSSS, and FHSS used in digital communication systems.	1, 2,3,5,8,11	1,2

MODULE-1	No. of Hrs. 10

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 (T1 carrier).

MODULE-2	No. of Hrs. 10

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.

MODULE-3	No. of Hrs. 10

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

MODULE-4	No. of Hrs10

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.

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Digital Communication	**Simon Haykin**	2nd Edition	John Wiley and sons	2004

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Digital and analog Communication System	**K.SamShanmugham**	2nd Edition	John Wiley and sons	2008
2.	Introduction to Analog and Digital Communication System	**Simon Haykin**	2nd Edition	John Wiley and sons	2004

Online Courses and Video Lectures:

1. https://www.youtube.com/watch?v=XyZerq7-IvA
2. https://www.youtube.com/watch?v=xltpukBncs8

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	ThreeCIE's conductedfor20markseach and reduced to 10 marks	30
Laboratory Component	Conduction and Simulation of the different digital modulation techniques	20
Total		**50**

PRACTICAL COMPONENT OF DIGITAL COMMUNICATION

Teaching -Learning– Evaluation Scheme:

Sl.No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
4.	Class Room Teaching & Learning	3	14	42
5.	Lab Conduction	2	14	28
6.	Activity Based Learning	-	-	40
7.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**120**

Laboratory experiments (for integrated course):

Lab Program	Hardware
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
	Simulation using Multisim / MATLAB
1.	PCM generation and Detection
2.	DPCM generation and Detection
3.	DM generation and Detection
4.	ADM generation and Detection

5.	DSSS Mbaseband transmission and detection
6.	DSSSM with BPSK transmission and detection
7.	MSK modulator and demodulator
8.	Slow FHSS Hopping and De-hopping
9.	Fast FHSS Hopping and De-hopping

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, components required, circuit, theory related to the experiment, theoretical calculation and results obtained.**
- **Each experiment will be evaluated and will be averaged to 10 marks.**

Assessment (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 theoretical calculations followed by practical (Hardware/Simulation) conduction of the experiment after getting approval from the concerned course faculty.**
- **Document the results obtained and compare the theoretical and practical (Hardware/Simulation) results.**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO2**
CO1	3	2			2			2				3	2
CO2		2	2		2			2				2	2
CO3		2	2		2			2				2	2
CO4	2	3	2		2			2			1	2	1

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Title	HARDWARE DESCRIPTION LANGUAGE LABORATORY		
Course Code	24EC505	(L-T-P) C	(0-0-2)1
Exam	3	Hours/Week	2
SEE	50 marks	Total Hours	28P+2E=30

Course Objective: Students will gain hands-on experience in simulating, testing, and debugging combinational and sequential circuits using Xilinx design tools.

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

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

COs	Statement	POs	PSOs
1.	Demonstrate the use of the ISE Simulator for modeling and simulation of combinational and sequential circuits.	1,2,5,8	1,2
2.	Design and develop Verilog HDL descriptions, create test benches for functional verification, and implement on CPLD/FPGA platforms.	1,2,3,5,8	1,2
3.	Document the design, implementation, verification, and analysis of combinational, sequential and arithmetic logic circuits through technical reports.	5,8,9	1,2

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/Week	No. of Weeks	Hours/ Semester
1	Lab Conduction	2	14	28
2	Evaluation	-	-	02
Total Learning Hours/Semester				30

ABL: Lab based learning (28Hrs.)

Exp No.	Experiment Title	Hours
I	**Programming**	
1.	Verilog code to realize all the logic gates.	2
2.	Verilog program for Encoder without priority and with priority.	2
3.	Verilog code for Multiplexer, De-multiplexer, Comparator, Code converters.	2+2
4.	Verilog code to describe a Half Adder/Half Subtractor using different Modeling styles.	2
5.	Verilog code to describe a Full adder/Full Subtractor using different modeling styles.	2
6.	Verilog code for a) 4-bit parallel adder b)4-bit ALU/8-bit ALU.	2
7.	Verilog codes for SR, D, JK, T-flip-flops.	2
8.	Designing 4-bit Binary counter, BCD counter and any arbitrary sequence counter.	2
9.	Verilog code for Shift left; Shift right, SIPO, SISO, PISO, PIPO operations	2
10.	Verilog code for Ring counter/Johnson counters.	2
II	**Interfacing**	

1.	Stepper Motor.	2
2.	DC Motor.	2
3.	DAC interface.	2

Proposed Assessment Plan for 50 marks:

Tool	Remarks	Marks
Assessment method	Continuous Evaluation Record writing Lab CIE	10 20 20
Total		**50**

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.

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc24_cs61/preview?utm_source=chatgpt.com
2. https://onlinecourses.nptel.ac.in/noc25_ee180/preview?utm_source=chatgpt.com

Course Articulation Matrix

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

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Professional Elective Course I

Course Title	**OPERATING SYSTEMS**		
Course Code	**24EC511**	**(L-T-P)C**	**(3-0-0)3**
Exam	**3 Hours**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**42L+38ABL+10E=90**

Course Objective: To enable the students to understand the fundamentals of operating systems, scheduling, memory management techniques and organization of file systems.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the fundamental concepts of operating systems, system structures, operating system services, process management, threads, and process scheduling algorithms..	1, 2,5,8,11	1,2
2	Analyze process synchronization mechanisms, scheduling techniques, and deadlock handling methods in operating systems.	1, 2, 3,5,8,11	1,2
3	Design memory management and file system solutions using concepts of paging, virtual memory, file organization, allocation methods, and storage management techniques.	1, 2, 3,5,8,11	1,2
4	Develop real-time system applications using RTOS concepts, hardware architectures, RTOS building blocks, and real-time kernel functionalities.	1, 2, 3,5,8,11	1,2

MODULE-1	**11Hrs.**

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;

MODULE-2	**10 Hrs.**

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.

MODULE-3	**11Hrs.**

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: File System: File concept; Access 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	**10Hrs**

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

Prescribed Text Book:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Operating System Principles	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	8th edition	Wiley-India	2012
2.	Real-Time System Design and Analysis	Philips A. Laplante	3rd Edition	John Wley & Sons	2004

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Operating systems - A concept based Approach	D.M Dhamdhere	2nd Edition	Tata McGraw-Hill	2002
2.	Operating Systems	P.C.P. Bhatt	2nd Edition	PHI	2006
3.	Operating systems	Harvey M Deital	3rd Edition	Pearson Education	1990

E Books and Online course material:

1. https://www.pearson.com/en-us/subject-catalog/p/modern-operating-systems/P200000003479/9780137618880?utm

Online course and video lecture:

1. **https://youtu.be/jciGIvn7UfM?si=36Fb3NmzcQ841a-L**
2. **https://ocw.mit.edu/courses/6-828-operating-system-engineering-fall-2012/?utm**

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Class Room Teaching &Learning	3	14	42
2.	Activity Based Learning (ABL1 & ABL2)	-	-	38
3.	Evaluation ofLearning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
Internals	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted Activity1-Laboratory component (10 Marks). Activity2- Mini Project (10 Marks).	20
Total		**50**

Activity Based Learning (38 Hours)

ABL1(15Hours): Laboratory component		**Hours**
1.	Apply the concepts of Process control system calls to build applications to demonstrate use of fork, execve, wait, getpid, exit system calls	15
2.	Apply the pthread library to build Applications to demonstrate use of pthread library functions to create and manage threads.	15
3.	Apply the concepts of Process/Thread synchronization to build Applications to demonstrate process/ thread synchronization using semaphores and mutex. Implement Dining philosophers problem, reader-writer and producer-consumer.	15
4.	Apply the concepts of Process/Thread synchronization for file access to build applications to demonstrate process/thread synchronization using file locks.	15
Total		**15**
ABL2 (23Hours): Mini Project The students are expected to implement a mini project using operating system concepts and APIs/system calls. They are required to form a team with constraint of maximum 3 persons in a team, select a problem/application of their choice to implement and to take confirmation from faculty in charge before starting the project. The objectives of project implementation are: □□Explore and understand underlying architecture, kernel structure and associated components for implementation of the project.□□Design and implement the solution using appropriate tools and platform.□□Documentation and submission of report		**Hours** 23
Total Learning Hours/Semester		**38**

Evaluation of Learning Process (10Hours)

Type of Evaluation	**Hours**
Test(1,2and3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	**Program Outcomes[POs]**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	-	-	1	-	-	2	-	-	2	1	1
CO2	2	2	1	-	1	-	-	2	-	-	1	2	1
CO3	2	3	2	1	3	-	-	2	-	-	2	2	2
CO4	2	2	2	1	2	-	-	2	-	-	1	2	3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Title	DATA STRUCTURES USING C		
Course Code	24EC512	(L-T-P) C	(3-0-0)3
Exam	3	Hours/Week	3
SEE	50 Marks	Total Hours	42L+38ABL+10EV

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand various types of data structures and operations performed on it	1,5,8	2
2	Design and implement operations on trees and various types of queues.	1,3,5,8,9	2
3	Construct hash tables and implement operations on linked lists.	1,3,5,8,9	2
4	Apply stacks to solve computational problems and implement various searching and sorting techniques.	2, 3,5,8,9	2

MODULE-1	No. of Hrs. 11

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)

MODULE-2	No. of Hrs. 11

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)

MODULE-3	No. of Hrs. 10

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)

MODULE-4	No. of Hrs. 10

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)

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	"Data Structures using C"	Reema Thereja	Second edition	Oxford Press	2014
2.	"Data Structures and Algorithm Analysis in C"	Mark Allen Weis	Second Edition	Pearson Education	2003

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	"Data structures using C and C++"	Y. Langsam, M. J. Augenstein, A.M. Tanenbaum	2ndEdition	-	2002

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/106102064
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs81
3. http://www.digimat.in/nptel/courses/video/106106133/L39.html

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
4.	Class Room Teaching &Learning	3	14	42
5.	Activity Based Learning (ABL1&ABL2)	-	-	38
6.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to10 marks	30
Activity Details	Details of activities to be conducted Activity1-Simulation-Based Learning Activity:The activity involves learning and analyzing Data Structures concepts in the C programming language using simulations tools (10 Marks). Activity2- Real-World Problem-Solving Activity: The activity focuses on solving practical real-world problems using Data Structures in C programming(10 Marks).	20
Total		**50**

Activity Based Learning (38Hours)

ABL1-Simulation-Based Learning Activity:The activity involves learning and analyzing Data Structures concepts in the C programming language using simulations tools.

Component	Description	Hours	Marks
Simulation	Simulation of data structure operations using C programming concepts	6	10
Preparation	Preparation and planning for implementation activities	4	
Execution	Execution of data structure implementations	4	
Report Preparation	Documentation of activity outcomes	4	

CO	PO	PSO	Hours
1,4	**1,2,3,5 ,8,9**	**2**	**18**

ABL2- Real-World Problem-Solving Activity: The activity focuses on solving practical real-world problems using Data Structures in C programming.	**2,3,4**	**1,2,3,5 ,8,9**	**2**	**20**

Component	Description	Hours	Marks				
Problem Identification	Identification of real-world problems	4	10				
Design and Planning	Design of solutions using stacks, queues, linked lists and trees	5					
Implementation	Development and testing of data structure solutions	7					
Report Preparation	Preparation of technical reports	4					
Total Learning Hours/Semester							**38**

Evaluation of Learning Process (10Hours)

Type of Evaluation	**Hours**
CIE (1,2and3)	3
Demonstration of activity and report submission	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3				2			2					2
CO2	2		3		2			2	1				3
CO3	2		3		2			2	1				3
CO4		3	2		2			2	1				3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Title	OBJECT ORIENTED PROGRAMMING using C++		
Course Code	24EC513	(L-T-P) C	(3-0-0)3
Exam	3 hours	Hours/Week	3
SEE	50 Marks	Total Hours	42L+48ABL=90

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: with mapping shown against the Program Outcomes (POs)

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

Sl. No.	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Apply the concepts of object-oriented programming using classes and objects.	1, 2	1
2	Describe syntax, functions and OOP concepts using C++.	1, 2,8,9	1, 2
3	Develop C++ Programs using inheritance, Classes and pointers.	1, 2,8,9	1, 2
4	Illustrate the process of console I/O and file stream operations using C++.	1, 2	1

MODULE-1 — **No. of Hrs. 11**

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.

MODULE-2 — **No. of Hrs. 10**

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.

MODULE-3 — **No. of Hrs. 11**

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.

MODULE-4 — **No. of Hrs 10**

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.

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Object Oriented Programming with C++	**E. Balagurusamy.**	6th edition	McGraw Hill Education (India) Private Limited	2014

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Object Oriented Programming using C++	**Robert Lafore**	1st edition	Golgotha publications	2004

Online Courses and Video Lectures:

1. https://www.youtube.com/watch?v=2Dhec_2zGUk
2. https://www.youtube.com/watch?v=mlIUKyZIUUU

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
7.	Classroom Teaching &Learning	3	14	42
8.	Activity Based Learning (ABL1&ABL2)	-	-	38
9.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to10 marks	30
Activity Details	Details of activities to be conducted 1) Details of activity 1- Students has to write a program for real time application using C++ without using OOP concept 2) Details of activity 2- For same application they have to write code using OOP concept and compare the methods.	20
Total		**50**

Course Articulation Matrix

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

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Title	ARTIFICIAL INTELLIGENCE		
Course Code	24EC514	(L-T-P) C	(3-0-0)3
Exam	3	Hours/Week	3
SEE	50 Marks	Total Hours	42L+10+38ABL=90

Course Objective: The students should be able to study the concepts of Artificial Intelligence and learn the methods of solving problems using Artificial Intelligence

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Formulate real-world problems using appropriate Artificial Intelligence concepts	1, 2,9,11	1,2
2	Apply search, game-playing, and planning techniques to solve AI problems effectively.	1, 2,5,8	1,2
3	Evaluate and model uncertain environments using probabilistic reasoning and knowledge representation techniques.	1,2,5,9	1,2
4	Design and implement machine learning and AI algorithms for practical engineering applications.	1, 2,3, 5,8,11	1,2

MODULE-1 — No. of Hrs.11

INTRODUCTION What is AI?, History of AI, state of the art, Risk and Benefits of AI, Intelligent agents structure of agents

PROBLEM SOLVING: Solving problems by searching, Search Algorithms, Informed and Uninformed Search, Local search and optimization problems.

Self Study: Applications of Artificial Intelligence.

(**Text Book 1:** 1.1,1.3,1.4,1.5, 2.1,2.4, 3.1,3.2, 3.3, 3.4, 3.5 and 4.1)

MODULE-2 — No. of Hrs.11

CONSTRAINT SATISFACTION PROBLEMS: Defining Constraint Satisfaction Problems, game theory, optimal decisions in games, knowledge based agents and the Wumpus world.

AUTOMATED PLANNING: Definition of Classical Planning**,** Algorithms for Classical Planning, Time, Schedules and Resources.

Self Study: Baye's Rule

(**Text Book 1:** 5.1, 6.1, 6.2, 7.1, 7.2, 11.1, 11.2, 11.6, 12.5.)

MODULE-3 — No. of Hrs.10

PROBABILISTIC REASONING: Representing knowledge in an uncertain domain, Semantics of Bayesian Networks, Time and Uncertainity, Kalman Filters, Dynamic Bayesian Networks.

Self Study: Clustering Algorithms.

(**Text Book 1:** 13.1,13.2, 14.1, 14.4, 14.5).

MODULE-4 — No. of Hrs.10

MACHINE LEARNING: Forms of learning, Supervised Learning, Learning Decision Trees, Model selection and Optimization, The theory of Learning, Linear Regression and Classification, Non-Parametric models, Developing Machine Learning systems.

Self Study: Ensemble Learning.

(**Text Book 1:** 19.1 to 19.9).

Prescribed Text Book:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Artificial Intelligence: A Modern Approach	Stuart J. Russell and Peter Norvig	4th	Pearson Education, India	2021

Reference Book:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Artificial Intelligence: A guide for thinking humans by Melanie Mitchell.	Melanie Mitchell	1st	Farrar, Straus and Giroux	2019
2.	Artificial Intelligence: A Guide to Intelligent Systems	Michael Negnevitsky	4th	Pearson	2024

EBooks and online course materials:

1. https://www.youtube.com/watch?v=Yq0QkCxoTHM
2. https://www.youtube.com/watch?v=nVyD6THcvDQ
3. http://digimat.in/nptel/courses/video/106102220/L01.html

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2. https://nptel.ac.in/courses/106102220
3. https://onlinecourses.nptel.ac.in/noc24_ge47/preview

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
10.	Class Room Teaching &Learning	3	14	42
11.	Activity Based Learning (ABL1 & ABL2)	-	-	38
12.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
Internals	Three tests conducted for 20 marks each and reduced to10marks	30
Activity Details	Details of activities to be conducted Activity 1 - Simulation of algorithms using python or any other suitable language. (10 Marks). Activity 2 - Implementation of algorithms for Practical Applications. (10 Marks).	20
Total		**50**

Activity Based Learning (38 Hours)

ABL1 (15 Hours): Simulation of algorithms covering problem solving, search techniques, planning, reasoning, probabilistic models, and learning methods using Jupiter/Colab Software and obtain the simulation results. (Any one Experiment in the following list of experiments). **CO's:CO1 and CO2** **PO's: PO1, PO2, PO5, PO8, PO9 and PO11** **PSO's: PSO1 and PSO2**		**Hours**
5.	Simulation of Breadth First Search and Depth First Search	15
6.	Implementation of A* Path Finding Algorithm for Robot Navigation	15
7.	Simulation of 8-Puzzle Problem using Best First Search	15
8.	Tic-Tac-Toe Game using Minimax Algorithm	15
9.	Map Coloring using Constraint Satisfaction Problem (CSP)	15
10.	Water Jug Problem using State Space Search	15
11.	Chatbot Simulation using Rule-Based Knowledge Representation	15
12.	Hidden Markov Model Simulation for Weather Prediction	15
13.	Reinforcement Learning for Simple Maze Navigation	15
14.	Naïve Bayes Classifier for Email Spam Detection	15
Total		**15**
ABL2 (23Hours): Implementation of algorithms for various Practical Applications		Hours
The implementation of algorithms for Practical Applications covering intelligent agents, search techniques, planning, probabilistic reasoning, machine learning, reinforcement learning, and language processing. **CO's:CO3 and CO4** **PO's: PO1, PO2, PO3, PO5, PO8, PO9 and PO11** **PSO's: PSO1**		23
Total Learning Hours/Semester		**38**

Evaluation of Learning Process (10Hours)

Type of Evaluation	**Hours**
Test (1,2 and 3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3	2							1		1	2	2
CO2	3	3			2			1				2	2
CO3	3	3			2				1			2	2
CO4	3	2	1		2			1			1	2	2

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VI Semester

Course Title	VLSI Circuits		
Course Code	24EC601	(L-T-P) C	(3-0-0)3
Exam	3 Hrs	Hours/Week	3
SEE	100	Total Hours	42L+38ABL+10E=90

Course Objective: To impart knowledge of CMOS VLSI design principles, including MOS device characteristics, CMOS logic and fabrication, layout and physical design methodologies, processing technologies, and timing analysis, enabling students to design and optimize reliable and efficient VLSI circuits and systems.

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

Upon completion of the course, students shall be able to

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Comprehend the fundamentals of CMOS technology, MOS transistors, CMOS logic gates, and sequential circuits used in VLSI systems.	1,2	1
2	Apply manufacturing rules such as DRC, circuit extraction, antenna rules, and layer density rules in CMOS VLSI design and verification.	1,2,3	1
3	Design CMOS circuits by considering the effects of threshold voltage, temperature, and device geometry variations to achieve desired performance characteristics.	1, 2,3,5,8,9	1,2
4	Evaluate the performance of CMOS circuits through simulation by analyzing parameters such as delay, power consumption, and noise margins.	1,2,3,5,8,9	1,2

MODULE-1 — No. of Hrs.: 10

Introduction: A Brief History, Preview, MOS Transistors, CMOS Logic: The Inverter, The NAND Gate, CMOS Logic Gates, The NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers , Sequential Circuits, CMOS Fabrication and Layout: Inverter Cross-Section, Fabrication Process, Layout Design Rules, Gate Layouts , Stick Diagrams, Design Partitioning: Design Abstractions, Structured Design, Behavioral, Structural, and Physical Domains, Example: A Simple MIPS Microprocessor, Physical Design: Floor planning, Standard Cells, Pitch Matching, Slice plans, Arrays, Area Estimation. [Text 1: Chapter 1]

MODULE-2 — No. of Hrs.: 10

MOS Transistor Theory: Introduction, Long-Channel I-V Characteristics, C-V Characteristics: Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Detailed MOS Diffusion Capacitance Model, Nonideal I-V Effects**:** Mobility Degradation and Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Leakage, Temperature Dependence, Geometry Dependence, DC Transfer Characteristics**:** Static CMOS Inverter DC Characteristics, Beta Ratio Effects, Noise Margin, Pass Transistor DC Characteristics. [Text 1: Chapter 2]

MODULE-3 — No. of Hrs.: 11

CMOS Processing Technology: Introduction, CMOS Technologies**:** Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO_2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Metrology, Layout Design Rules**:** Design Rule Background, Scribe Line and Other Structures, MOSIS Scalable CMOS Design Rules, Micron Design Rules, CMOS Process Enhancements**:** Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS, Technology-Related CAD Issues**:** Design Rule Checking (DRC), Circuit Extraction, Manufacturing Issues: Antenna Rules, Layer Density Rules. [Text 1: Chapter 3]

MODULE-4	No. of Hrs.: 11
Delay: Introduction**,** Definitions, Timing Optimization, Transient Response, RC Delay Model**:** Effective Resistance, Gate and Diffusion Capacitance, Equivalent RC Circuits, Transient Response, Elmore Delay, Layout Dependence of Capacitance, Determining Effective Resistance, Linear Delay Model**:** Logical Effort, Parasitic Delay, Delay in a Logic Gate, Drive, Extracting Logical Effort from Datasheets, Limitations to the Linear Delay Model, Logical Effort of Paths:Delay in Multistage Logic Networks, Choosing the Best Number of Stages, Example, Summary and Observations, Limitations of Logical Effort, Iterative Solutions for Sizing. [Text 1: Chapter 4]	

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	CMOS VLSI Design- A Circuits and Systems Perspective	Neil H E Weste, and David Money Harris	4th	Pearson.	2015

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Principles of CMOS VLSI Design- A Systems Perspective	Neil H E Weste and Kamran Eshraghain	4th	Perason	2008
2	Introduction to VLSI Design	Eugene D Fabricius	4th	Pearson.	2009
3	Basic VLSI Design	Douglas A Pucknell, Kamran Eshraghian	3rd	PHI	2005
4	Fundamentals of Modern VLSI Devices	Yuan Taur and Tak H. Ning	3rd	Cambridge University Press	2022

E-Books and study materials:

1. **https://www.linkedin.com/posts/suresh-kumar-63507638_notes-for-coms-digital-vlsi-design-activity-7068210486604894208-R7bV?utm**
2. **https://digimat.in/nptel/courses/video/108107129/L01.html?utm**

Online Courses and Video Lectures:

1. **https://nptel.ac.in/courses/108106158?utm**
2. https://nptel.ac.in/courses/106103237?utm
3. https://nptel.ac.in/courses/117101106?utm

Teaching -Learning– Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Classroom Teaching & Learning	3	14	42
2.	Evaluation of Learning Process	-	-	10
3.	Activity Based Learning	-	-	38
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1) Details of activity 1: Simulation 2) Details of activity 2: Flipped Class	20
Total		**50**

Evaluation of Learning Process (10Hours)

Type of Evaluation	Hours
Test(1,2and3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Activity Based Learning (38 Hours)

ABL1 (30Hours): Each student selects different analog or digital circuits for the layout design.		**Hours**
1.	Selection of the circuit to be designed and the software tool required for the same.	8
2.	Analysis of the working of the circuit.	6
3.	Simulate the circuit and design the layout.	10
4.	Conclusion and prepare the report.	6
Total		**30**
ABL2 (8Hours): Discuss the designing of circuit simulation and layout Design.		**Hours**
Step 1: Pre-Class Preparation		1
Step 2: Pre-Class Assessment		1
Step 3: In-Class Engagement		2
Step 4: Collaborative Learning		2
Step 5: Post-Class Assessment		1
Step 6: Reflection and Follow-Up		1
Total Learning Hours/Semester		**38**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO2**
CO1	3	2										2	
CO2	2	2										2	
CO3	3	2	2		2			2	2			2	2
CO4	3	2	2		2			2	2			2	2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Title	Digital Signal Processing		
Course Code	24EC602	(L-T-P) C	(3-0-0)3
Exam	3Hours	Hours/Week	3
SEE	50Marks	Total Hours	42L+38ABL+10E=90

Course Objective: To enable students to understand and apply concepts of Digital Signal Processing for analysis of signals, design of digital filters, and realization of DSP systems.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the fundamentals of Digital Signal Processing and analyze discrete-time signals using DFT and its properties.	1, 2, 3	1,2
2	Apply Fast Fourier Transform (FFT) algorithms and efficient convolution techniques such as overlap-add and overlap-save for spectral analysis and signal processing.	1, 2, 3, 5, 7, 8, 9, 11	1,2
3	Design and implement FIR and IIR digital filters using various techniques such as windowing, frequency sampling, and analog-to-digital transformations.	1, 2, 3, 5, 7, 8, 9, 11	1,2
4	Illustrate digital filter structures and assess the architecture and performance of Digital Signal Processors for real-time applications.	1, 2, 3, 5, 7, 8, 9, 11	1,2

MODULE-1	11Hrs.
Introduction to discrete-time signals and systems. Frequency domain sampling and reconstruction of discrete-time signals. Discrete Fourier Transform (DFT) as a linear transformation. DFT relationship with other transforms. Properties of DFT. Circular convolution and its relationship with linear convolution. Additional properties and applications of DFT.	
MODULE-2	**10 Hrs.**
Overlap-save and overlap-add methods for linear filtering. Direct computation of DFT. Efficient computation using FFT algorithms. Radix-2 FFT algorithms for DFT and IDFT using Decimation-in-Time (DIT) and Decimation-in-Frequency (DIF) approaches. Goertzel algorithm. Chirp Z-transform and its applications.	
MODULE-3	**10 Hrs.**
Introduction to FIR and IIR filters. FIR filter design using window techniques (Rectangular, Hanning, Hamming). Frequency sampling method for FIR design. Characteristics of analog filters. Design of Butterworth filter. Impulse invariance method and bilinear transformation for IIR filter design. Mapping of transfer functions from analog to digital domain.	
MODULE-4	**11Hrs**
Structures for realization of digital filters: Direct Form I and Direct Form II for FIR and IIR systems. Introduction to Digital Signal Processors. Architectural features of DSP processors. Generations of DSPs. Fixed-point and floating-point number representation. Detailed study of TMS320C67xx processor architecture and features. Introduction to real-time DSP concepts and applications in audio, speech, image, and communication systems.	

Prescribed Text Book:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Digital Signal Processing: Principles, Algorithms and Applications	John G. Proakis, Dimitris G. Manolakis	5th	Pearson Education	2021 **ISBN:** 9780137348657
3	Digital Signal Processing	Monson H. Hayes	3rd	Tata McGraw Hill Education	2008 **ISBN:** 978-0071154251

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Digital Signal Processing	S. Salivahanan	4th	Tata McGraw-Hill.	2019 **ISBN:** 9789353167424
2.	Digital Signal Processing: Theory & Lab	D. Ganesh Rao , Vineeta P. Gejji	2nd	Pearson Education	2010
3.	Digital Signal Processing	P. Ramesh Babu	2nd	Scitech Publications	2006
4.	Digital Signal Processing	A. Anand Kumar	2nd	PHI Learning Pvt. Ltd.	2014

E-Books and online course materials:

1. https://www.pearson.com/en-us/search.html?aq=digital%20signal%20processing
2. https://www.amazon.in/Digital-Signal-Processing-Ramesh-Babu/dp/8183710816
3. https://www.amazon.in/DIGITAL-SIGNAL-PROCESSING-Monson-Hayes/dp/0070153868
4. https://backbencher.club/digital-signal-processing-2/
5. http://azdocuments.in/2020/09/digital-signal-processing18ec52.html#google_vignette

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc25_ee23/preview
2. https://www.coursera.org/learn/dsp1
3. https://www.youtube.com/playlist?list=PL9567DFCA3A66F299
4. https://www.youtube.com/watch?v=6dFnpz_AEyA
5. https://www.youtube.com/watch?v=2e2mhNQHSXQ

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Class room Teaching & Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)	-	-	38
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan(for50marksofCIE):

Tool	Remarks	Marks
Internals	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	**Mini Project:** Design and implementation of DSP operations including signal generation, FFT analysis, convolution, and FIR/IIR filters using hardware (Arduino Uno/Raspberry Pi) or software tools (Tinkercad/Wokwi/Falstad/Google Colab). The project should include waveform and frequency analysis, noise filtering, comparison of theoretical and practical results, and submission of a technical report.	20
Total		**50**

Activity Based Learning(38Hours)

Mini-Project Work Plan: **1. Execution** The execution phase involves understanding the problem statement and implementing the proposed Digital Signal Processing (DSP) system. Students will carry out signal generation, FFT analysis, convolution, and FIR/IIR filter design using software tools such as Python (Google Colab) or simulation platforms, and optionally hardware platforms like Arduino or Raspberry Pi. This phase also includes coding, circuit setup (if applicable), testing of individual modules, debugging, and validating the system through waveform and frequency response analysis. **2. Report Preparation** In this phase, students document the entire mini-project work in a structured technical report. The report should include the problem statement, objectives, system design, methodology, implementation details, results, and performance analysis. Supporting elements such as block diagrams, flowcharts, code snippets, graphs, and observations must be included. The report should clearly highlight the comparison between theoretical concepts and practical/simulation results, along with conclusions and references. **3. Presentation and Demonstration** This phase involves presenting the mini-project to evaluators through a structured PowerPoint presentation followed by a live demonstration. The presentation should cover the problem definition, design approach, implementation process, and key results. During the demonstration, students must showcase the working model or simulation outputs and explain system behavior, filtering performance, and frequency analysis. This phase also includes answering questions during viva-voce to evaluate understanding and clarity of concepts. **Note:** Evaluation of the mini-project will be carried out based on predefined assessment rubrics covering execution, technical understanding, report quality, presentation, and demonstration.	**38 Hours**

The mini-project is designed for a total duration of 38 hours and is structured into different phases covering planning, design, implementation, testing, documentation, and evaluation activities. The detailed breakdown is given below:

15.	Problem Identification & Planning	4
16.	Background Study & Design	6
17.	Software / Simulation Implementation or Hardware Implementation (if applicable)	16
18.	Testing & Performance Analysis	6
19.	Documentation / Report Writing	3
20.	Presentation & Demonstration	3
Total Learning Hours/Semester		**38**

Evaluation of Learning Process(10Hours)

Type of Evaluation	Hours
Test(1,2and3)	3
Mini-project	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	Program Outcomes[POs]											PSO's	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2									2	2
CO2	3	3	2		2		1	2	2		1	2	3
CO3	2	3	2		2		1	2	2		1	2	3
CO4	3	2	2		2		1	2	2		1	2	3

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	**Optical Fiber Communication**		
Course Code	**24EC603**	**(L-T-P) C**	**(3-0-0)3**
Exam hours	**3**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**(42L+38ABL+10E) =90**

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	PSOs
1	Understand the fundamentals of optical fiber communication systems, fiber structure, modes of propagation, and transmission characteristics of optical fibers	1, 2,11	1, 2
2	Analyze attenuation mechanisms, dispersion effects, and signal propagation characteristics in various types of optical fibers	1, 2,11	1, 2
3	Examine the operating principles and performance characteristics of optical sources, detectors, and fiber optic receivers	1, 2,3,11	1, 2
4	Demonstrate the working of optical fiber components such as couplers, connectors, WDM devices, and optical amplifiers used in communication systems	1, 2,3,8,9,11	1, 2

Course Contents:

MODULE-1	**No. of Hrs.10**

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, bending loss, dispersion, Intramodal dispersion, Intermodal dispersion. (Text2)

MODULE-2	**No. of Hrs.10**

OPTICAL SOURCES AND DETECTORS: Introduction, LED's, double hetero junctionstructure,LASERdiodes,Photodetectors:PinPhotodetector,AvalanchePhotodiodes.(Text1)
OPTICAL RECEIVERS AND DIGITAL LINKS: Introduction, Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, burst modereceiver, Analog receivers. (Text1)

MODULE-3	**No. of Hrs.10**

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].

MODULE-4	**No. of Hrs.10**

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]

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Optical Fiber Communication	**GerdKeiser**	5th Ed	MGH	2017
2	Optical Fiber Communications	**John M. Senior**	3rd Edition	Pearson Education	2009

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Fiber Optic Communication	**Joseph C Palais**	4th	Pearson	2004

ACTIVITIES

Activity Number	Activity Name	Description		Hours/ Semester	Marks	Pos
1	Paper Presentation on Emerging Trends in Optical Fiber Communication	Students will study and present recent advancements related to optical fiber losses, attenuation mechanisms, optical components and other modern optical communication technologies	Topic Selection & Literature survey	10Hrs	**10**	**2,5,9,11**
			Presentation and report submission	10 Hrs		
			Assessment	20 Hrs		
2	Industrial Visit and Technical Report Submission	Students will visit a relevant industry/telecommunication organization to gain practical exposure to optical fiber communication systems and submit a detailed technical report based on their observations.		8 Hrs	**10**	**1,2,9,11**

Course Articulation Matrix

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

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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	**VLSI CIRCUITS LABORATORY**		
Course Code	**24EC604**	**(L-T-P)C**	**(0-0-2)1**
Exam	**3Hrs.**	**Hours/Week**	**2Hrs.**
SEE	**50 Marks**	**Total Hours**	**28P+2E=30**

Course Objective: The students will have hands-on experience on design concepts underlying VLSI chips.

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

Upon completion of the course, students shall be able to

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Analyze, simulate, and design combinational and sequential digital circuits and functional blocks using MOSFETs, logic gates, and structural modeling techniques.	1,2,3,4,5,8,9	1,2
2	Apply VLSI physical design methodologies, including lambda-based and micron-based design rules, to create circuit layouts.	1,2,3,4,5,7,8,9	1,2
3	Optimize logic gate implementations with respect to area, performance, and power using modern VLSI design and synthesis tools.	1,2,3,4,5,7,8,9,11	1,2

Teaching-Learning–Evaluation Scheme:

Sl.No	Teaching and Learning Method	No. of Hours/Week	No. of Weeks	Hours/ Semester
1	Lab Conduction	2	14	28
2	Evaluation	-	-	02
Total Learning Hours/Semester				30
ABL:Lab based learning(28Hrs.)				

Sl. No	Experiment Title	Hours
	Simulation of schematic and layout design in CMOS technology using the software tools DSCH 2.6c and Microwind	
1.	Design and simulation of CMOS Inverter and analysis of voltage transfer characteristics	2
2.	Design and layout of basic CMOS logic gates (AND, OR, NAND, NOR)	2
3.	Design and layout of Exclusive Gates (XOR and XNOR)	2
4.	Design and simulation of Half Adder	2
5.	Design and simulation of Full Adder	2
6.	Design and implementation of 2-bit Parallel Adder	2
7.	Design and implementation of Magnitude Comparator	2
8.	Design and simulation of Encoder and Decoder circuits	2
9.	Design and simulation of Multiplexer and Demultiplexer circuits	2
10.	Design and simulation of D Flip-Flop with Reset	2
11.	Design and simulation of T Flip-Flop with Reset	2
12.	Design and simulation of JK Flip-Flop	2

13.	Design and implementation of Clock Divider (Divide-by-4) circuit	2
14.	Design MOD-8 or MOD-16 counters.	2
Total		**28**

Proposed Assessment Plan(for50marksof CIE):

Tool	Remarks	Marks
Internals	Continuous Evaluation–10Marks Record writing -20Marks Lab CIE -20Marks	50
Total		**50**

Prescribed Text Book:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	CMOS VLSI Design: A Circuits and Systems Perspective	Neil H. E. Weste and David Harris	4th Edition	Pearson Education	2011
2.	Digital Integrated Circuits: A Design Perspective	Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic	2nd Edition	Prentice Hall	2003

Online Courses and Video Lectures:

1. http://www.digimat.in/nptel/courses/video/108107129/L20.html
2. https://nptel.ac.in/courses/117106092
3. https://www.youtube.com/watch?reload=9&v=TGy4Oc0xvrU

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**
CO1	3	3	2	2	3			2	2			3	2
CO2	2	3	3	2	3		1	2	2			3	2
CO3	2	2	3	2	3		1					3	3
CO4	2	3	3	2	3		1	2	2		1	2	3

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Course Title	**Digital Signal Processing Laboratory**		
Course Code	**24EC605**	**(L-T-P) C**	**(0-0-2)1**
Exam	**3Hours**	**Hours/Week**	**2 Hrs.**
SEE	**50Marks**	**Total Hours**	**28+2E=30**

Course Objective: Provide hands-on experience in Digital Signal Processing using tools such as Scilab for analysis, design, and implementation of DSP operations and digital filters**.**

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Apply fundamental concepts of Digital Signal Processing including sampling, convolution, correlation, and discrete-time system analysis for signal processing applications.	1,2,3,4,5	1,2
2	Analyze discrete-time signals using frequency-domain techniques such as DFT, FFT, Goertzel algorithm, and Chirp Z-Transform.	1,2,3,4,5	1,2
3	Design and implement FIR and IIR digital filters using Scilab and analyze and document the results through systematic laboratory records and reports.	1,2,3,4,5, 8,9,11	1,2

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours / Week	No. of Weeks	Hours / Semester
1	Lab Conduction	2	14	28
2	Evaluation	-	-	02
Total Learning Hours/Semester				30
ABL : Lab based learning(28Hrs.)				

Sl No.	List of Experiments	28 Hours
1.	Verification of the Sampling Theorem for different sampling conditions.	2
2.	Computation of N-point DFT of standard discrete-time signals such as sine and cosine signal.	2
3.	Computation of 4-point and 8-point DFT and IDFT of a given sequence using the standard equation.	2+2
4.	Computation of 4-point and 8-point DFT using FFT algorithms and inverse FFT (IFFT).	2
5.	Computation of circular convolution of two discrete-time sequences.	2
6.	Implementation of linear and circular convolution using DFT and IDFT methods.	2
7.	Computation of DFT for long data sequences using overlap-add and overlap-save methods.	2
8.	Computation of autocorrelation and cross-correlation of discrete sequences and verification of their properties.	2
9.	Detection of Specific Frequency Components Using Goertzel Algorithm	2
10.	Frequency Spectrum Analysis Using Chirp Z-Transform (CZT)	2
11.	Impulse response of discrete-time systems and solution of corresponding difference equations with and without initial conditions	2
12.	Design and implementation of FIR digital filters using Rectangular, Hamming, Hanning, and Kaiser window techniques.	2

13.	Design and implementation of Butterworth IIR digital filters for low-pass, high-pass, band-pass, and band-stop responses.	2

Textbook:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Digital Signal Processing: Principles, Algorithms, and Applications	Proakis, J. G., & Manolakis, D. G.	5th	Pearson Education	2014
2	An Introduction to Scilab for Engineers and Scientists	Sandeep Nagar	2nd	Apress	2020
3	S. Palani	Principles of Digital Signal Processing	2nd	Springer	2022
4	R. S. Senthilkumar	Digital Signal Processing and Its Applications	2nd	Anuradha Publications, Chennai	2012

Software Download Link:

1. https://www.scilab.org/download/

E-Books and online course materials:

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

Online Courses and Video Lectures:

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

Proposed Assessment Plan (for 50 marks):

Parameter	Remarks	Marks	Total Marks
Internals	Continuous Evaluation Record Writing CIE	10Marks 20Marks 20Marks	50
Total			**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes[POs]											PSO's	
CO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	2	1	2							2	2
CO2	2	3	3	2	2							2	3
CO3	2	3	3	1	2			1	2		2	2	3

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Course Title	**MAIN PROJECT PHASE-1**		
Course Code	**24EC606**	**(L-T-P) C**	**(0-0-4)2**
Exam	**3**	**Hours/Week**	**4**
SEE	**50 Marks**	**Total Hours**	**-**

Course Objective: To be able to identify a relevant problem that requires technical solution and conduct survey for the same.

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

Upon completion of the course, students shall be able to

#	**Course Outcomes**	**Mapping to PO's**	**Mapping to PSO's**
1	Identify a problem, through Extensive literature Survey leading to publication of a survey paper.	**1,2,11**	**-**
2	Plan & design the solution to the chosen problem	**3**	**2**
3	Make oral presentation and documentation of the work carried out	**8,9,10**	**-**

Course Contents:

During VI semester, candidates in consultation with the guides shall carry out literature survey to finalize the topic of the project. The same project will be continued in Seventh semester. Students are expected to present the project synopsis, system analysis, requirements, and specifications and should publish a technical paper on Literature survey. The evaluation will be carried out in three stages.

- Project Stage 1 – Team Formation, Guide Allotment and Topic Selection (No marks).
- Project Stage 2 – Extensive Literature survey, Problem Definition and Objectives
- Project Stage 3 – Preliminary Design, Report Preparation and Publication

The evaluation of the project phases shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the project coordinators in consultation with the Head of the department. For Multidisciplinary projects guides will be allotted from each concerned branch.

Performance Indicators	Low (40%)	Medium (70%)	High (100%)
Literature Survey, Problem Definition and Objectives (30 Marks)	Literature Survey, Problem Definition and Objectives not pertaining to the title of the project (12)	Incomplete Literature Survey, Improper Problem Definition and Objectives (21)	Extensive Literature Survey with clear state of the art problem definition and objectives (30)
Presentation (10 Marks)	Disorganized and ineffective presentation (4)	Organized but not good content wise (7)	Effectively organized and well framed contents (10)
Preliminary Design (10 Marks)	Has no coherent strategies for problem solving (4)	Has some strategies for problem – solving, but does not apply them consistently (7)	Formulates strategies for solving problems (10)
Report Preparation (20 Marks)	Disorganized and contents are not sufficient (8)	Organized but not good content wise (14)	Effectively organized and well framed contents (20)
Presentation (10 Marks)	Disorganized and ineffective presentation (4)	Organized but not good content wise (7)	Effectively organized and well framed contents (10)
Paper Publication (10 Marks)	Paper submitted and awaiting results (4)	National or International Conference (7)	Journal (10)
Punctuality (Project Dairy Maintenance) (10 Marks)	Not meeting the guide regularly (4)	Meeting regularly but doesn't document details of every session (7)	Up to date dairy maintenance (10)

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Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	3	3	3	-	-	-

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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Open Elective Course – I

Course Title	**Sensors and Actuators**		
Course Code	**24OEEC61**	**(L-T-P) C**	**(3-0-0) 3**
Exam	**3 Hrs**	**Hours/Week**	**03**
SEE	**50 Marks**	**Total Hours**	**40**

Course Objectives: The objective of the course is to educate students in microtechnology and its application in fabricating sensors and systems.

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

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the basics of sensors, actuators, and their operating principle.	1,2	1
2	Illustrate the working principles of different types of sensors and actuators used in industrial applications	1,2	1
3	Apply different types of deposition methods for designing and developing sensors.	1,2,3,5,8,9, 10	1,2
4	Analyze the fabrication and manufacturing processes for the design of sensors and Actuators	1,2,3,5,8,9, 10	1,2

MODULE-1 **No. of Hrs. 12**

Basics of Energy Transformation: Transducers-Types of transducers, Sensors: - Sensor Classification, Selection criteria, Sensor Descriptions-Temperature sensor, magnetic field sensor, light sensor, and Strain Gauge, Actuators descriptions -Piezoelectric actuator, Thermal actuator, and electrical actuator.

Understanding of thin film physics: MOSFET Characteristics, Application in MOSFET and its variants - GASFET, OGFET, ADFET, ISFET, PRESSFET, CEMFETs, and BIOFET.

Self-Study: Basics of MOSFET and FET

MODULE-2 **No. of Hrs. 10**

Thin Film Deposition Techniques I: Chemical Vapor Deposition,APCVD, LPCVD, PECVD,HDPCVD.

Thin Film Deposition Techniques II: Physical Vapor Deposition, Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition.

Self-Study: Ion Implantation and Oxidation

MODULE-3 **No. of Hrs. 10**

Processing techniques: Photolithography, silicon micromachining, Bulk silicon micromachining, Surface silicon micromachining, LIGA process.

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

Self-Study: Materials for MEMS and Microsystems.

MODULE-4 **No. of Hrs. 10**

Micro Actuators: Workingprinciples of Actuators. Piezoelectric actuators, electrostatic actuators, micropumps, and micro-actuators with practical applications

Microsystems Design: Mechanical Design Using Finite Element Method, Design of a Silicon Die for a Micro Pressure Sensor

Self-Study: Practical applications of sensors and actuators

Prescribed Textbooks:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Sensors and Signal Conditioning	Pallas-ArenyRamón, and John G. Webster			
2	Instrumentation: Devices and Systems,	C S Rangan, G R Sarma, V S V Mani,	2nd	McGraw-Hill Education (India),	2014.
3	MEMS and Microsystems Design and Manufacture	TaiRanHsu	2nd	TataMcGraw-Hill	2002

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Microsystem Design	Stephen D.Senturia	2nd	Kluwer Academic Publishers	,2001
2	Foundations of MEMS	ChangLiu	2nd	Pearson Education India limited	2006

EBooks and online course materials:

1. https://www.taylorfrancis.com/books/mono/10.1201/9781482274004/fundamentals-microfabrication-marc-madou
2. https://link.springer.com/book/10.1007/b117574

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/117105082
2. https://nptel.ac.in/courses/118102003

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs were conducted for 20 marks each and reduced to 10 marks	30
Activity Details	1) Presentation of journals related to the sensors (IEEE or Elsvier or any standard Publishers) 2) Presentation of journals related to the actuators (IEEE or Elsvier or any standard Publishers)	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3	2										2	
CO2	2	2										2	
CO3	1	2	2					1	1	2		1	2
CO4	2	2	2					1	1	2		1	2

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Course Title	EMBEDDED SYSTEMS DESIGN		
Course Code	24OEEC62	(L-T-P) C	(3-0-0)3
Exam	3 hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	42L + 48ABL=90

Course Objective: To enable students to understand embedded system fundamentals, design methodologies, and architectural components required for the analysis and development of embedded applications.

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

Upon completion of the course, students shall be able to

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Interpret the features of embedded systems in comparison with general computing systems and summarize their characteristics, classification, and application areas.	1,2,11	1
2	Analyze the architecture of typical embedded systems, including processors, memory organization, sensors, actuators, and communication interfaces.	1,2,8,11	1,2
3	Apply embedded firmware design approaches using reset circuits, watchdog timers, oscillators, real-time clocks, and embedded development languages.	1,2	1,2
4	Illustrate RTOS-based embedded system design concepts such as operating systems, tasks, threads, multitasking, multiprocessing, and task scheduling techniques.	1,2,11	1,2

MODULE-1	No. of Hrs: 10

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems v/s General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. Applications Specific-Embedded system and Domain Specific-Embedded System.

MODULE-2	No. of Hrs: 11

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: On-board and External Communication Interfaces

MODULE-3	No. of Hrs:10

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Hardware Design and Development, : Analog electronic components, digital electronics components, Embedded Firmware Design Approaches and Development Languages,

MODULE-4	No. of Hrs: 11

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and multitasking, Task Scheduling, Processor trends in embedded industry, embedded OS trends and development language trends.

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Introduction to Embedded Systems	Shibu K.V	2nd Edition	Mc Graw Hill	2016

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Embedded Systems	Raj Kamal	4th Edition	Mc Graw Hill	2020
2	Embedded System Design	Frank Vahid	1st Edition	John Wiley & Sons	2003

Online Courses and Video Lectures:

1. https://www.coursera.org/courses?query=embedded%20systems
2. **https://onlinecourses.nptel.ac.in/noc20_cs14/preview**

Teaching -Learning– Evaluation Scheme: 10 hrs.

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Classroom Teaching & Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)			38
3.	Evaluation of Learning Process			10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs will be conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Practical-based learning ● Developing an embedded system solution for a real-world application such as smart home automation, environmental monitoring, industrial automation, healthcare monitoring, smart agriculture, or IoT-based systems.	20
Total		**50**

Activity-Based Learning (38 Hours)

Activity-Based Learning -1	**Hours**
ABL2 (20 Hours): Students will: • Identify and analyze embedded systems used in everyday applications such as consumer electronics, automobiles, healthcare devices, and industrial systems. • Explore the major hardware components of embedded systems, including processors, memory devices, sensors, actuators, and communication interfaces. • Compare embedded systems with general purpose computing systems through case studies and application-oriented discussions.	**20**
Activity-Based Learning -2	
ABL2 (20 Hours): Students will: • Study and demonstrate the working principles of embedded hardware and firmware components using simulation tools or development platforms. • Explore real-time operating system concepts such as tasks, processes, threads, multitasking, and scheduling through practical examples and demonstrations. • Investigate emerging trends in embedded systems, processors, operating systems, and development tools through mini case studies on real-world applications.	**20**
Total Hours	**38**

Evaluation of Learning Process (10 Hours)

Type of Evaluation		**Hours**
Test(1,2and3)		3
Demonstration of activity		4
Semester End Exam		3
Total		**10**

Course Articulation Matrix

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

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	WIRELESS COMMUNICATION		
Course Code	24OEEC63	(L-T-P) C	(3-0-0)3
Exam	3 hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	42L + 48ABL=90

Course Objective: To enable students to analyze wireless communication systems, evaluate network performance, and assess contemporary wireless technologies and standards.

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

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the basics of Wireless Communication and Networks.	1,2,11	1
2	Realize the complicated nature of wireless propagation and use of simple models to determine power requirements.	1,2,5,11	1,2
3	Differentiate multipath channel models and assess the effectiveness of various diversity combining techniques	1,2,5,11	1,2
4	Interpret the functionalities and applications of cellular and non-cellular wireless communication systems.	1,2,3,11	1,2

MODULE-1	10 Hrs.

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, , Diffraction

Self Study: Ground Reflection Model (No Derivation only final expression)

MODULE-2	11 Hrs.

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,

Self Study: RAKE Receiver

MODULE-3	11 Hrs.

Non-Cellular Networks: LoRA technology, Zigbee, Z-Wave, SIGFOX Wireless Systems and Standards-I: AMPS-Overview, Call Handling, CDMA Digital Cellular Standard (IS-95)-Frequency and Channel Specification. **Self Study: Bluetooth and Wi-Fi**

MODULE-4	10 Hrs.

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

Self Study: GSM Channel types

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	"Wireless Communications: Principles and Practice"	Theodore S. Rappaport	Second Edition	Pearson Education	2024

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	"Wireless and Mobile Networks, Concepts and Protocols"	**S.S Manvi**	Second Edition	Wiley India Pvt. Ltd	2016
2	"Mobile Communications Engineering"	**William C Y LEE**	Second Edition	McGraw-Hill	1998
3	"Wireless communication"	**D.P.Agarwal**,	Second Edition	Cengage Learning,	2016.

EBooks and online course materials:

1. https://ieeexplore.ieee.org/book/5635423

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/117/102/117102062/

Teaching -Learning– Evaluation Scheme: 10 hrs.

Sl.No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Classroom Teaching & Learning	3	3	42
2.	Activity Based Learning (ABL1&ABL2)			38
3.	Evaluation of Learning Process			10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs will be conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Practical-based learning ● Students will simulate wireless propagation and diversity techniques using suitable tools, study the operation of cellular (2G–5G) and non-cellular networks, and analyze wireless communication standards such as GSM and CDMA through practical examples and case studies.	20
Total		**50**

Activity-Based Learning (38 Hours)

Activity-Based Learning -1	Hours
ABL2 (20 Hours): Students will: • Investigate the wireless communication technologies used in everyday applications such as smartphones, smart homes, IoT devices, and wearable systems. • Compare the features, coverage, data rates, and applications of cellular (2G–5G) and non-cellular (LoRa, ZigBee, Z-Wave, SIGFOX) wireless networks. • Present their findings through a group discussion or seminar.	**20**
Activity-Based Learning -2	

ABL2 (20 Hours): Students will: • Analyze the performance of wireless communication systems under different propagation conditions using case studies or simulation tools. • Study the role of diversity techniques in reducing fading and improving communication reliability. • Examine the architecture and services of wireless standards such as GSM and CDMA and present their observations in a technical report..	**20**
Total Hours	**38**

Evaluation of Learning Process (10 Hours)

Type of Evaluation		**Hours**
Test(1,2and3)		3
Demonstration of activity		4
Semester End Exam		3
Total		**10**

Course Articulation Matrix

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

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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	Introduction to Communication Engineering		
Course Code	24OEEC64	(L-T-P) C	(3-0-0)3
Exam	3 hours	Hours/Week	3
SEE	50	Total Hours	40

Course Objective: The objective is to understand the fundamentals of modulation techniques, switching systems, traffic engineering, and digital communication methods for telecommunication applications.
Course Outcomes: :{with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Apply the concept of Analog Modulation and its various modulation techniques.	1,2,5	1,2
2	Analyze the concept of various telecommunication Switching systems used in telephone systems	1,2	1,2
3	Analyze the working principles of space and time switching and its combinations to provide more simultaneous conversations	1,2	1,2
4	Analyze the concept of Digital Modulation and its various modulation techniques.	1,2,5	1,2

MODULE-1	No. of Hrs.10
Analog Modulation: Time and Frequency domain description AM waves, Time and Frequency domain description DSBSC Modulation,Single sideband modulation. Vestigial Sideband modulation and Frequency Modulation (Qualitative analysis), FDM and TDM.	
MODULE-2	**No. of Hrs.10**
Telecommunication Switching System: Introduction, Manual Switching system, Step-by-step/Strowger Switching system, Cross-bar switching system and SPC Switching System Unit of traffic, congestion, Measurement and modeling of traffic, Lost call systems, Queuing systems (Qualitative analysis).	
MODULE-3	**No. of Hrs.10**
Time division switching: Space and time switching, Time division switches networks (TSN), non-blocking networks, Grades of service of Time division switching networks. call-processing functions, Introduction, customer line signaling	
MODULE-4	**No. of Hrs.10**
Digital Modulation Techniques: Baseband and Pass-band Transmission, ASK, PSK, FSK, DPSK and QPSK	

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	An introduction to Analog and Digital. Communications	Simon Haykin	9	John Wiley	2009
2	Telecommunications Switching Traffic & Networks	J E Flood		Pearson education,	2004.

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Digital telephony	John C Bellamy	3	Wiley India	2000.
2	Principle of telecommunication and switching	Thygarajan and Viswanathan		PHI	2004.

EBooks and online course materials:

1. https://www.wileyindia.com
2. https://www.pearsoned.co.in

Online Courses and Video Lectures:

1. https://www.courseera.org/
2. https://nptel.ac.in/courses/

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted Activity -1 (Simulation) (10) Activity – 2 (Report)(10)	20
Total		**50**

Activity-1
Generation and Detection of AM
DSBSC Modulation and demodulation
Single Side Band (SSB) modulation and demodulation
VSB Generation & Detection
FM Generation & Detection
Generation of FDM signal
Direct FM generation and detection
Indirect FM generation and detection
Design of De-emphasis circuit
Generation TDM signal

Course Articulation Matrix

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

MALNADCOLLEGEOFENGINEERING,HASSAN
(An Autonomous Institution Affiliated to VTU, Belagavi)
DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title		**E-Waste Management**	
Course Code	**25OEEC65**	**(L-T-P) C**	**3-0-0-3**
Exam	**3 Hours**	**Hours/Week**	**3 Hours**
SEE	**50 Marks**	**Total Hours**	**42**

Course Objective: The objective of this course is to provide students with a comprehensive understanding of the issues, challenges, and strategies related to electronic waste (e-waste) management. It aims to equip learners with the knowledge of environmental and health impacts, legal frameworks, and sustainable practices involved in the handling, recycling, and disposal of e-waste.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Explain the sources, composition, hazardous properties, and environmental and health impacts of electronic waste (e-waste).	1,6,7,10,11	-
2	Analyze the global and national dimensions of e-waste generation, trade, management practices, and recycling economics.	1,6,7,10,11	-
3	Evaluate e-waste control measures, regulatory frameworks, Extended Producer Responsibility (EPR), and stakeholder roles in sustainable e-waste management.	1,6,7,10,11	-
4	Describe and assess e-waste recycling technologies, resource recovery processes, and material recovery techniques used in electronic waste management.	1,2,6,7,10,11	-

MODULE-1	**11 Hours**

Introduction.E- Waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.

MODULE-2	**11 Hours**

E-waste hazardous on Global trade: Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India‘s stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.

MODULE-3	**10 Hours**

E-waste control measures: Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise.

[**Self-Learning:** Reduction of waste at source.]

MODULE-4	**10 Hours**

E-Waste Recycling- E-Waste Recycling Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials.

[**Self-Learning:** Mechanical Processing Steps].

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	E-waste: Implications, Regulations and Management in India and Current Global Best Practices	Rakesh Johri	2nd	Oxford university press	2013
2.	Electronic Waste Management.	Hester R.E. and Harrison R.M	-	Science,	2009

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Electronic Waste	Fowler B	1st	Toxicology and Public Health Issues Elsevier	2017

E-Resource: https://news.mit.edu/2013/ewaste-mit

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted Activity1- E-Waste Survey and Data Collection • Conduct a survey in the college, neighbourhood, or community to identify the types and quantities of e-waste generated. • Prepare a report with data analysis and recommendations Activity2-Assignment/Quiz	10 10
Total		**50**

Course Articulation Matrix:

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2					3	3			3	3	-	-
CO2	2					3	3			3	3	-	-
CO3	2					3	3			3	3	-	-
CO4	2	2				3	3			3	3	-	-

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	**ENTREPRENEURSHIP AND MANAGEMENT**		
Course Code	**24OEEC66**	**(L-T-P) C**	**(3-0-0)3**
Exam	**3hrs**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**42L+48ABL=90**

Course Objective: To enable students to understand the fundamentals of entrepreneurship, evaluate business opportunities, and acquire the skills required to plan, organize, and manage a new enterprise effectively.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Comprehend the concepts, characteristics, and significance of entrepreneurship and assess the feasibility of business opportunities.	2,6,11	1,2
2	Develop and design a comprehensive business plan for a new venture.	2,3,8,11	1,2
3	Apply organizational and managerial principles to establish and launch an enterprise successfully.	2,3,8,9,11	1,2
4	Analyze and manage business processes and human resource practices involved in entrepreneurial ventures..	2,8,9, 10, 11	1,2

MODULE-1	**10Hrs.**
Entrepreneurs & Entrepreneurship: Introduction, what is Entrepreneurship? Who are Entrepreneurs and what do they do? **The Context of Entrepreneurship**: Issues affecting entrepreneurship in action, identifying environmental opportunities, Understanding competitive advantage	
MODULE-2	**10Hrs.**
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	
MODULE-3	**10Hrs.**
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.	
MODULE-4	**10Hrs**
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.	

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1	Entrepreneurship in Action	Mary Coulter,	2nd Edition	PHI	2020
2	Entrepreneurship Development	E. Gordon & K. Natarajan	-	Himalaya publishers	2008

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	**Entrepreneurship Development**	S S Khanka, S Chand & Co	-	SCH	2011
2.	**Entrepreneurship Development and Management**	A. K. Singh	-	JBA publishers	2014
3.	**Entrepreneurship: Theory, Process, Practice (12th Edition)**	Donald F. Kuratko	12th	Cengage	2024

EBooks and online course materials:

1. **https://archive.org/details/entrepreneurship00mary**
2. **https://www.indeed.com/career-advice/career-development/entrepreneur-management**

Online Courses and Video Lectures:

1. **https://archive.nptel.ac.in/courses/110/106/110106141/**
2. **https://nptel.ac.in/courses/110101167?utm_source=chatgpt.com**
3. **https://nptel.ac.in/courses/110106141?utm_source=chatgpt.com**

Teaching -Learning– Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1	Class Room Teaching & Learning	3	14	42
2	Integrated Lab Component	-	-	-
3	Evaluation of Learning Process	-	-	10
4	Activity Based Learning (ABL)	-	-	41
	Total Learning Hours/Semester			**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1) Documentation on Industrial visit on how they started their venture 2) Business plan to start venture	20
Total		**50**

Activity Based Learning (38Hours)

ABL (41 Hours): Knowledge of entrepreneurship concepts, business planning, venture creation, and management processes to develop entrepreneurial skills.	Hours
Techniques involved in identifying business opportunities, preparing business plans, organizing resources, and managing entrepreneurial ventures. In this activity students will develop and present a business plan for a startup idea.	38
Total	**38**
Total Learning Hours/Semester	**38**

Evaluation of Learning Process (7 Hours)

Type of Evaluation	**Hours**
Test(1,2and3)	3
Presentation	4
Semester End Exam	3
Total	10

Course Articulation Matrix

Course Outcomes		**Program Outcomes**											
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PS 01**	**PSO 2**
CO1		2				2					2	1	1
CO2		3	3					2			2	2	2
CO3		2	3					3	2		2	2	2
CO4		2						2	2	2	1	1	2

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

COURSE TITLE: ELECTRONIC INSTRUMENTATION AND MEASUREMENT	
Course Code: 24OEEC67	**LTPC: 3-0-0-3**
Exam Hours: 3hours	Hours / Week : 3
SEE: **50 Marks**	Total hours: **42L+48ABL=90**

Course Objective: The student will have the knowledge of generalized measurement system, its construction, working and errors associated with them and also understand different electronic operation.

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

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

COs	Statement	POs	PSO
1.	Analyze instrument characteristics, errors and generalized measurement system.	1,2,8,9,11	1
2.	Analyze Instrument calibration and working of CRO/special oscilloscopes and spectrum analyzer for measurement.	1,2,8,9,11	1
3.	Analyze and interpret different signal generator circuits for the generation of various waveforms and need of different transducers.	1,2,8,9,11	1
4.	Understand and use different display devices and data acquisition system.	1,2,8,9,11	1

Course Contents:

MODULE-1	**Teaching Hours**
Measurement systems, units and standards, and Measurement Errors: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems). **Digital Instruments & calibrations:** Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and successive approximation principles, Resolution and sensitivity, General specifications, Digital Multimeters, Digital Frequency meters, Digital measurement of time, Automation and Digital Instruments, Instrument Calibration: comparison methods, Digital multimeters as standard instruments.	**12 Hours**
MODULE-2	
Display devices: Introduction, CRT features, Dual Trace Oscilloscopes, digital storage oscilloscopes and its applications, Oscilloscope controls, Oscilloscope probes, Classification of Displays: LCD, LED, backlight LEDs, PLASMA, OLED and QLED Transducers: Introduction, Electrical transducer, selecting a transducer, capacitive transducer, Inductive transducer, piezo electrical transducer.	**10 Hours**
MODULE-3	
Signal generators: Introduction, Low frequency signal generators, function generator, pulse generators, RF signal generator, sweep frequency generators. **Biomedical application instruments:** Blood gas analyzer, Blood glucose meter, Electronic cardiac meter, digital/IR thermometer.	**10 Hours**
MODULE-4	
Data Acquisition and conversion: Objective of DAS, signal conditioning for the inputs, single data acquisition system, multi- channel DAS. **Miscellaneous Instruments:** Distortion meter, Spectrum analyzers, Network Analyzer, Digital Power/Energy Meter.	**10 Hours**

Text Books:

1. **David A Bell,"** Electronic Instrumentation and Measurements", oxford University Press, 3rd Edition, 2013.
2. **H S Kalsi**, "Electronic Instrumentation", Tata McGraw-Hill Education, 3rd Edition, 2012

Reference Books:

1. **John P Bentely**, "Principles of measurement systems",3rd Edition, Pearson Education, 2000.
2. **Rangan, Sharma & Mani**," Instrumentation Devices and systems", TMH 2nd edition, 2005.
3. **D. Helfrick and W.D. Cooper**, "Modern Electronic Instrumentation and Measuring Techniques", Pearson,1st Edition, 2015.
4. **Albert D.Helfrick.** Electrical Spectrum and Network Analyzers: A practical Approach, Pearson, 2015.

EBooks and online course materials/Online Courses and Video Lectures

1. **https://libcat.iitd.ac.in/bib/229478**
2. **https://www.digimat.in/nptel/courses/video/108105153/L16.html**
3. **https://onlinecourses.nptel.ac.in/noc19_ee44/preview**
4. **https://www.digimat.in/nptel/courses/video/108105153/L12.html**

Teaching-Learning– Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1	Class Room Teaching &Learning	3	14	42
2	Activity Based Learning(ABL1&ABL2)	-	-	38
3	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three tests conducted for 20marks each and Reduced to10 marks	30
Activity Details	Details of activities to be conducted 1) Prepare a report on how electronic instruments are used for various applications choose a particular electronic instrument 2) Presentation on different Biomedical application instruments and Miscellaneous Instruments	20
Total		**50**

Activity Based Learning (38Hours)

ABL1(20Hours): Students will understand and analyze working of electronic instrument that reflect the practical applications	**Hours**
In this activity, students will demonstrate concepts of Electronic Instruments and prepare a report	
Total	**18**
ABL2(21Hours): Analyzing the working of different application instruments and other miscellaneous instrument	
Students analyze various Bio Medical application instruments and prepare presentation regarding its working principle.	**20**
Total Learning Hours/Semester	**38**

Evaluation of Learning Process (7Hours)

Type of Evaluation	**Hours**
Test(1,2and3)	3
Presentation	4
Semester End Exam	3
Total	**10**

Course articulation matrix

Course Outcomes	**Program Outcomes [POs]**											**Program Specific Outcomes**	
Cos	**PO1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO11**	**PS01**	**PSO2**
CO1	3	2						**2**	**2**		**2**	**2**	
CO2	3	2						**2**	**2**		**2**	**2**	
CO3	3	2						**2**	**2**		**2**	**2**	
CO4	2	2						**2**	**2**		**2**	**2**	

MALNADCOLLEGEOFENGINEERING,HASSAN
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DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	Automotive Electronics		
Course Code	24OEEC68	(L-T-P) C	(3-0-0)3
Exam	3Hours	Hours/Week	3
SEE	50Marks	Total Hours	42L+38ABL+10E=90

Course Objective: To develop an understanding of automotive electronic systems and embedded technologies, enabling students to design and implement automotive control, communication, and diagnostic systems using sensors and actuators.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the fundamentals of automotive systems, engine operation, and electronic engine control strategies used in modern automobiles.	1,2	1
2	Apply the principles of automotive sensors and actuators in embedded control systems for vehicle applications.	1,2,3,5,8,9, 11	1,2
3	Illustrate the operation of digital engine control systems, ECUs, and automotive diagnostic techniques.	1,2,3,5,8,9, 11	1,2
4	Analyze safety systems and emerging automotive technologies, including electric, hybrid, and intelligent vehicles.	1,2,3,5,8,9, 11	1,2

MODULE-1 — 11Hrs.

Automotive: Fundamentals: Evolution of automotive electronics, automobile physical configuration, major automotive systems, engine construction and operation (engine block, cylinder head, four-stroke cycle), ignition systems, diesel engines, drivetrain components (transmission, drive shaft, differential), suspension, braking, and steering systems.

Electronic Engine Control: Need for electronic engine control, exhaust emissions and fuel economy, engine control system concepts, engine performance parameters, engine mapping, effects of air-fuel ratio, spark timing and EGR on performance, control strategies, electronic fuel control systems, intake manifold pressure analysis, and electronic ignition systems.

MODULE-2 — 10 Hrs.

Automotive Sensors: Role of sensors in automotive control systems, measurement variables, airflow rate sensor, MAP sensor, crankshaft position sensors, magnetic reluctance sensor, Hall-effect sensor, optical position sensor, throttle angle sensor, engine coolant temperature sensor, oxygen (lambda) sensor, and piezoelectric knock sensor.

Automotive Actuators: Solenoid actuators, fuel injectors, EGR actuators, and ignition system actuators.

MODULE-3 — 10 Hrs.

Digital Engine Control Systems: Features of digital engine control, fuel control modes, EGR control, electronic ignition control, closed-loop ignition timing, spark advance correction, integrated engine control systems, secondary air management, evaporative emission control, automatic system adjustment, and system diagnostics.

Control Units (ECUs): Operating conditions, ECU design, data processing, programming, digital modules, and control unit software.

MODULE-4 — 11Hrs

Automotive Diagnostics: Timing light, engine analyzer, on-board diagnostics (OBD), off-board diagnostics, expert systems, and accelerometer-based airbag systems.

Future Automotive Electronic Systems: Alternative fuel engines, electric and hybrid vehicles, fuel-cell vehicles, collision avoidance systems, tire pressure monitoring systems, head-up displays, speech synthesis, navigation systems and sensors, voice recognition systems, adaptive cruise control, vehicle stability systems, and autonomous driving technologies.

Prescribed Text Book:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Understanding Automotive Electronics: An Engineering Perspective	William B. Ribbens	8th	Butterworth-Heinemann (Elsevier)	2017
2	Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive	Robert Bosch GmbH (Ed.)	5th	Springer Vieweg	2014
3.	Sensors and Transducers	D. Patranabis	3rd	PHI Learning Pvt. Ltd	2017

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Sensors and Transducers	Ian R. Sinclair	3rd	Newnes	2001
2.	Instrumentation: Devices and Systems	C. S. Rangan, G. R. Sarma, V. S. V. Mani,	2nd	McGraw-Hill Education.	2009

E-Books and online course materials:

1. https://www.sciencedirect.com/book/monograph/9780128104347/understanding-automotive-electronics
2. https://openlibrary.org/works/OL1739913W/Understanding_automotive_electronics

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2. 2. https://onlinecourses.nptel.ac.in/noc25_de02/preview
3. 3. https://onlinecourses.nptel.ac.in/noc25_ee33/preview

Teaching-Learning–Evaluation Scheme:

Sl.No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Classroom Teaching & Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)	-	-	38
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan(for50marksofCIE):

Tool	Remarks	Marks
Internals	Threetestsconductedfor20markseachand reducedto10marks	30
Activity Details	**Activity 1:** Poster Presentation on Emerging Automotive Technologies Students shall prepare and present a poster on recent advancements in automotive electronics, such as electric and hybrid vehicles, autonomous driving systems, ADAS, vehicle networking, or intelligent transportation systems, highlighting their working principles, applications, benefits, and future scope. **Activity 2**: Simulation of Automotive Electronic Systems Using Open-Source Software. Students shall perform simulation experiments on automotive electronic systems using open-source software/tools, focusing on applications such as sensor interfacing, engine control, vehicle diagnostics, or automotive communication systems, and submit a report on the methodology and results obtained.	20
Total		**50**

Activity Based Learning(38Hours)

ABL1 (15 Hours): Poster Presentation on Emerging Automotive Technologies Students will explore recent advancements in automotive electronics and intelligent transportation systems. They will select a topic such as electric vehicles, hybrid vehicles, autonomous driving, Advanced Driver Assistance Systems (ADAS), vehicle networking, or smart mobility solutions, conduct a literature survey, and prepare a technical poster. Students will present the working principles, applications, advantages, challenges, and future scope of the chosen technology, followed by technical discussions and evaluation.		**Hours** **20**
Comprehensive List		
1.	Battery Electric Vehicles (BEVs)	2
2.	Hybrid Electric Vehicles (HEVs)	2
3.	Plug-in Hybrid Electric Vehicles (PHEVs)	2
4.	Fuel Cell Electric Vehicles (FCEVs)	2
5.	Battery Management Systems (BMS)	2
6.	Fast Charging Technologies for EVs	1
7.	Wireless Charging for Electric Vehicles	1
8.	Regenerative Braking Systems	1
9.	Solid-State Batteries for EVs	1
10.	Vehicle-to-Grid (V2G) Technology	1
Total		**15**
ABL2 (28 Hours): Simulation of Automotive Electronic Systems Using Open-Source Software Students will learn the fundamentals of automotive electronic systems through simulation-based experiments using open-source platforms such as Wokwi, Tinkercad, SimulIDE, Arduino IDE, or		**23 Hours**

CAN simulation tools. They will perform experiments involving automotive sensor interfacing, actuator control, engine monitoring, vehicle diagnostics, and automotive communication systems. Students will analyze system behavior under different operating conditions, compare simulation results with theoretical concepts, and prepare a technical report documenting their observations and findings.		
1.	Engine Temperature Monitoring and Cooling Fan Control – Simulate engine temperature sensing and automatic cooling fan operation using a temperature sensor.	2
2.	Throttle Position and Engine RPM Monitoring – Simulate throttle position input and measure engine RPM for performance monitoring.	2
3.	Fuel Level Monitoring System – Simulate fuel level measurement and generate low-fuel warning indications.	2
4.	Automatic Headlight Control System – Control vehicle headlights automatically based on ambient light intensity.	2
5.	Ultrasonic Sensor-Based Parking Assistance System – Detect nearby obstacles and provide parking assistance alerts.	2
6.	Automotive Indicator and Hazard Light Control System – Implement turn indicators and hazard warning light operation using programmed logic.	2
7.	Digital Vehicle Dashboard Simulation – Display vehicle parameters such as speed, RPM, fuel level, and temperature on a digital dashboard.	2
8.	Battery Voltage and Vehicle Health Monitoring System – Monitor battery voltage and vehicle status parameters to detect abnormal conditions.	2
9.	CAN Bus Communication Between ECUs – Simulate data exchange between vehicle electronic control units using the CAN protocol.	2
10.	Mini Electronic Control Unit (ECU) Simulation – Develop a basic ECU model integrating sensors, actuators, and control logic for vehicle monitoring.	2
11.	Rain-Sensing Automatic Windshield Wiper System – Simulate automatic windshield wiper operation based on rain sensor input.	2
12.	Engine Fault Detection and Warning System – Monitor sensor data and generate alerts when abnormal engine conditions are detected.	1
Total Learning Hours/Semester		**23**

Evaluation of Learning Process(10Hours)

Type of Evaluation	**Hours**
Test(1,2and3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	**ProgramOutcomes[POs]**											**PSO's**	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2									1	3	2
CO2	3	3	2	2	2			1	1		2	3	2
CO3	2	3	2	2	2			1	1		2	3	2
CO4	3	3	2	2	2			1	1		2	3	2

MALNADCOLLEGEOFENGINEERING,HASSAN
(An Autonomous Institution Affiliated to VTU, Belagavi)
DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING
Professional Elective Course – II

Course Title	Quantum Computation and Information		
Course Code	24EC621	(L-T-P) C	(3-0-0)-3
Exam	3 hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: This course will enable students to:

- The objective of this course is to provide a strong foundation in quantum computing theory and practical applications.
- It introduces the basic principles of quantum mechanics, qubits, circuit model of quantum computing, etc., and provides hands-on experience on programming a quantum computer using IBM Qiskit.
- It also includes an introduction to quantum machine learning.

Course Outcomes: The students should be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Understand the fundamental concepts of quantum mechanics and quantum computing.	1,2	1,2
2	Represent quantum states and operations mathematically using Dirac notation and matrix forms.	1	1
3	Design and implement quantum circuits using Qiskit.	1, 2,3, 5,9,10,11	2
4	Develop simple quantum Computation and learningsolutions.	1, 2,3, 5,9,10,11	2

MODULE-1	No. of Hrs.
Quantum Computation: History & Overview, Review of linear algebra: Dirac notation, Hilbert spaces, Unitary, Hermitian, and Normal matrices, Inner product, Outer product, Tensor product, Postulates of Quantum Mechanics, Stern and Gerlach experiment, Qubit, Bloch Sphere. Self-Study: Basics of Qubits	**10Hours**
MODULE-2	
Circuit model of Quantum Computing: Quantum gates and Circuit, Qiskit programming. Entanglement: Bell state, Quantum Teleportation, Superdense coding, Phase kickback, No-cloning theorem, Quantum parallelism, Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm, Grover search algorithm Self-Study: Basics of Quantum Computing,	**10 Hours**
MODULE-3	
Quantum Fourier Transform, Quantum Phase Estimation, Shor's algorithm, Quantum Error Correction, Gottesman-Knill Theorem, Surface codes, **Quantum Machine Learning:** Data encoding – Basis encoding, Amplitude encoding, Hamiltonian Encoding, Swap test, Q-means clustering. Self-Study: Basic ideas of quantum communication,	**10 Hours**
MODULE-4	
Quantum information and Cryptography: Von Neumann entropy and properties, Schumacher compression, noisy-coding theorem, quantum key distribution, entropic uncertainty relations Distance measures, Graph states and codes, Quantum error correction, fault-tolerant computation Self-Study: Basics of Quantum information	**10 Hours**

Prescribed Textbook:

Sl. No	Book Title	Authors	Publisher	Year
1	Quantum Computationand Quantum Information	MichaelA.Nielsen	Cambridge UniversityPress	
2	Quantum computation and quantum information	Nielsen M. A., and Chuang I. L.	Cambridge University Press	2000

Reference Books:

Sl. No	Book Title	Authors	Publisher	Year
1	Introduction to Quantum Computation and Information.	H.-K. Lo, T. Spiller, S. Popescu,	World Scientific,	1998
2	An Introduction to Quantum Computing	Phillip Kaye, Raymond Laflamme, and Michele Mosca	Oxford University Press	2006

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E-Books and online course materials:

- https://tinyurl.com/yka8ts5w
- https://tinyurl.com/3wcrwxc7
- https://tinyurl.com/5e5f8vsx

Web links and Video Lectures (e-Resources):

- https://tinyurl.com/2tec5d6c
- https://tinyurl.com/2tjnzcyn
- nptel.ac.in/courses/115101092
- https://tinyurl.com/32jpwscb
- NPTEL :NOC:Quantum Information and Computing (Physics)

Activities

Activity 1 Term paper **Activity 2** • Learn the coding exercises to help to build fluency in quantum programming. • Simulate using IBM's Qiskit and QuTiP libraries in Google Colab, model, and build quantum circuits. • Practice through real-world examples on IBM's quantum computers. • Build quantum circuit, modeling, and cryptography emphasizes Computingtheoretical principles and practical skills. • To construct and test quantum circuits independently.	

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3	2								2		2	1
CO2	2	3								2		3	
CO3	2	2	3		3				1	2	1		3
CO4	2	2	2		3				1	2	1		3

MALNADCOLLEGEOFENGINEERING,HASSAN
(An Autonomous Institution Affiliated to VTU, Belagavi)
DEPARTMENTOF ELECTRONICS AND COMMUNIATION ENGINEERING

Course Title	**Information Coding and Cryptography**		
Course Code	**24EC622**	**(L-T-P) C**	**(3-0-0)3**
Exam	**3Hours**	**Hours/Week**	**3**
SEE	**50Marks**	**Total Hours**	**42L+38ABL+10E=90**

Course Objective: To provide knowledge of information theory, source and channel coding techniques, error control coding, and cryptographic methods for efficient, reliable, and secure communication systems.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand information sources using entropy, mutual information, and source coding techniques.	1,2	1,2
2	Analyze communication channels and evaluate channel capacity along with linear block codes for error detection and correction	1,2,4,5,8,9	1,2
3	Apply cyclic and convolutional coding techniques for reliable data transmission and decoding.	1,2,3,4,5, 8,9,11	1,2
4	Apply security principles and cryptographic techniques, including symmetric and asymmetric encryption, for secure communication systems.	1,2,3,4,5, 8,9,11	1,2

MODULE-1	**11Hrs.**

Information theory: Introduction to information theory, Measure of information, Average and mutual information, Source entropy, Properties of entropy,
Source Coding I: Types of codes, Source Coding theorem, Huffman Coding, The Lempel Ziv Algorithm, arithmetic coding, Source efficiency and extension Entropy of a source with memory.

MODULE-2	**10 Hrs.**

Source Coding II: Shannon's First Encoding Theorem, Shannon-Fano Encoding Algorithm, Run Length Encoding, Information Channels, Channel Models, Channel Capacity, 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, Channel Coding, Information Capacity Theorem

MODULE-3	**11 Hrs.**

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 and Matrix Description of Cyclic Codes

MODULE-4	**10Hrs**

Introduction to 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.

Prescribed Text book:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Information Theory Coding and Cryptography	Ranjan Bose	3rd	Tata McGraw-Hill Education	2016
2	Information Theory and Coding	Murlidhar Kulkarni, K.S. Shivaprakasha	2nd	Wiley India Pvt. Ltd.	2019
3	Cryptography and Network Security	Atul Kahathe	3rd	Tata McGraw-Hill	2017

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Introduction to Analog and Digital Communication	Sam Shanmugam,	3rd	John Wiley & Sons.	2006
2.	Cryptography and Network Security	Behrouz A Forouzan, Debdeep Mukhopadhyay,	3rd	Mc-Graw Hill	2015

E-Books and online course materials:

1. https://www.tutorialspoint.com/cryptography/index.htm
2. https://www.inference.org.uk/itprnn/book.html
3. http://cs.umd.edu/~jkatz/imc.html
4. https://www.vtunotes.org/?utm_source=chatgpt.com
5. https://vtuzone.in/?utm_source=chatgpt.com

Online Courses and Video Lectures:

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

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No.of Hours/ Week	No.of Weeks	Hours / Semester
1.	Classroom Teaching & Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)	-	-	38
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan(for50marksofCIE):

Tool	Remarks	Marks
Internals	Threetestsconductedfor20markseachand reducedto10marks	30
ActivityDetails	**Activity 1:** Information Coding Simulation Exercise: Students perform source coding and channel coding experiments such as Huffman coding, Shannon-Fano coding, Run Length Encoding, Hamming code generation, cyclic code implementation, or convolutional code analysis using MATLAB, Scilab, Python, or online simulation tools. A brief report containing methodology, results, and observations must be submitted. **Activity 2:** Term Paper: Students prepare a term paper on a recent topic related to Information Theory, Coding, or Cryptography such as data compression techniques, error control coding, network security, cryptographic algorithms, blockchain security, or secure communication systems. The paper should include a literature review, technical discussion, applications, and future scope.	20
Total		**50**

Activity Based Learning(38Hours)

ABL1(15Hours): Implementation and analysis of source coding and channel coding techniques such as Huffman Coding, Shannon-Fano Coding, Run Length Encoding, Hamming Codes, Cyclic Codes, and Convolutional Codes using MATLAB, Scilab, Python, or online simulation tools. Students analyze coding efficiency, error detection and correction capabilities, and submit a brief report on their observations and results.		**Hours**
11.	Calculation of information content, average information, and mutual information for different source probabilities.	2
12.	Computation of source entropy, source efficiency, and redundancy for memoryless and memory sources.	2
13.	Analysis of source coding theorem and comparison of different source coding techniques.	2
14.	Study of channel models and estimation of channel capacity and Shannon limit.	2
15.	Design and analysis of linear block codes for error detection and correction.	1
16.	Encoding and decoding of Hamming codes using matrix methods.	1
17.	Syndrome decoding and performance analysis of linear block codes.	1
18.	Encoding and decoding of cyclic codes using polynomial division and shift register methods.	1
19.	Analysis of convolutional codes using tree diagrams, trellis diagrams, and Viterbi decoding.	2
20.	Implementation and comparison of cryptographic techniques including substitution ciphers, transposition ciphers, DES, RSA, and Diffie–Hellman key exchange.	1
Total		**15**
ABL2(23Hours):		**Hours**
Preparation and presentation of a term paper on recent topics in Information Theory, Coding, and Cryptography such as data compression, error control coding, cryptographic algorithms, network security, blockchain security, or secure communication systems. The activity includes literature surveys, technical analysis, report writing, and presentation of findings.		**23**
Total Learning Hours/Semester		**38**

Evaluation of Learning Process(10Hours)

Type of Evaluation	**Hours**
Test(1,2and3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	**Program Outcomes[POs]**											**PSO's**	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			1							3	2
CO2	2	3		3	2			1	1	1		2	3
CO3	3	3	2	2	3			2	2	1		2	3
CO4	3	3	2	2	3			2	2	1		2	3

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	24EC623	(L-T-P) C	(3-0-0)3
Exam	3	Hours/Week	3
SEE	50 Marks	Total Hours	42L+38ABL+10EV

Course Objective: Design and develop java application programs using object-oriented concepts.
Course Outcomes{with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Understand the fundamental object-oriented programming principles	1,5,8	2
2	Implement control structures and methods effectively to design readable and efficient Java programs.	1,2,3,5,8,9	2
3	Apply the concept of inheritance to promote code reusability and extend functionality in object-oriented applications.	1,2,3,5,8,9	2
4	Implement interfaces to achieve abstraction and multiple inheritance in Java, enabling flexible and scalable software solutions.	1,3,5,8,9	2

MODULE-1	No. of Hrs. 11

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 in Java.
Data Types and Operators: Java's Primitive Types, Operators: Arithmetic, Bitwise, Relational, Boolean Logical, Assignment Operators, Arrays, and Strings.
Self-Learning Concept: A Closer Look at Variables

MODULE-2	No. of Hrs. 11

Program Control Statements: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, , Garbage collection
Self-Learning Concept: The "This" keyword

MODULE-3	No. of Hrs. 10

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.

MODULE-4	No. of Hrs. 10

Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Implementing Multiple Interfaces, and Interfaces can be extended, Nested Interfaces. Packages: Package Fundamentals, Packages and Member Access, Importing Packages, Static import.

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Java Fundamentals, A comprehensive Introduction (Chapters1,2,3,4,5,6,7,8,9,10,12)	Herbert Schildt, DaleSkrien	-	Tata McGraw Hill	2013
2.	Java–The complete Reference(Chapter 19).	Herbert Schildt	Eight Edition	Tata Mc graw Hill	-

Reference Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Java Programming,	Hari Mohan Pandey	-	Pearson Education	2012

Online Courses and Video Lectures:

1. https://.nptel.ac.in/courses/106/105/106105191
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs36
3. https://www.shiksha.com/online-courses/programming-in-java-by-nptel-course-nptel22

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No. of Weeks	Hours/ Semester
1.	Class Room Teaching &Learning	3	14	42
2.	Activity Based Learning (ABL1&ABL2)	-	-	38
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to10 marks	30
Activity Details	Details of activities to be conducted Activity 1- Simulation Based Activity:The activity involves implementing Object-Oriented Programming (OOP) concepts using the Java programming language and analyzing their behavior through simulations. (10 Marks). Activity 2- Real-World Problem-Solving Activity: The activity focuses on solving real-world problems using Object-Oriented Programming concepts in Java (10 Marks).	20
Total		**50**

Activity Based Learning (38Hours)

<table>
<tr><td colspan="4">ABL1- Simulation Based Activity:The activity involves implementing Object-Oriented Programming (OOP) concepts using the Java programming language and analyzing their behavior through simulations.
<table><tr><td>Component</td><td>Description</td><td>Hours</td><td>Marks</td></tr><tr><td>Simulation</td><td>Simulation of basic programs using object-oriented programming concepts</td><td>6</td><td rowspan="4">10</td></tr><tr><td>Preparation</td><td>Preparation and planning of activity implementation</td><td>4</td></tr><tr><td>Execution</td><td>Execution of Java program</td><td>4</td></tr><tr><td>Report Preparation</td><td>Report preparation of outcomes</td><td>4</td></tr></table></td><td>CO
1,2</td><td>PO
1,2,3,5,8</td><td>PSO
2</td><td>Hours
18</td></tr>
<tr><td colspan="4">ABL2- Real-World Problem-Solving Activity: The activity focuses on solving real-world problems using Object-Oriented Programming concepts in Java.
<table><tr><td>Component</td><td>Description</td><td>Hours</td><td>Marks</td></tr><tr><td>Problem Identification</td><td>Identification of real-world problems</td><td>4</td><td rowspan="4">10</td></tr><tr><td>Design and Planning</td><td>Design of solutions using inheritance, interfaces and constructors</td><td>5</td></tr><tr><td>Implementation</td><td>Development of object-oriented solutions</td><td>7</td></tr><tr><td>Report Preparation</td><td>Preparation of technical reports</td><td>4</td></tr></table></td><td>2,3,4</td><td>1,2,3,5,8</td><td>2</td><td>20</td></tr>
<tr><td colspan="4">Total Learning Hours/Semester</td><td></td><td></td><td></td><td>38</td></tr>
</table>

Evaluation of Learning Process (10 Hours)

Type of Evaluation	**Hours**
CIE (1,2 and3)	3
Demonstration of activity and report submission	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3				2			2					1
CO2	2	1	3		2			2	1				2
CO3	3	2	2		2			2	1				2
CO4	3		3		2			2	1				1

Course Title:	5G TECHNOLOGIES AND BEYOND		
Course Code	24EC624	(L-T-P) C	(3-0-0)3
Exam	3Hours	Hours/Week	3
SEE	50Marks	Total Hours	42L+10E+38ABL=90

Course Objective: The objective of the course is to provide exposure to the new communication systems services for 5G networks and beyond where technologies enabledforwirelesscommunicationforimprovementofcommunicationsystemisanalyzed.

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

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Interpret the role of IoE enabling technologies, data security mechanisms, and 5G communication systems.	1,6,7,8,9	1
2	Investigate the use cases, requirements, system concepts, and architectural framework of 5G wireless communication networks.	1,6,7,8,9	1
3	Assess the performance of MIMO and Massive MIMO systems, beam forming techniques, and advanced 5G radio access technologies for efficient wireless communication.	1,6,7,8,9	1
4	Analyze the vision, architecture, and key enabling technologies of 6G networks, including terahertz communications, reconfigurable intelligent surfaces, edge intelligence, and tactile internet applications.	1,6,7,8,9	1

MODULE-1	11Hrs.
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 IoE, System Management and Protection for IoE, Applications of IoE, Healthcare, Education System Smart Environment, Enabling IoE in Developing Countries. **5GIntroduction:** Historicalbackground,FromICTtothewholeeconomy,Rationaleof 5G: high data volume, twenty-five billion, connected devices and wide requirements, Global initiatives, Standardization activities.	
MODULE-2	**10 Hrs.**
5Guse cases and system concept: Use casesandrequirements,5G system concept. **The5Garchitecture:** Introduction,High-levelrequirementsforthe5Garchitecture, Functional architecture and 5Gflexibility, Physical architecture and 5Gdeployment.	
MODULE-3	**10 Hrs.**
MIMO Antennas:A5GCommunicationPerspective: Introduction, Single Element Versus Multiple Antenna System, MIMO Antenna System, Comparative Study of SISO, MIMO and Massive MIMO System, mm-Wave MIMO, Antenna Array Beam forming. **The 5G radio-access technologies:** Access design principles for multi-user communications, Orthogonal multiple-access systems, Spread spectrum multiple-access systems, Capacity limits of multiple-access methods, Multi-carrier with filtering: a new waveform: Filter-bank based multi-carrier, Universal filtered OFDM, Non-orthogonal schemes for efficient multiple access, Non-orthogonal multiple access(NOMA), Sparse code multiple access(SCMA), Interleave division multiple access (IDMA), Radio access for V2X communication, Medium access control for nodes on the move, Conclusion.	

MODULE-4	11Hrs
The6GVision:Introduction,EvolutionofMobileNetworks,andInternet,6GNetwork ArchitecturesandKeyEnablingTechnologies.Four-TierNetworks:Space-Air-Ground-Underwater, Key Enabling Technologies, Millimetre-Wave and Terahertz Communications, Reconfigurable Intelligent Surfaces, From Network Softwarization to Network Intelligentization, Toward 6G: A New Era of Convergence. **Immersive Tactile Internet Experiences via Edge Intelligence**: Introduction, The Tactile Internet: Automation or Augmentation of the Human, Haptic Traffic Characterization, Teleoperation Experiments, 6-DoF Teleoperation without Deadband Coding, 1-DoF Teleoperation with Deadband Coding, Packetization, Packet Inter arrival Time Sample Autocorrelation FiWi Access Networks: Revisited for Clouds and Cloudlets, FiWi: EPON and WLAN: C-RAN: Cloud vs. Cloudlet, Low-Latency FiWi Enhanced LTE-A Het Nets, Delay Analysis, Assumptions, Local Teleoperation, Non local Teleoperation, Edge Sample Forecast, Results and Conclusions.	

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	**"Enabling Technologies for Next Generation Wireless Communications"**	Usman, M., Wajid, M., & Ansari, M.D	First edition	CRC Press	2020
2.	**"5G and Beyond Wireless Systems"**	Manish Mandoli, Devendra Gurjar, PrabinaPattanayak	-	Springer Series	2021
3.	**"Toward 6G: A New Era of convergence"**	Ebrahimzadeh, A., Maier, M.	-	United Kingdom: Wiley	2021

Reference Book:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	"**5G Mobile and Wireless Communications Technology**"	Dohler, M., & Nakamura, T	2nd Edition	Cambridge University Press	2016

Online course and video lecture:

1. https://www.youtube.com/watch?v=SbYltPawklg&list=PLFW6lRTa1g81SMpel8aIFBubvO0h1UOJV
2. https://www.youtube.com/watch?v=AfAqSu9st1U&list=PLXjHn7CHrmRVdDO11OG6ihpa6Vf8QhuS

Teaching-Learning–Evaluation Scheme:

Sl. No	Teaching and Learning Method	No. of Hours/ Week	No.of Weeks	Hours/ Semester
1.	Class Room Teaching &Learning	3	14	42
2.	Activity Based Learning (ABL1 & ABL2)	-	-	34
3.	Evaluation of Learning Process	-	-	10
Total Learning Hours/Semester				**90**

Proposed Assessment Plan(for50marksofCIE):

Tool	Remarks	Marks
Internals	Three tests conducted for 20 marks each and Reduced to10marks	30
Activity Details	Details of activities to be conducted 9) Activity 1- Report and presentation on emerging technologies in the current trend (10 Marks). Activity 2- Report on Industrial visit regarding 5G Technology Communications (10 Marks).	10 10
Total		**50**

Activity Based Learning - (38 hours)

ABL1(20 hours): Report and presentation on emerging technologies in the current trend

Objective: To enhance students' knowledge of 5G and beyond wireless technologies, explore emerging communication trends, and improve technical presentation skills through innovative visual representation of advanced networking concepts.

21.	Evolution of Mobile Communication: From 1G to 6G
22.	Massive MIMO Technology in 5G Networks
23.	Millimeter Wave (mm Wave) Communication in 5G
24.	Beamforming Techniques for 5G and 6G Networks
25.	Internet of Things (IoT) Enabled by 5G
26.	6G Wireless Communication: Vision and Future Applications
27.	Role of Artificial Intelligence in 5G and Beyond Networks
28.	Space-Air-Ground Integrated Networks in 6G
29.	Network Slicing in 5G Technology
30.	Cyber security Challenges in 5G and 6G Networks
31.	Applications of 5G in Smart Healthcare
32.	Green Communication and Energy-Efficient 6G Networks

ABL2 (18 hours): Report on Industrial visit regarding 5G Technology Communications

Objective: To understand the architecture, components, and working principles of 5G communication systems and to gain practical exposure to advanced wireless communication technologies used in modern industries.

Plan of Action:

Identify the Industry: Select a telecommunications company, research center, or organization involved in 5G technology development and deployment.

Obtain Permission: Seek approval from the institution and obtain consent from the industry for the visit.
Pre-Visit Preparation: Study the fundamentals of 5G communication, network architecture, spectrum allocation, and key enabling technologies.
Conduct the Industrial Visit: Observe 5G infrastructure, network equipment, testing facilities, and operational procedures. Interact with technical experts to understand practical implementations.
Data Collection: Record observations, collect brochures, technical information, and note key learning outcomes.
Analysis and Discussion: Analyze the information gathered and discuss the applications, benefits, and challenges of 5G technology.
Report Preparation: Compile the findings, observations, photographs, and conclusions into a structured industrial visit report.
Presentation and Review: Present the outcomes of the visit and share the knowledge gained with peers and faculty members.

Evaluation of Learning Process(10Hours)

Type of Evaluation	Hours
Test(1,2and3)	3
Demonstration of activity	4
Semester End Exam	3
Total	**10**

Course Articulation Matrix

Course Outcomes	Program Outcomes[POs]												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3					2	1	2	3			1	
CO2	3					2	1	2	3			1	
CO3	3					2	1	2	3			1	
CO4	3					2	1	2	3			1	