Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure and Syllabus of

Pattern "A24"

T Y B.Tech.

Electronics and Telecommunication Engineering

Effective from Academic Year 2026-27

Prepared by: - Board of Studies in Electronics and Telecommunication Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Approved by: Academic Board, Vishwakarma Institute of Technology, Pune

Chairman – BOS **Dean Academics** **Chairman – Academic Board**

Department of Electronics & Telecommunication Engg. V.I.T. PUNE - 48.

Head,
Department of E&TC
VIT, Pune - 48

Institute Vision

"To be a globally acclaimed institute in technical education and research for holistic socio-economic development."

Institute Mission

- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision

"To be a centre of academic excellence in Electronics, Telecommunication and related domains through continuous learning and innovation."

Department Mission

- To provide state of art education in Electronics and Telecommunication Engineering to meet current and future needs of society, industry, and academia.
- To strengthen collaborations with industries and institutes of repute to foster research culture among faculty members and students.
- To promote ethically conscious engineers demonstrating sustainable entrepreneurship and professional maturity in a social context.

Program Educational Objectives (PEOs)

Graduates of the program will

1. Have a comprehensive knowledge of Electronics engineering fundamentals to face the challenges of real-life complex problems.
2. Be professionals imbibed with a spirit of leadership, ethical behavior, and societal commitment.
3. Be compliant to constantly evolving technology through lifelong learning.

Program Specific Objectives (PSOs)

E&TC Graduates will have the ability to:

1. Design, develop and analyze complex Electronic Systems for communication, Signal Processing, Embedded Systems, and VLSI applications.
2. Identify and apply domain-specific hardware and software tools to solve real-world problems in Electronics and Communication.

Program Outcomes (POs)

Engineering Graduate will be able to

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

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

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

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

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

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

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

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

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

CONTENTS

E & TC Third Year Structure Pattern "A24", Semester 1

E & TC Third Year Assessment scheme

Branch: E & TC Third Year Structure Pattern " A24", Semester 1,

AY 2026-27

Subject No	Category	Course Code	Subject Name	Teaching Scheme(Hrs/Week)			Credits
				Theory	Lab	Tut	
S1	PCC	ET3288	Digital Integrated Circuit Design	3	2		4
S2	PCC	ET3289	Embedded system design	2	2		3
S3	PEC1	ET3290A ET3290B ET3290C ID3002	Machine learning and Computer Vision Wireless Communication Electromagnetic Engineering Mainframe Technique	3	2		4
S4	PEC2 Coursera		Coursera	-		-	3
S5	OE1 Coursera		Coursera	-			4
S6	MDM3	MM1001A MM1001B	Design And Analysis Of Algorithm Automative Electronics	2		1	3
S7	VSEC-DT	ET3282	Design Thinking-3		-		1
S8	ERI-	ET3291	Engineering Research And Innovation-1		-		2
			Total Hours	10	6	1	24

Chairman – BOS

Dean Academics

Chairman – Academic Board

Head,
Department of E&TC
VIT, Pune - 48

Department of Electronics & Telecommunication V.I.T. PUNE - 48.

PEC2: Coursera

MD3168:4G/5G Network

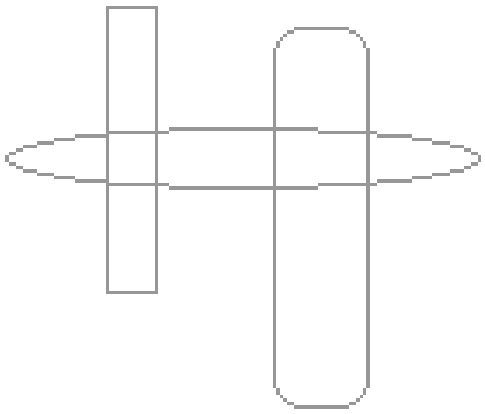
OE1: Coursera

MD3201:FINTECH

MD3202:DIGITAL MARKETING

MD3203:ENTREPRENEURSHIP

MD3204:MANAGEMENT



Vishwakarma Institute of Technology

Issue 1 : Rev No. 00: Dt. 03/07/26

FF No. 653_A

Title : Course Structure

Branch : E & TC **Year:** TY **Academic Year :** 2026-27 **Semester:** I **Module:** 5 **Pattern:** A24

Level _5.5																							
Course Code	NEP Course Category	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks													Credits			
			Theory	Tutorial	Practical	CVV	CP	LAB/TUT	GD/PPT	HA	MSE(W)	MSE(R)	MSE(O)	ESE/R)	ESE (W)	ESE (O)	PRACT+ CVV	ESE-Direct Evaluation	Theory	Tutorial	Practical	Total
Semester I																							
ET3288	PCC	Digital Integrated Circuit Design	3		2										40		60		3		1	4
ET3289	PCC	Embedded system design	2		2	20	30	10							40				2		1	3
ET3290A	PEC1	Machine learning and Computer Vision	3		2	20	40		20	20									3		1	4
ET3290B		Wireless Communication																				
ET3290C		Electromagnetic Engineering																				
ID3002		Mainframe Technique																				
MD3168	PEC2 Coursera	4G/5G Network																100(FE-Final evaluation)	3			3
MD3201	OE1 Coursera	FINTECH																100(FE-Final evalution)	4			4
MD3202		Digital Marketing																				
MD3203		Entrepreneurship																				
MD3204		Management																				
MM1001A	MDM 3	Design and analysis of Algorithm	2	1			30		20	10					40				2	1		3
MM1001B		Automative Electronics																				
ET3282	VSEC-DT																	100				1
ET3291	ERI-											30		70								2
Total			**10**	**1**	**6**	**40**	**100**	**10**	**40**	**30**		**30**		**70**	**120**		**60**	**300**	**17**	**1**	**3**	**24**

Abbreviations Used	
PPT	Powerpoint Presentation
GD	Group Discussion
CVV	Comprehensive Viva Voce
LAB	Laboratory
TUT	Tutorial
CP	Course Project
PR	Practical
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
R/W/O	Review /Written/Online

BOS Chairman

Head,
Department of E&TC
VIT, Pune - 48

Department of Electronics & Telecommunication Engg.
V.I.T. PUNE - 48.

Dean Academics

FF No.: 654

ET3288: Digital Integrated Circuit Design

Teaching Scheme	Examination Scheme
Credits: 04	
Lectures: 3 Hrs./week	PR+CVV: 60 Marks
Practical: 2 Hrs./week	
Tutorial:	ESE (W): 40 Marks

Prerequisite:
Semiconductor Physics / Devices, MOSFET, I-V Characteristics, basic semiconductor equations
Digital Electronics: Logic Gates, Boolean Algebra, Truth table, K-maps, Combinational Circuits, Sequential Circuits, FSM.

Course Objectives:

- Understand the need and concept of 3D MOSFETs by explaining the need for advanced transistor architectures and identifying their typical structures.
- Design digital logic circuits based on different circuit families with different trade-offs in speed, power, complexity and robustness
- Acquire skills in the use of Computer Aided Design (EDA and TCAD) tools for Digital and DeviceDesign
- Understand and apply various abstraction levels to implement a digital system
- Model digital circuit with HDL, simulate, synthesis and prototype in PLDs
- Generate smart test bench for verifying the functionality

Course Outcomes:
Students will be able to
1. Compare conventional planar 2D MOSFETs and FinFET technology (3D MOSFETs) in terms of structure, performance, scalability, and applications.
2. Design CMOS combinational and Sequential circuits
3. Illustrate the VLSI design flow, microelectronics fabrication process, layout design, and programmable logic devices.
4. Develop Verilog programs using suitable abstraction level to represent and verify combinational and sequential digital circuits.
5. Apply blocking and nonblocking procedural assignments appropriately in Verilog HDL and distinguish their behavior in digital circuit modeling
6. Evaluate Design for Testability (DFT) techniques and test generation methods for digital integrated circuits

SECTION I

UNIT I

MOSFET - Device perspective, 3D MOSFETs – Need, Typical structures, FinFET vs MOSFET - comparison of the two technologies, highlighting differences in structure, performance, and applications, Notion of Scaling

UNIT II

CMOS Combinational Circuits: Inverter, Need of PUN and PDN for digital circuits, Ratioed logic, DCVSL, Pass Transistor logic, Level restorer, Transmission Gate logic, Dynamic Logic Design, Speed and power dissipation in dynamic logic, Signal Integrity issues in Dynamic Design, Domino Logic, np CMOS
CMOS Sequential Circuits - Overview of working, Latches and Flip-Flops, Timings in Sequential Circuits - Setup and hold time, Multiplexer based latch, Mux based FF, Clock overlap issues, C^2MOS Logic, Semiconductor Memory – ROM, RAM, FLASH,

UNIT III

Microelectronics Fabrication and Layout, Typical VLSI design flow, Top-Down and Bottom-Up approach, Standard Chips, PLDs, FPGAs and ASICs. Role of hardware description languages – Conquer the Complexity, Concurrency in hardware.

SECTION II

UNIT IV

Introduction to Verilog HDL: Levels of Design Description, Module, System Tasks, Simulation and Synthesis. Verilog Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators. Gate level modelling and Data flow modelling.

UNIT V

Behavioral modeling: Procedural constructs- initial & always block, procedural assignments – blocking and nonblocking statements, difference in blocking and nonblocking statements, Selection statements- if-else, case, iterative statements- while, for, repeat, forever loop. Task, function, system tasks and functions.

UNIT VI

Design For Testability (DFT) - DFT methods for digital circuits, Ad-hoc methods, Structured methods, Automatic Test Equipment (ATE), Scan, Partial Scan, Built-in self-test (BIST), Boundary scan, Automatic Test Pattern Generation (ATPG).

Text Books:

1. Kang, Sung-Mo, and Yusuf Leblebici. CMOS digital integrated circuits. Tata McGraw -Hill Education, 2003.
2. Rabaey, Jan M., Anantha P. Chandrakasan, and Borivoje Nikolić. Digital integrated circuits: a design perspective. Vol. 7. Upper Saddle River, NJ: Pearson Education, 2003.

3. Palnitkar, Samir. Verilog HDL: a guide to digital design and synthesis. Vol. 1. Prentice Hall Professional, 2003.

Link to e-books http://www.stem-edu.com/wp-content/uploads/2017/02/Rabaey-Digital-Integrated-Circuits-Asign-Perspective-2Nd-Edition.pdf

Reference Books:

1. Weste, Neil HE, and David Harris. CMOS VLSI design: a circuits and systems perspective. Pearson Education India, 2015.
2. Ciletti, Michael D. Advanced digital design with the Verilog HDL. Vol. 1. Upper Saddle River: Prentice Hall, 2003.

List of Practicals:

1. Study of writing a SPICE Netlist, various types of Analysis, SPICE Model, notion of sub-circuit and simulation of MOSFET I-V, CMOS Inverter or any small circuit in consultation with the instructor
2. Symmetric CMOS Inverter
   - Schematic and simulation
   - Size of PMOS and NMOS
   - VTC simulation
3. Logic Gates (Any ONE)
   - Two-input NAND gate or NOR gate
   - Schematic, Symbol, Testbench
   - Apply stimulus and simulate
   - OP, DC, and transient analysis
4. Layout Optimization
   - Layout of second experiment (logic gates)
   - Optimize area with device matching
5. Experiment 5: DRC, LVS, and RC Extraction
   - Perform DRC, LVS, and RC extraction on the layout
6. Experiment 6: Post-Layout Simulation
   - Post-layout simulation of experiment 4
   - Compare results with experiment 2

   Verilog Experiments

7. Experiment 7: 2:1 Multiplexer
   - Verilog code, testbench and simulation
8. Experiment 8: Combinational Circuits (Any Circuit in consultation with the Instructor)
   - Comparator:
     - Verilog code, simulation and synthesis
   - 8-bit Adder:
     - Verilog code, simulation and synthesis
9. Experiment 9: Sequential Circuits (Any Circuit in consultation with the Instructor)

- Counter
- Flip-flop
- Verilog code, simulation, and synthesis

10. Digital Circuit Design
    RTL to GDSII (RTL Code, Simulations, Synthesis, Physical Design)
    - Tools: Synopsys or Cadence

11. Suitable experiments on DFT like -
    - Design and simulate a scan-enabled D flip-flop
    - Design an LFSR-based pseudo-random pattern generator (LBIST)

List of Projects:

* Fast Inverse Square Root using FPGA
* Design of a 4-Bit 4-Operand Adder Using Verilog: An Abstraction Analysis
* A 4-Input 8-Bit Comparator with Enhanced Binary Subtraction
* Simulation and Analysis of six T SRAM Cell in NGSpice
* Design of Double Precision Floating Point Comparator for multiple inputs
* FPGA-Based 8-bit True Random Number Generator
* High Performance Logarithmic Multipliers
* Implementation of a High-Performance 32-bit floating point multiplier via Karastuba Algorithm
* FPGA Based Optimized Object Detection
* Smart Parking System Using FPGA
* Configurable Multi-Image Transposed Steganography on FPGA
* ELLIPTIC CURVE CRYPTOGRAPHY (ECC) IMPLEMENTATION USING VERILOG
* Power Tools Classification using FPGA
* Pattern Recognition on Neural Networks using FPGA
* OBJECT DETECTION AND COMMUNICATION USING FPGA
* FPGA based Lane detection system
* High Efficiency, Low Power Divider using FPGA
* Development and Deployment of High-Precision Floating Point Comparator
* Design Of BLDC Motor Controller ASIC With Integrated Encoder Feedback
* Design and Implementation of ALU for16-bit single-cycle MIPS processor
* Multi-Operand Cryptographic Number Analyzer
* FPGA Based Arrhythmia Detection Using Machine Learning
* Design of Barrel Shifter using Reversible Logic
* POWER EFFICIENT 4-BIT SYNCHRONOUS COUNTER USING HYBRID DATA ENCODING
* Implementing AES-256 key Algorithm on FPGA
* 32-bit Carry Select Adder Design for High-Speed and Low-Power FPGA Applications
* ANN based power estimation for VLSI circuits
* Performance Analysis of Multi-Operand 4-Bit Adders
* Pattern Recognition using Neural Network on FPGA

CO-PO Mapping

CO	Program Outcomes (PO)											SO		
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	SO1	SO2
CO1	3	3	2	3	3	0	0	1	2	3	2	2	3	2
CO2	3	3	2	3	3	0	0	1	2	3	2	2	3	2
CO3	3	3	2	3	3	0	0	1	2	3	2	2	3	2
CO4	3	3	2	3	3	0	0	1	2	3	2	2	3	2
CO5	3	3	2	3	3	0	0	1	2	3	2	2	3	2
CO6	3	3	2	3	3	0	0	1	2	3	2	2	3	2
Average	3	3	2	3	3	0	0	1	2	3	2	2	3	2

FF No.: 654

ET3289: Embedded System Design

Teaching Scheme	**Examination Scheme**
Credits : 03	CP: 30 Marks
Lectures : 02 Hrs/week	CVV: 20 Marks
Practical : 02 Hrs/week	LAB: 10 Marks
Tutorial : 0 Hrs/week	ESE(W): 40 Marks

Prerequisites:	
Computer architecture, Operating system concepts, C programming	
Course Objectives:	
1.	Explain hardware and software architecture and their selection towards embedded system design efficacy with reference to techno commercial design metrics.
2.	Elaborate Classic ARM processor architecture and its evolution
3.	Impart the knowledge of interfacing and programming of ARM7 based LPC2148 microcontroller.
4.	Impart the knowledge of interfacing and programming of Cortex based LPC1768 microcontroller
5.	Demonstrate the usage of Raspberry Pi architecture with OS towards embedded applications.
6.	Impart usage of open-source OS(Linux) for embedded application.
Course Outcomes:	
After completion of the course, student will be able to:	
1.	Identify an appropriate hardware and software architecture for effective design and development of an embedded system with optimized design metrics.
2.	Justify the architecture of ARM7 for embedded system.
3.	Implement ARM based LPC2148 system for on-chip and off-chip peripheral devices.
4.	Implement ARM Cortex based LPC1768 system for on-chip and off-chip peripheral devices.
5.	Develop Raspberry Pi based embedded applications using GPIO.
6.	Use Linux for the embedded application development.

Section 1:	**Topics/Contents**

Unit 1: Introduction to Embedded Systems (04 Hours)

Review of microcontrollers (08,16 bit), CISC and RISC comparison, Hardware and software architecture, Techno-commercial Design metrics, Embedded Memory, Strategic selection of processor/architecture and memory

Unit 2: ARM7 Architecture (04 Hours)

ARM Design Philosophy, ARM evolution, Overview of ARM7 architecture, Programming model, Execution modes and Exceptions, PLL, Bus architecture, Interrupt Structure

Unit 3: LPC2148 Architecture and Programming (06 Hours)

LPC2148 features, Memory map, GPIO programming (LED/LCD/KEY), On chip peripheral

programming (Timer, Interrupt, ADC, UART, SPI, I2C)

Section 2:	Topics/Contents

Unit 4: ARM cortex (04 Hours)

Introduction to Cortex M4 architecture, Interrupt Structure, CMSIS Structure, GPIO programming, on-chip peripheral programming.

Unit 5: Raspberry Pi 4/5 (04 Hours)

Introduction to Raspberry Pi 4/5, Architecture overview and hardware features. Installation and And configuration of Raspberry Pi OS, GPIO programming, Peripheral Interfacing and programming

Unit 6: Embedded Linux (06 Hours)

Introduction to Embedded Linux environment, Embedded Linux architecture and components, Boot process, File system basics, Process management, IPC concepts, Cross-compilation, Embedded Linux application development process.

Text Books:

1	Frank Vahid and Tony Givargis, "Embedded System Design – A Unified hardware/ Software introduction" 3rd edition, Wiley
2.	Andrew N. Sloss, Dominic Symes, and Chris Wright, "ARM System Developer's Guide "Publisher: Morgan Kaufmann (Elsevier)
3.	D. Molloy, Exploring Raspberry Pi, 1st ed., Indianapolis, IN, USA: Wiley, 2016.
4.	Joseph Yiu, The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, Third Edition, Newnes, United States,2013
5.	Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach 2nd edition, Prentice Hall.

Reference Books:

1	J. D. Bakos, Embedded Systems: ARM Programming and Optimization, 1st ed., Burlington, MA, USA: Elsevier, 2015.
2	K.V.K Prasad, "Embedded/Real-Time Systems, Publisher: Dreamtech Press
3	LPC 2148 data sheet
4.	A. K. Singh, Operating Systems Foundations with Linux on Raspberry Pi, 1st ed., Cambridge, UK: Arm Education, 2019

List of Practicals

1. Introduction to ARM microcontroller IDEs and tool chain

A] GPIO Programming

2. Interfacing and Program development for LED and Switch with LPC2148

3. Interfacing and Program development for 16X2 LCD with LPC2148

B] On -chip peripheral programming

4. Interfacing and Program development for on-chip ADC with LPC2148.

5. Interfacing and Program development for on-chip UART with LPC2148.

6. Interfacing and Program development for external and internal interrupt with LPC2148

C] Cortex Programming

7. Interfacing and Program development for seven segment display with LPC1768.

8. Interfacing and Program development for PWM based DC motor speed control with LPC1768

9. Raspberry-Pi Programming

10. Exercise of installation and configuration of OS on Raspberry-Pi 3 /4

11. Interfacing and Programming for RiPi -GPIO programming (LCD with I2C module)

D] Embedded Linux

12. Demonstration of Linux porting and application development on ARM architecture.

CO-PO Mapping

CO	Program Outcomes (PO)												PSO	
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO12	PSO1	PSO2
CO1	3	0	1	0	0	0	0	0	0	0	1	1	1	1
CO2	2	2	2	0	0	0	0	0	0	0	0	2	2	2
CO3	2	2	3	0	3	0	0	0	0	0	0	2	3	2
CO4	2	2	3	0	3	0	0	0	0	0	0	2	3	2
CO5	2	2	3	0	3	0	0	0	0	0	0	2	3	3
CO6	3	3	3	0	3	0	0	0	0	0	0	3	3	3
Average	2.33	1.83	2.5	0	2	0	0	0	0	0	0.16	2	2.5	2.16

FF No.: 654

Course Code: Machine Learning and Computer Vision

T.Y.BTech

Teaching Scheme	Examination Scheme
Credits : 4	CP: 30 Marks
Lectures : 3 Hrs/week	CVV: 20 Marks
Practical : 2 Hrs/week	Lab Assessment: 10 Marks
Tutorial : - Hrs/week	ESE : 40 Marks

Prerequisites:	
•	Linear Algebra ,Statistics and Probability
Course Objectives:	
•	To understand fundamental concepts of machine learning including types, model generalization, bias-variance tradeoff, and feature engineering techniques.
•	To develop knowledge of supervised learning techniques such as regression and classification using models like linear regression, logistic regression, SVM, and decision trees.
•	To explore unsupervised learning approaches including clustering and dimensionality reduction techniques such as k-means and PCA.
•	To introduce the fundamentals of computer vision, image formation, and camera models used in vision systems.
•	To understand core image processing techniques including filtering, enhancement, segmentation, and feature extraction methods.
•	To learn deep learning concepts and architectures such as CNNs and their applications in computer vision tasks.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Apply machine learning concepts to analyze data, perform feature engineering, and address bias-variance tradeoff.
2.	Implement supervised learning algorithms for regression and classification and evaluate their performance.
3.	Apply unsupervised learning techniques such as clustering and dimensionality reduction to extract meaningful patterns from data.
4.	Explain image formation principles and apply geometric transformations in computer vision systems.

5.	Implement image processing techniques such as filtering, segmentation, and feature extraction for visual data analysis.
6.	Design and apply deep learning models, especially CNNs, for solving computer vision problems like image classification.

Section1:	Topics/Contents

Supervised Learning -Regression

Introduction to Machine Learning, Types of machine learning, Generalization: Concept of Model and Training, Concept of Bias and Variance. Feature Engineering and Dimensionality reduction. Linear models for regression: Linear Basis Function Models, Concept of Gradient and Error function used in regression, regularization: Ridge and Lasso regression, Multilayer perceptron (MLP) and back propagation algorithm,

RMS Prop and Adam optimization techniques,

Supervised Learning -Classification

Linear Models for Classification, Logistic regression, Linear Discriminant Analysis, Bayesian Classification, Support Vector Machines, Random forest classifiers, Decision Trees, Evaluation of classification performance. Case Study: Classification

Unsupervised Learning

k-Means Clustering, Hierarchical Clustering

Principal Components Analysis, Gaussian Mixture models, Maximum Likelihood Estimation

Section2:	Topics/Contents

Introduction to Computer Vision and Image formation

Human Vision System, Introduction and Goals of Computer Vision, Image formation: Geometric transformations, Geometric Camera Models, Single camera setup of image formation. Image formation in a stereo vision setup. Camera Callibration

Fundmentals of Image Processing

Concepts Image enhancement : Contrast enhancement ,image filtering , Image transforms , colour models and transformations, Introduction to image segmentation

Edges and contours Texture Descriptors Corner Point Detectors, Scale Invariant Feature Transform. Stereo image formation. Shape from Shading.

Introduction to Deep Learning

Challenges in Machine learning: Vanishing Gradient problems, Computational Load, Architecture of ConvNet, Convolution Layer, Pooling Layer, and Applications of CNN's in Computer Vision, Case study using CNN based classification

Text Books: *(As per IEEE format)*	
1	Alpaydin, Ethem. *Introduction to machine learning*. MIT press, Third Edition.
2	Laurene Fausett, Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Pearson Education, Inc, 2008. *me(s) of author(s); Title of the book; Edition No., Publisher*
3	Szeliski, Richard. *Computer vision: algorithms and applications*. Springer Nature, 2022.
4	M.K. Bhuyan , " Computer Vision and Image Processing: Fundamentals and Applications", CRC Press, USA, ISBN 9780815370840
Reference Books: *(As per IEEE format)*	
1	Christopher Bishop, "*Pattern Recognition and Machine Learning*", Springer, 2007.
2	Goodfellow, Ian, Yoshua Bengio, Aaron Courville, and Yoshua Bengio. *Deep learning*. Vol. 1. Cambridge: MIT press, 2016.
3	Forsyth & Ponce, "Computer Vision-A Modern Approach", Pearson Education.

List of Practical's:

1. Write a program to perform regression tasks over a given data using direct functions and evaluate its performance.
2. Write a program to perform classification tasks over a given data using direct functions and evaluate its performance.
3. Write a program to perform classification tasks over a given data using Support Vector evaluate its performance.
4. Implement K means clustering algorithm for a given data.
5. Implementation of Image Enhancement Techniques
6. Implement and test Convolutional Neural Network (CNN) for digit recognition.

List of Project areas:

1. Regression and Classifications using MLP ,SVM,Random forest ,XG boost etc
2. Classifications using Convolution Neural Networks
3. Image Analysis based on CV and Deep learning.

CO-PO Mapping

CO	Program Outcomes (PO)												PSO	
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	3	3	2	2	3	3	2
CO2	3	3	3	3	3	2	2	3	3	2	2	3	3	2
CO3	3	3	3	3	3	2	2	3	3	2	2	3	3	2
. CO4	3	2	2	2	3	1	1	3	2	2	1	3	3	1
. CO5	3	3	2	3	3	2	2	3	3	2	2	3	3	2
. CO6	3	3	3	3	3	2	2	3	3	2	2	3	3	3
Average	3	2.83	2.66	2.88	3	1.83	1.83	3	2.88	2	1.83	3	3	2

FF No.: 654

ET3290B: Wireless Communication

Teaching Scheme	Examination Scheme
Credits : 4	CP: Marks
Lectures : 3 Hrs/week	GD/PPT/HA: Marks
Practical : 2 Hrs/week	MSE (W/O): Marks
Tutorial : 0 Hrs/week	ESE (W/O): Marks

Prerequisites:	
•	The prerequisites for studying Wireless Communication include a strong foundation in basic analog and digital communication concepts such as modulation, demodulation, and the effects of noise on signals. Students should be familiar with signals and systems, including the analysis of continuous and discrete signals and the use of tools like Fourier transforms. A basic understanding of electromagnetic theory is essential to grasp wave propagation and antenna behavior. Knowledge of probability and random processes is also important for analyzing noise and fading in wireless channels. Additionally, students should have a background in basic electronics and communication engineering concepts, along with a general understanding of networking principles such as cellular architecture and communication protocols.
Course Objectives:	
1.	To understand the fundamentals of wireless communication systems and the evolution of cellular networks (2G, 3G, etc.).
2.	To study radio wave propagation mechanisms and analyze large-scale path loss models used in wireless communication.
3.	To understand small-scale fading and multipath propagation effects in mobile communication channels.
4.	To learn various multiple access techniques such as FDMA, TDMA, CDMA, and SDMA used in wireless systems.
5.	To understand mobility management in cellular networ**ks**, including handoff strategies, location management, and GSM procedures.
6.	To study wireless communication standards and signaling systems**,** including GSM, CDMA, ISDN, and SS7.

Course Outcomes:	
	After completion of the course, student will be able to
1.	Differentiate four generations of wireless standard for cellular networks.
2.	Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.
3.	Spell the trade-offs among frequency reuse, signal-to-interference ratio, capacity,

	and spectral efficiency
4.	Calculate capacity of cellular systems
5.	Explain mobility in wireless communication System.
6.	Describe wireless standards

Section1:	Topics/Contents

Unit 1: Introduction to Wireless Communication Systems (7 Hours)

Introduction to Wireless Communication Systems, Examples of Wireless Communication Systems, Trends in Cellular Radio and Personal Communications.

Overview of Wireless Communication Generations: First Generation (1G), Second Generation (2G) Cellular Networks, 2.5G, Third Generation (3G) wireless Networks,

The Cellular Concept: Introduction, Frequency Reuse, Channel Assignment strategies, Hand off Strategies, interference and system capacity, improving coverage and capability in Cellular Systems

Unit 2: Mobile Radio Propagation - Large Scale Path Loss (7 Hours)

Introduction to Radio wave propagation, free space propagation model, propagation mechanisms, Practical Link Budget design using path loss models, Outdoor propagation models, Indoor propagation models, signal penetration into buildings, Ray tracing and site specific modeling

Unit 3: Mobile Radio Propagation – Small Scale Path Loss (7 Hours)

Small Scale Multi path propagation, small scale multi-path measurements, parameters of mobile multi path channels, Types of small scale fading, Examples of fading behavior

Section2:	Topics/Contents

Unit 4: Multiple Access Techniques for Wireless Communications (7 Hours)

Overview of multiple access techniques: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA),Space Division Multiple Access (SDMA), Orthogonal Frequency Division Multiple Access (OFDMA)

Unit 5: Mobility Management in Wireless Networks (6 Hours)

Mobility Management Functions, Mobile Location Management, Mobility Model, Mobile Registration, GSM Token-Based Registration, IMSI Attach and IMSI Detach (Registration and Deregistration) in GSM, Paging in GSM, Handoff Process and Algorithms, Handoff Call Flows,Overview of call management in 5G System.

Unit 6: Wireless Systems and Standards (7 Hours)

Common Channel Signaling, Integrated Services Digital Network (ISDN), Introduction to Signaling System No.7(SS7), Global System for mobile (GSM), CDMA, Digital Cellular Standard (IS-95).

Text Books: ***(As per IEEE format)***

1	Theodore S, Rappaport; Wireless Communications; Principle and practice Second edition, PHI
2	Jochen Schiller; Mobile Communications; Second Edition, Pearson Education

	Reference Books: *(As per IEEE format)*
1	Heysik Kim, „Wireless Communications Systems Design", Wiley Publications,
2	Vijay Garg, „Wireless Communications& networking", Morgan Kaufman Series in networking
3	Andrea Goldsmith, „Wireless Communications", Cambridge University Press
4	William C.Y. Lee, „Wireless & Cellular Telecommunication", McGraw Hill, 3rd Edition

List of Practical's:

1. Simulate two ray model to determine the free space loss and the power received
2. Simulation of Rayleigh fading channel
3. Simulation of Rician fading channel
4. Simulate fading environment and loss based on Okumura - Hata model
5. Implementation of OFDM system using Matlab for either Text/Audio/Video data transmission considering frequency selective channel
6. Implementation of MIMO system using Matlab for either Random data/Text/Audio/Video data transmission considering Rician channel.
7. Simulation of comparison of wireless Technologies.

List of Project areas:

1. A simple OFDM system for transmitting data over frequency selective fading channel
2. Free space Propagation – Path Loss model to determine the free space loss and the power received.
3. Observe the BER performance of DS-CDMA in multipath channel for single user case Model a fading channel based on Rayleigh & Rician Fading.
4. A simple Large MIMO system for transmitting data over flat or frequency selective fading channel
5. A simple Massive MIMO system for transmitting data over flat or frequency selective fading channel.
6. A simple MIMO-OFDM system for transmitting data over flat or frequency selective fading channel.
7. Protocol based Wireless network system design.

CO-PO Mapping

CO	Program Outcomes (PO)												PSO	
CO/ PO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	–	–	1	2	2	–	–	1	–	2	2	1
CO2	3	3	2	2	2	0	1	–	–	–	–	2	3	2
CO3	3	3	2	2	2	0	1	–	–	–	–	2	3	2
CO4	3	3	3	2	2	1	1	–	–	–	–	2	3	2
CO5	2	2	2	1	2	1	0	–	1	2	–	2	2	3
CO6	2	2	1	–	2	2	0	–	1	2	–	2	2	3
Aver age	2.67	2.5 0	1.67	1.17	1.83	1	0.83	0	0.33	0.83	0	2	2.50	2.17

Syllabus Template FF No.: 654

Course Code: ET 3290C

Electromagnetic Engineering

Teaching Scheme	Examination Scheme
Credits : 4	GD/PPT/HA: 30 Marks
Lectures : 3 Hrs/week	ESE (W/O): 40 Marks
Practical : Hrs/week	CVV (W/O): 30 Marks
Lab : 1 Hrs/week	

Prerequisites:	
•	Basics of Physics, Basics of Calculus

Course Objectives:	
•	Build the mathematical foundation required for EM field analysis.
•	Understand electric fields under static conditions.
•	Study magnetic fields due to steady currents.
•	Understand dynamic electromagnetic fields.
•	Study Electromagnetic Wave propagation.
•	Introduction to antennas and radiation.

Course Outcomes:	
	After completion of the course, student will be able to
1.	Apply vector calculus tools to electromagnetic fields.
2.	Compute electric fields, potentials, and capacitance.
3.	Analyse magnetic fields and inductive systems.
4.	Understand Electromagnetic field interactions.
5.	Analyse Electromagnetic Wave propagation.
6.	Understand electromagnetic radiation and antennas.

Section1:	Topics/Contents

Unit 1: Vector Calculus Basics

Coordinate systems: Cartesian, Cylindrical, Spherical; Vector algebra: dot product, cross product; Gradient, Divergence, Curl; Line, surface, and volume integrals ;Divergence theorem, Stokes' theorem

Unit 2: Electrostatics

Coulomb's Law; Electric field intensity and flux density; Gauss's Law; Electric potential; Poisson's and Laplace's equations ; Capacitance and dielectrics ;Energy storage

Unit 3: Magnetostatics

Biot–Savart Law; Ampere's Law; Magnetic flux density and field intensity; Magnetic vector potential; Magnetic materials ; Inductance

Section2:	Topics/Contents
Unit 4: Time-Varying Fields and Maxwell's Equations Faraday's Law; Displacement current; Maxwell's equations; Continuity equation; Poynting Vector Unit 5: Uniform Plane Waves Wave equation; Plane waves in free space and media; Intrinsic impedance; Skin depth; Reflection and transmission Unit 6: Radiation Theory Basics Retarded potentials; Dipole radiation; Radiation patterns; Antenna parameters; Basic antenna types; Antenna Arrays – Broadside and End fire	
Text Books: *(As per IEEE format)*	
1	*Name(s) of author(s); Title of the book; Edition No., Publisher* Hayt, Buck; 'Engineering Electromagnetics'; 7th Edition, McGraw Hill Pub.
2	Jordan, Balmain; ' Electromagnetic Waves and Radiating Systems; 2nd Edition, PHI
3	Sadiku; 'Elements of Electromagnetics'; 2nd Edition, Oxford Press
Reference Books: *(As per IEEE format)*	
	.*Name(s) of author(s); Title of the book; Edition No., Publisher*
1	N.N.Rao; 'Elements of Electromagnetics'; 6th Edition, Pearson Education
2	Nathan Ida,' Engineering Electromagnetics'; 2nd Edition, Springer

List of Labs:

Lab 1: Coordinate Systems & Transformations

Conversion between Cartesian, Cylindrical, Spherical

Practice problems on position vectors

Lab 2: Vector Operations

Dot and cross product applications

Physical interpretation (work, torque)

Lab 3: Differential Operators

Gradient, Divergence, Curl

Identify irrotational and solenoidal fields

Lab 4: Coulomb's Law & Electric Field

Field due to point, line, and surface charges

Superposition principle

Lab 5: Gauss's Law Applications

Symmetry-based problems (sphere, cylinder, plane)

Electric flux density

Lab 6: Potential & Capacitance

Electric potential calculations

Capacitance of parallel plate, spherical systems

Lab 7: Biot–Savart & Ampere's Law

Magnetic field due to current-carrying conductors

Solenoid and toroid problems

Lab 8: Magnetic Materials & Inductance

Permeability, magnetization

Self and mutual inductance calculations

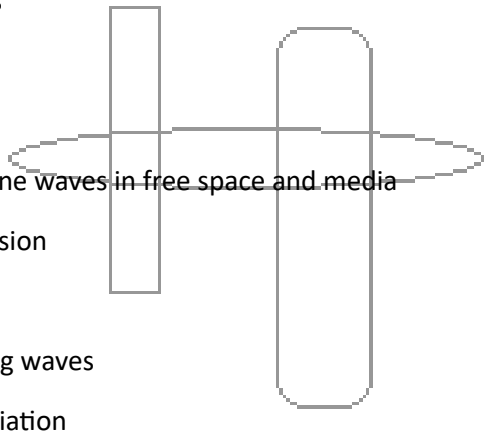
Lab 9: Maxwell's Equations

Integral and differential forms

Physical interpretation

Lab 10: Wave Propagation

Wave equation derivation Plane waves in free space and media



Lab 11: Reflection & Transmission

Boundary conditions

Reflection coefficient, standing waves

Lab 12: Antenna Basics & Radiation

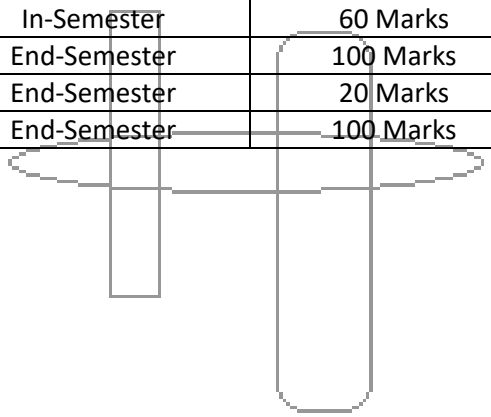
Dipole radiation

Radiation patterns, antenna parameters

	Program Outcomes (PO)													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1	1	0	0	0	0	1	0	0	2	2
2	3	3	1	2	1	0	0	0	0	1	0	0	3	2
3	3	3	2	2	1	0	0	0	0	1	0	0	3	2
4	3	3	2	2	1	0	0	0	0	1	0	0	3	2
5	3	3	2	2	1	0	0	0	0	1	0	0	2	2
6	3	2	2	1	1	0	0	0	0	1	0	0	2	2
Avg.	3	2.66	1.66	1.66	1	0	0	0	0	1	0	0	2.5	2

EME - assessment scheme: CVV 20, CP 40, GD/PPT 20, HA 20

Assessment	Mode of Assessment	Assessment	Converted to
CP (MCQ)	In-Semester	60 Marks	40 Marks
PPT	End-Semester	100 Marks	20 Marks
HA (descript.)	End-Semester	20 Marks	20 Marks
CVV	End-Semester	100 Marks	20 Marks



Syllabus Template FF No. : 654

ID3002: Mainframe Technology

Credits: 4

Teaching Scheme Theory: 3 Hours/Week

Lab: 2 Hours/Week

Course Prerequisites: Problem Solving Skills

Course Objectives:

1. To introduce IBM Z Mainframe Technology.
2. To learn industry-critical enterprise computing skills.
3. To introduce IBM Mainframe Operating System z/OS.
4. To learn z/OS Access and Interaction Basics.
5. To study the Operating System Environment for computing.
6. To learn z/OS REXX, COBOL Programming

Course Outcomes:

Students will be able to:

1. Understanding of IBM Z Mainframe Technology.
2. Apply the industry-critical enterprise computing skills.
3. Apply IBM Mainframe Operating System z/OS for Large Enterprise.
4. Apply z/Os Access and Interaction Basics.
5. Design and develop a program for Job Control Language using z/OS.
6. Design and develop a program for REXX, COBOL using z/OS.

Course Relevance:

A mainframe technology course remains highly relevant for building a stable, high-paying IT career. Enterprises in banking, insurance, and government rely on mainframe systems for mission-critical operations, massive transaction volumes, and high-security needs, creating steady demand for skilled professionals to maintain and modernize these systems.

Syllabus Theory

Unit 1: Introduction to IBM Z Mainframe Technology (4 Hours)

Introducing IBM Z Hardware, IBM z16, IBM z16 single frame, IBM z16 rack mount, IBM z15 T01 and T02 machines, Applications of IBM Z, Modern Mainframe innovations: z15 and z16 systems, Containerization and Kubernetes on Mainframes, Mainframe Hardware components such as Central Processing Unit (CPU), Memory and Storage Systems, Input/Output Devices, Case studies of Mainframe implementations.

Unit 2: Learn Industry-Critical Enterprise Computing Skills (4 Hours) IBM Z Mainframe Skills Depot: Mainframe System Administrator, Mainframe Application Developer/Programmer, Mainframe Modernization Architect, Database Administrator (DBA),

Storage Administrator, System Programmer (SysProg), Network Administrator, Mainframe DevOps Engineer, Cybersecurity Engineers, to name a few job roles in the vast and amazing world of the IBM Z Mainframes.

Unit 3: z/OS Introduction (6 Hours)

z/OS: Essential Technology of Large Enterprises, Introducing IBM Mainframe Operating Systems, z/OS - IBM Z Flagship Operating System, z/OS Professional Documentation, Architecture of IBM Z systems, networking, and security aspects.

Unit 4: z/OS Access and Interaction Basics (7 Hours) Time Sharing Option, Interactive System Productivity Facility (ISPF) Editor, System Display and Search Facility (SDSF), TN3270, SSH, FTP. Introduction to Structured Programming

Datasets and Data Access Methods: Dataset Names and Types, Sequential Dataset, Partitioned Datasets, VSAM - Virtual Storage Access Method, Disk Storage, Volume Labels, VTOC, Extents, System Utilities and Tools, Dataset management utilities (IEBCOPY, IEFBR14, IEBGENER, IDCAMS, etc.), DFSORT basic and examples

Unit 5: Operating System Environment (7 Hours)

Unix System Services (USS), JCL - Job Control Language, JES - Job Entry Subsystem, System Catalog, Components, Messages, System Log, Virtual Storage and Address Spaces, System and User Address Space Management, Key Controlled Protection for Address Spaces, Security, RACF, Communications Server, z/OS Operator Commands, z/OS Initial Load Program Process, Virtualization and Cloud computing.
Data Definition (DD) Statement: Connecting a physical dataset to a program's internal logical filename. SPACE allocation (Primary, Secondary, Directory blocks for PDS, and RLSE).

Unit 6: Mainframe Programming (8 Hours)

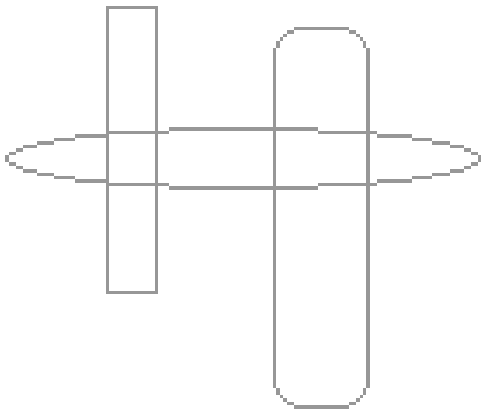
z/OS REXX programming, Learning COBOL programming with VS code, z/OS Unix System Services (USS), JCL (Job Control Language), Interactive System Productivity Facility (ISPF), Java on z/OS, Virtual Storage

Access Method (VSAM), Ansible Automation, creating fully automated CI/CD pipelines involving components residing on z/OS, Zowe, Big Data and Analytics: Hadoop on Mainframes, Machine Learning Integrations. Mainframe Application Lifecycle Management. Agile project Methodology.

Level Numbers: Structural levels (01-49), elementary items (77), condition names (88). Computational data types like Packed Decimal (COMP-3). Looping/Iteration: PERFORM, UNTIL, TIMES, USING (Parameters), Perform <Para Name1> Through <Para Name2>, REDEFINES and RENAMES clauses, Arrey (single and double Dimension), Static and Dynamic Table in Working Storage.

List of Assignments:

Job Control Language (JCL) Assignments:



Syllabus Laboratory

1) Dataset operations (Create, Delete, Rename, Copy, Catalog, Uncatalog, etc.)

2) Submit Job, Redirect Output, Check Job Status and Output.

3) Condition code handling, JCL overrides.

4) Creating an In-stream PROC with symbolic parameters, calling it multiple times based on return codes.

COBOL Programming Assignments:

1) Control Structures: If-Else Condition and Simple Loop (PERFORM UNTIL)

2) File Handling: Sequential and Indexed (VSAM)

3) Perform varying, Error handling, etc.

4) Create a file using Data definitions using precise byte alignments for personal and business customers / accounts.

Syllabus Course Project

Sample Project List: (https://openmainframeproject.org/)

1) To Write a COBOL application program that reads input from three files, merges their contents, and writes to an output file containing one sorted list.

2) Demonstrate file-handling capabilities using a REXX program.

3) Write a Cobol Application program to read files (ATM, POS and Dated Transactions) to update Account file.

CO-PO Mapping

	Program Outcomes (PO)												PSO			
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	2							2	2	3		
CO2	3	3	2	1	3				1			2	3	3	2	
CO3	3	3	2	2	3							2	3	3	2	1
CO4	2	3	2	2	3				1	1		2	3	3	2	1
CO5	3	3	3	2	3				1	1	1	2	3	3	3	2
CO6	3	3	3	2	3				2	2	1	3	3	3	3	2
Average	2.83	2.83	2.17	1.67	2.83				1.25	1.33	1.00	2.17	2.83	3.00	2.40	1.50

CO Attainment levels:

Weights for attainment levels: L1 - Easy-0.75 L2 - Comfortatble-0.7 L3 – Medium – 0.65 L4 – Somewhat difficult – 0.6 L5 – Difficult – 0.55

CO1 – L3, CO2– L3, CO3 – L3, CO4 – L4, CO5 – L5 and CO6 – L5

Future Courses Mapping:

Advanced Mainframe Technologies.

Job Mapping:

Mainframe Technology is widely used for large scale enterprises such as Banking, Insurance Air Traffic Control and various large- and small-scale enterprises. It is the backbone for large scale enterprises which needs high security and zero down time.

<u>For MOOCs and other learning Resources</u>

Unit-1:

- https://www.ibm.com/z/education
- https://www.redbooks.ibm.com/redbooks.nsf/redbookabstracts/crse0304.html

Unit-2:

- https://www.youtube.com/watch?v=aEXHOBYv56E

Unit-3:

- https://www.youtube.com/watch?v=aEXHOBYv56E
- https://www.redbooks.ibm.com/redbooks.nsf/redbookabstracts/crse0304.html

Unit-4:

- https://www.redbooks.ibm.com/redbooks.nsf/redbookabstracts/crse0304.html

Unit-5:

- https://learn.ibm.com/course/view.php?id=9890
- https://publibz.boulder.ibm.com/zoslib/books/tutorials/introjcl/index.html

Unit-6:

- https://openmainframeproject.org/projects/cobol-programming-course/
- https://learn.ibm.com/course/view.php?id=9890
- https://learn.ibm.com/course/view.php?id=7552
- https://learn.ibm.com/course/view.php?id=8722
- https://publibz.boulder.ibm.com/zoslib/books/tutorials/introjcl/index.html

E-Resources:

- https://ibmzxplore.influitive.com/users/sign_in
- https://www.ibm.com/z/education
- https://www.tutorialspoint.com/cobol/cobol_overview.htm

MOOC Courses:

1. https://www.ibm.com/training/
2. https://learn.ibm.com/
3. https://www.ibm.com/z/education
4. https://www.redbooks.ibm.com/redbooks.nsf/redbookabstracts/crse0304.html

FF No.: 654

MM1001B: Design and Analysis of Algorithms

Teaching Scheme	**Examination Scheme**
Credits : 03	CP: 30Marks
Lectures : 2 Hrs/week	GD/PPT:20 Marks
Practical : Nil	HA: 10 Marks
Tutorial : 1 Hr/week	ESE (W/O):40 Marks

Prerequisites:	
•	C++ Programming, Data Structures
Course Objectives:	
•	Analyze the asymptotic performance of algorithms.
•	Demonstrate a familiarity with major algorithms and data structures.
•	To apply algorithmic strategies while solving problems.
•	Apply important algorithmic design paradigms and methods of analysis.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Analyze running times of algorithms based on asymptotic analysis using recurrence method, substitution method and Master Theorem
2.	Design and analyze a variety of divide and conquer algorithms.
3.	Design and analyze a variety of Greedy algorithms
4.	Design and analyze a variety of dynamic programming algorithms
5.	Design and analyze a variety of backtracking algorithms
6.	Design and analyze a variety of branch and bound algorithms

Section1:	**Topics/Contents**

Unit- I : Introduction

Characteristics of algorithm. Asymptotic analysis of complexity bounds – best, average and worst-case behavior;

Analysis of recursive algorithms through recurrence relations: Substitution method, Masters' theorem.

Unit- II : Divide-and-Conquer

Brute Force: String Matching, Closest-Pair and Convex-Hull Problems, Exhaustive Search – Travelling Salesman Problem,

Divide and Conquer : Binary Search, Merge sort, Quick sort, Heap Sort.

Unit –III : GREEDY Technique Greedy Method: General strategy, the principle of optimality, Minimum spanning tree, Prim's algorithm, Kruskal's algorithm, Knapsack problem, Huffman code generation algorithm.	
Section2:	**Topics/Contents**
Unit IV: Dynamic Programming General Strategy, Principle of optimality – Binomial Coefficient, Coin changing problem, 0/1 Knapsack Problem, Floyd's algorithm, **Unit V: Backtracking** Backtracking general strategy, 8 Queen problem, Graph Coloring problem **Unit VI: Branch and Bound** Branch and bound general strategy, 0/1 Knapsack problem, Travelling Salesman problem	
Text Books:	
1	Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2nd Edition. University Press
2	Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2
Reference Books:	
1	Thomas H Cormen, Charles E Lieserson,"Introduction to Algorithms", 4TH Edition,
2	Michael T Goodrich and Roberto Tamassia,"Algorithm Design: Foundations, Analysis, and Internet Examples" 2nd Edition, Wiley

List of Tutorials:

1. Program to implement Binary Search using Divide and Conquer
2. Program to implement Merge sort using Divide and Conquer
3. Program to implement Quick sort
4. Program to implement Heap sort
5. Program to implement minimum and maximum using Divide and Conquer
6. Program to implement Prim's algorithm using Greedy method
7. Program to implement Kruskal's algorithm using Greedy method
8. Program to implement Knapsack problem using Greedy Algorithm
9. Program to implement Knapsack problem using Dynamic Programming
10. Program to implement All Pairs Shortest Path Using Dynamic Programming

List of Project areas:

Students are expected to develop codes for application problems by applying techniques studied in the course.

- Searching
- Sorting

- 0/1 Knapsack problem using dynamic programming.
- Coin changing problem using dynamic programming.
- Given a directed graph, determine the shortest distance between each pair of nodes
- Puzzle Problem using Branch and Bound
- Job Assignment Problem using Branch and Bound
- N Queen Problem using Branch and Bound
- Traveling Salesman Problem using Branch and Bound

CO-PO Mapping

CO	Program Outcomes (PO)													
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1													
CO2	2	2	2		2				1	1				2
CO3	2	2	2		2				1	1				2
CO4	2	2	2		2				1	1				2
CO5	2	2	2		2				1	1				2
CO6	2	2	2		2				1	1				2
Average	1.83	2	2		2				1	1				2

FF No.: 654

Course Code: Automotive Electronics

Teaching Scheme	**Examination Scheme**
Credits : 3	CP: 30 Marks
Lectures : 2 Hrs/week	GD/PPT: 20 Marks
Practical : -- Hrs/week	HA: 10 Marks
Tutorial : 1 Hrs/week	ESE (W): 40 Marks

Prerequisites:	
•	Electronic devices, digital systems, communication systems
Course Objectives:	
•	To understand the evolution, architecture, and role of electronics in modern automobiles
•	To describe the working principles of automotive sensors and actuators
•	To analyze the operation of engine management systems
•	To compare automotive communication protocols such as CAN, LIN, and FlexRay in vehicle networking
•	To evaluate the performance of automotive safety and comfort systems
•	To discuss the fundamentals of electric and hybrid vehicle technologies.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Explain the evolution, architecture, and role of electronics in modern automobiles
2.	Describe the working principles of automotive sensors and actuators
3.	Analyze the operation of engine management systems
4.	Compare automotive communication protocols such as CAN, LIN, and FlexRay in vehicle networking
5.	Evaluate the performance of automotive safety and comfort systems
6.	Discuss the fundamentals of electric and hybrid vehicle technologies.

Section1:	**Topics/Contents**

Unit 1: Introduction to Automotive Electronics (4 Lectures)

Evolution of automotive electronics; Architecture of modern vehicles; Role of electronics in automobiles; Automotive standards

Unit 2: Sensors and Actuators (5 Lectures)

Sensors: temperature, rain, light, pressure, position, speed; Actuators: relays, motors, solenoids; Signal conditioning techniques

Unit 3: Engine Management Systems (5 Lectures) Electronic Fuel Injection; Ignition systems; Air-fuel ratio control; Emission control; ECU basics	
Section2:	**Topics/Contents**
Unit 4: Automotive Communication Systems (5 Lectures) CAN protocol; LIN, FlexRay basics; OBD system; Networking architecture **Unit 5: Automotive Safety and Comfort Systems (5 Lectures)** ABS; Airbags; Electronic Stability Control; Cruise control; Climate control; ADAS basics **Unit 6: Electric and Hybrid Vehicles (4 Lectures)** EV basics; Battery Management System; Charging methods; Hybrid vehicles	
Text Books:	
1	William B. Ribbens; Understanding Automotive Electronics; 8th Edition, Butterworth-Heinemann (Elsevier).
2	Konrad Reif; Automotive Electronics: Systems and Components; 1st Edition, Springer Vieweg.
Reference Books:	
1	Ronald K. Jurgen; Automotive Electronics Handbook; 2nd Edition, McGraw-Hill.
2	Tom Denton; Automobile Electrical and Electronic Systems; 5th Edition, Routledge.

List of Tutorials:

- Electronic Control Units (ECUs) – architecture & functions
- Sensors and Actuators in vehicles
- Signal conditioning in automotive electronics
- Automotive embedded systems design
- Power electronics in automobiles
- Electronic Fuel Injection (EFI) system
- Ignition system (traditional vs modern)
- Air-Fuel ratio control using lambda sensor

- Engine Management System (EMS)
- Turbocharger electronic control
- Electric Vehicle architecture and components
- Battery Management System (BMS)
- EV charging methods (AC vs DC fast charging)
- Regenerative braking systems
- Hybrid electric vehicle control strategies
- Anti-lock Braking System (ABS)
- Electronic Stability Control (ESC)
- Airbag control system
- Advanced Driver Assistance Systems (ADAS)
- Collision avoidance systems
- CAN (Controller Area Network) protocol
- LIN and FlexRay communication systems
- Automotive Ethernet
- Vehicle networking architecture
- Diagnostics using OBD-II
- Lithium-ion battery technology in EVs
- Battery thermal management systems
- Energy management strategies in EVs
- Wireless charging for vehicles
- Supercapacitors in automotive
- Autonomous vehicle architecture
- Sensor fusion (LiDAR, radar, camera)
- AI in automotive systems
- Lane detection and path planning
- Challenges in self-driving vehicles
- Emission control systems (EGR, catalytic converter)
- BS6/Euro 6 norms and electronics role
- On-Board Diagnostics (OBD) system
- Exhaust after-treatment systems
- Automotive cybersecurity threats & solutions
- Secure ECU communication
- AUTOSAR architecture
- Software-defined vehicles (SDV)
- Over-the-air (OTA) updates
- Vehicle-to-Everything (V2X) communication
- Connected cars and IoT
- Digital twin in automotive

- Edge computing in vehicles
- Smart mobility systems

Course Projects:

Sr. No.	Project Title	Description	Technologies Used
1	Smart Automatic Headlight Control	Automatically switches headlights ON/OFF based on ambient light.	LDR, Arduino, Relay
2	Rain-Sensing Automatic Wiper System	Controls wiper speed according to rainfall intensity.	Rain Sensor, Servo Motor, Arduino
3	Reverse Parking Assistance System	Detects obstacles while reversing and provides buzzer alerts.	Ultrasonic Sensor, Buzzer, Arduino
4	Tire Pressure Monitoring System (Prototype)	Monitors tire pressure and alerts when pressure drops.	Pressure Sensor, ESP32, LCD
5	Driver Drowsiness Detection System	Detects eye closure and sounds an alarm.	Camera, Python/OpenCV, Raspberry Pi
6	Seat Belt Reminder System	Warns the driver if the seat belt is not fastened.	Limit Switch, Buzzer, Arduino
7	Smart Vehicle Speed Monitoring	Displays speed and warns when speed exceeds a preset limit.	Hall Effect Sensor, LCD, Arduino
8	Engine Temperature Monitoring System	Continuously monitors engine temperature and activates cooling fan.	LM35/DS18B20, Relay, Arduino
9	Smart Fuel Level Indicator	Measures and displays fuel level digitally.	Ultrasonic Sensor/Float Sensor, LCD
10	Automatic Car Parking System	Controls vehicle movement for automated parking (prototype).	Ultrasonic Sensors, Motor Driver, Arduino
11	Vehicle Anti-Theft System	Prevents unauthorized access using RFID or fingerprint authentication.	RFID/Fingerprint Sensor, Relay
12	Blind Spot Detection System	Detects nearby vehicles and alerts the driver.	Ultrasonic Sensors, LEDs
13	CAN Bus-Based Vehicle Communication	Demonstrates communication between automotive ECUs.	Arduino, MCP2515 CAN Module

Sr. No.	Project Title	Description	Technologies Used
14	OBD-II Vehicle Diagnostics Interface	Reads vehicle parameters such as RPM, speed, coolant temperature, and fault codes.	ELM327, Bluetooth, Mobile App
15	Smart Electric Vehicle Battery Monitoring	Monitors battery voltage, current, and temperature.	Voltage Sensor, Current Sensor, ESP32
16	Adaptive Cruise Control (Prototype)	Maintains safe distance from the vehicle ahead.	Ultrasonic Sensor, Motor Control
17	Automatic Emergency Braking System	Detects obstacles and applies brakes automatically (prototype).	Ultrasonic Sensor, Servo Motor
18	Smart Dashboard Display	Displays speed, fuel level, temperature, and warning indicators on an LCD/TFT.	Arduino/ESP32, TFT Display
19	IoT-Based Vehicle Health Monitoring	Sends engine parameters to a cloud dashboard for remote monitoring.	ESP32, MQTT, IoT Platform
20	Accident Detection and Emergency Alert System	Detects vehicle accidents and sends GPS location via SMS.	Accelerometer, GPS, GSM Module

CO-PO Mapping

CO	Program Outcomes (PO)												PSO	
CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	-	2	-	-	-	-	-	-	1	3	3
CO3	3	3	2	1	2	1	-	-	-	-	-	1	3	3
CO4	3	3	2	1	3	-	-	-	-	-	-	1	3	3
CO5	3	3	2	2	2	2	1	1	-	-	-	1	3	2
CO6	3	2	1	-	2	2	3	-	-	-	-	2	2	2
Average														

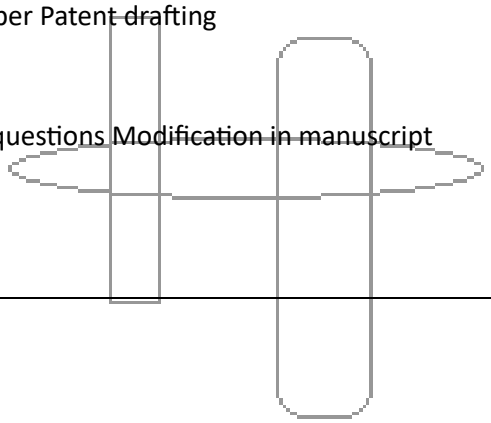
Syllabus Template **FF No.: 654**

ET3282 : Design Thinking 5

Teaching Scheme	**Examination Scheme**
Credits : 1	CP: Marks
Lectures : Hrs/week	GD/PPT/HA: Marks
Practical : Hrs/week	MSE (W/O):30 Marks
Tutorial : 1 Hrs/week	ESE (W/O):70 Marks

Prerequisites:	
●	Course Prerequisites: Problem Based Learning, Project Centric Learning Course Relevance:
Course Objectives:	
●	To provide ecosystem for students and faculty for paper publication and patent filing
Course Outcomes:	**[Publication of paper or patent]**
	After completion of the course, student will be able to
1.	Understand the importance of doing Research
2.	Interpret and distinguish different fundamental terms related to Research
3.	Apply the methodology of doing research and mode of its publication
4.	Write a Research Paper based on project work
5.	Understand Intellectual property rights
6.	Use the concepts of Ethics in Research , Understand Entrepreneurship and Business Planning
7.	

Section1:	**Topics/Contents**
What is research? Importance of Paper Publication and Patents Importance of Paper Publication and Patents Structure of Paper Journal Publication Publication in conference Literature Review Research Paper Writing Journal Ratings and Evaluation How to rate a Journal? Intellectual property (IP) Research Ethics Entrepreneurship	
Section2:	**Topics/Contents**
Structure of The paper Journal List (Top 50 Journals) Selection of the journal Use of various online journal selection tools Plagiarism checking Improving contents of the paper Patent drafting Patent search Filing of patent Writing answers to reviewer questions Modification in manuscript Checking of publication draft	

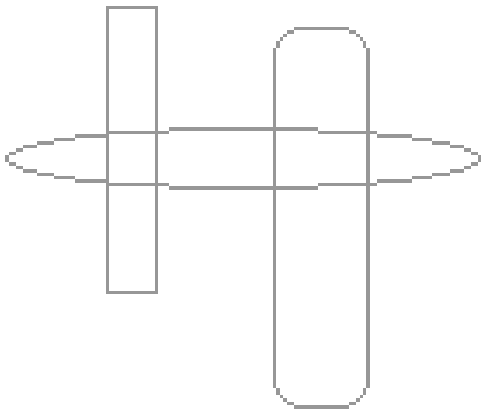


CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	**Program Outcome (PO)**												**PSO**	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	1							1	1	2
CO2	1	1	1	1	1							1	1	2

CO	Program Outcome (PO)												PSO	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO3	2	2	3	3	2	2	1	2	2	3		1	1	3
CO4	3	3	3	3	3	2	1	2	2	3	1	1	1	3
CO5	1	1	1	1	1							1	1	2
CO6	2	2	2	2	2	2	1	3	2	3		1	1	3
Avg	1.7	1.7	1.8	1.8	1.7	2.0	1.0	2.3	2.0	3.0	1.0	1.0	1.0	2.5



Syllabus Template **FF No.: 654**

ET3291: Engineering Research & Innovation-1

Teaching Scheme	**Examination Scheme**
Credits : 2	CP: Marks
Lectures : Hrs/week	GD/PPT/HA: Marks
Practical : 2 Hrs/week	MSE (W/O):30 Marks
Tutorial : Hrs/week	ESE (W/O):70 Marks

Prerequisites:	
●	Course Prerequisites: Research Based Learning Course Relevance: Research Centric Learning (RCL) is a powerful tool for students to work in areas of their choice and strengths. Along with course based research projects, curriculum can be enriched with semester long Engineering Research and Innovation courses, in which students can investigate socially relevant problems using various technologies and research methods from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such research problems, students can select relevant online courses and acquire skills from numerous sources under guidance of faculty and enrich their knowledge in the research domain, thereby achieving research centric learning. Modern world sustained and advanced through the successful completion of research and innovation. In short, if students are prepared for success in life, we need to prepare them for a research-based world. It is a style of active learning and inquiry-based learning. Research centric learning will also redefine the role of teacher as mentor in the learning process. The RCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.
Course Objectives:	
●	To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problems.
●	To Evaluate alternative approaches, and justify the use of selected tools and methods,
●	To emphasize learning activities those are long-term, inter-disciplinary and student-centric.
●	To engage students in rich and authentic learning experiences.
●	To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
●	To develop an ecosystem to promote entrepreneurship and research culture among the students
Course Outcomes:	
	After completion of the course, student will be able to
1.	Identify a real-life research problem or gap from societal and technological need point of view
2.	Choose and compare alternative research methodologies to select the most feasible one
3.	Analyze and synthesize the identified research problem from a technological and scientific perspective.

4.	Design a reliable and scalable research methodology/experimental approach to meet the challenges.
5.	Evaluate the research outcomes based on the criteria specified
6.	Inculcate a long life learning and research attitude towards the societal problems

Section1:	**Topics/Contents**

Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of ERI, laboratory course contents of "Engineering Research" are designed as a ladder to extend connectivity of research methodologies and emerging technologies to solve real world problems using an interdisciplinary approach. The ladder in the form of gradual steps can be seen as below:

Industry Communication Standards, Research Databases and Literature Repositories (IEEE Xplore, Scopus, Google Scholar), Patent Search and IPR Tools, Statistical and Data Analysis Tools, Computational Biology (Biomedical and Bioinformatics), Robotics and Automation, Industry 4.0 (Artificial Intelligence, Machine Learning, 5G and IoT, Cloud Computing, Big Data and Cyber Security etc).

Group Structure:

There should be a team/group of 4-5 students. A supervisor/mentor teacher assigned to individual groups. It is useful to group students of different abilities and nationalities together.

Selection of Research Problem/Topic:

● Students must focus on initiating the task/idea. The idea of inception and consideration shall be from following areas as a real world problem:

-Health Care, Agriculture, Defense, Education, Smart City, Smart Energy, Swaccha Bharat Abhiyan, Environment, Women Safety.

● This is the sample list to start with. Faculty and students are free to include other ar
eas which meet society's requirements at large.

● The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated disciplinary subject frame/domain.

● A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

● By exemplarity, a problem needs to refer to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.

Teacher's Role in RCL:

● Teacher is not the source of solutions rather he will act as the facilitator and mentor.

● To utilize the principles of problem solving, critical thinking and metacognitive skills of the students.

● To make the group aware about time management.

● Commitment to devote the time to solving student's technical problems and interested in helping students to empower them better.

Student's Role in RCL:

● Students must have ability to initiate the task/idea, they should not be mere imitators.

● They must learn to think.

● Students working in RCL must be responsible for their own learning.

● Students must quickly learn how to manage their own learning, instead of passively receiving instruction.

● Students in RCL are actively constructing their knowledge and understanding of the situation in groups.

● Students in RCL are expected to work in groups.
● They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Developing Inquiry Skills:
● Students in PCL are expected to develop critical thinking abilities by constantly relating: What they read to do? What do they want to do with that information?
● They need to analyze information presented within the context of finding answers.
● Modeling is required so that the students can observe and build a conceptual model of the required processes.
● Use the following mechanism to maintain the track of moving towards the solution.
How effective is …….?
How strong is the evidence for ……?
How clear is ……?
● What are the justifications for thinking? Why is the method chosen?
● What is the evidence given to justify the solution?

Literature Survey – To avoid reinvention of wheel:
● It is an integral part of self- directed learning
● Identify the information needed to solve a given problem or issue
● Be able to locate the needed information
● Use the information to solve the given problem effectively.
● Skills required by students in information literacy include:
● · How to prepare for the search? How to carry out research
● Sorting and assessing of information in general

Use of Research Methodology: - investigation, collaboration, comprehension, application, analysis, synthesize and evaluation

Focus on the following skills while working in a team to reach to solution:
● Collaborative learning
● Interpersonal Skills
● Resources Evaluation
● Metacognitive Skills
● Reflection Skills

Section2:	**Topics/Contents**

ERI Sample Research Case Studies: -
With the adaptation of industry communication standards and modern research tools and platforms, the following research problems can be taken up:
1) Research on soil moisture prediction and detection using sensor data and machine learning
2) Research on temperature monitoring and prediction using IoT sensors and analytics
3) Research on pressure sensing and anomaly detection techniques for industrial applications
4) Research on early smoke and fire detection using sensor fusion and AI
5) Research on human motion detection and activity recognition using sensors
6) Research on collision detection and avoidance systems using sensor fusion
7) Research on acoustic and sound-based anomaly detection using machine learning
...**not limited to.....Faculty and students are free to include other areas which meet society's requirements at large.**

Text Books: ***(As per IEEE format)***

1	*Research Methodology: Methods and Techniques. By C.R. Kothari. New Age International Publishers. ISBN:978-8122415223; 2004*

2	*Research Methodology: A Step-by-Step Guide for Beginners. By Ranjit Kumar, SAGE Publications. 2019.*
3	*Practical Research: Planning and Design. By Paul D. Leedy, Jeanne Ellis Ormrod, Pearson. 2019*
4	*The Craft of Research. By Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams. University of Chicago Press. 2016*
Reference Books: ***(As per IEEE format)***	
1	Creswell J.W.: Research Design: Qualitative, Quantitative and Mixed Methods Approaches. Sage Publications. 2014.
2	Research project management core textbook, second edition, Indian Edition, by Gopalan.
3	The Craft of Research. By Wayne C. Booth, Gregory G. Colomb & Joseph M. Williams

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)												PSO	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2					3		2	2	3	3
CO2	2	2	3	2	2		2		3		2	2	3	3
CO3	2	2	3	2	3		2		3	1	2	2	3	3
CO4	2	2	3	2	3	3		2	3		2	2	3	3
CO5	2	2	3	2	3	2			3		2	2	3	3
CO6	2	2	3	3	2				3		3	2	3	3
Avg	2.0	2.0	2.83	2.83	2.6	2.5	2.0	2.0	3.0	1.0	2.16	2.0	3.0	3.0