Vishwakarma Institute of Technology Issue 01 : Rev No. 00 : Dt. 01/08/22

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

NEP Compliant Structure &

Syllabus of

Department of Computer Science & Engineering

(Internet of Things & Cyber Security Including Block Chain Technology)

Pattern 'A-25'

S. Y. B. Tech.

Effective from Academic Year 2026-27

Prepared by: - Board of Studies of CSE-IoTCSBT

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

Chairman- BoS	Dean - Academics	Chairman – Academic Board
Dr. P M Shelke	Dr. P N. Mahalle	Dr. Rajesh Jalnekar

Contents

Program Outcomes

PO1 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.

PO2 Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3 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)

PO4 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).

PO5 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)

PO6 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).

PO7 Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8 Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9 Communication: Communicate effectively and inclusively within the engineering 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

PO10 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.

PO11 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.

Program specific outcomes:

PSO1: Graduates will be able to design, implement, and optimize Internet of Things (IoT) systems.

PSO2: Graduates will be equipped to assess security vulnerabilities, design secure systems, and implement Blockchain-based distributed ledger solutions.

FF No.: 653

Structure

Branch: CSE-IoTCSBT Year: Second Year (SY) Academic Year 2025-26

Subject No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week))			Total	Credits
			Theory	Lab	Tut		
S1	CB2003	Fundamentals of Data Structures	3	2	0	5	4
S2	CB2004	Data Communication and Networking	2	0	1	3	3
S3	CB2005	Basics of IoT	2	2	0	4	3
S4	CB2006	Object Oriented Programming	1	2	0	3	2
MDM	MM0501	Probability and Statistics	2	0	1	3	3
HSS	HS2002	From Campus to Corporate - 1	2	0	0	2	2
RAD	HS2001	Reasoning and Aptitude Development - 3	1	0	0	1	1
DT	CB2001	Design Thinking – 1	0	0	1	1	1
ISMA	IR2101	OR International Tech Front Module	-	-	-	-	1
EDI	CB2002	Engineering Design and Innovation – 1 OR	0	4	0	4	2
IEDP	IR2102	International Innovation Program	-	-	-	-	2
		Total	**13**	**10**	**3**	**26**	**21**

Examination scheme

SUBJECT HEAD	COURSE	CREDITS	CVV	CP	LAB	GD/ PPT	HA	MSE (W)	MSE (R)	ESE (R)	ESE TH (W)	PRACT +CVV	ESE DIRECT EVALUATION	TOTAL
S1	Fundamentals of Data Structures	4		20							40	40		100
S2	Data Communication and Networking	3	20	30	10			40						100
S3	Basics of IoT	3	20	30	10						40			100
S4	Object Oriented Programming	3	20	30	10						40			100
S5	Probability and Statistics	3	20	20			20	40						100
S6	From Campus to Corporate - 1	2							50	50				100
S7	Reasoning and Aptitude Development - 3	1											100	100
S8	Design Thinking – 1	1											100	100
S9	Engineering Design and Innovation – 1	2							30	70				100
		22												**900**

FF No. : 654

CB2003: Fundamentals of Data Structures

Credits: 4 **Teaching Scheme**: Theory: 3 Hours/Week, Lab: 2 Hours/Week

Prerequisites:

1. Knowledge of programming fundamentals using C or Python
2. Understanding of control structures, functions, and arrays
3. Basic concepts of memory management and file handling

Course Objectives:

1. To introduce students to linear and nonlinear data structures and their applications
2. To develop problem-solving skills by applying data structures to real-life scenarios
3. To understand and analyze the complexity of algorithms
4. To implement and apply various sorting and searching techniques
5. To develop efficient programs using stacks, queues, linked lists, trees, and graphs
6. To expose students to memory management, recursion, and performance trade-offs

Relevance of this course:

Data structure is the backbone of efficient software development, enabling programmers to store, organize, and process data effectively. By understanding and applying concepts such as arrays, linked lists, stacks, queues, trees, and graphs, students learn to design algorithms that solve real-world problems with optimal performance. This course builds foundational problem-solving and analytical skills essential for fields like systems programming, application development, artificial intelligence, and cyber security. Mastery of data structures equips students to write robust, maintainable, and scalable software, which is a critical competency for every computer engineer.

SECTION I

Unit 1: Introduction to Data Structures and Complexity (7 Hours)

Abstract Data Types, need of data structures, classification of data structures, complexity analysis of algorithms using Big-O, Big-Ω and Big-Θ notations, time-space trade-off, recursion basics and applications

Unit 2: Arrays and Searching & Sorting Techniques (7 Hours)

1D and 2D arrays, sparse matrix representation, strings and string manipulation, dynamic arrays, linear search, binary search, bubble sort, selection sort, insertion sort, merge sort, quick sort, time complexity of all techniques. Case Study - Sensor data buffering using arrays, Pattern matching in intrusion detection or Analyzing large-scale array logs for anomalies

Unit 3: Linked Lists (7 Hours)

Memory fragmentation & pointer behavior, Singly linked list, doubly linked list, circular linked list, operations (insert, delete, traverse, search), applications such as polynomial operations, memory management using dynamic allocation

SECTION II

Unit 4: Stacks and Queues (7 Hours)

Stack operations and applications like expression evaluation, infix to postfix conversion, recursion using stack; queue operations, circular queue, priority queue, deque, applications of queues in real-world problems

Unit 5: Trees (7 Hours)

Tree terminologies, binary trees, binary search trees (BST), tree traversals (in -order, preorder, post-order), expression trees, Huffman coding, applications in decision making and file systems

Unit 6: Graphs (7 Hours)

Graph representation using adjacency list and matrix, BFS, DFS, applications of graphs in networking and social media like transitive closure (Warshall's algorithm) and topological sorting. Applications: Networking, Social graphs, IoT network routing, Blockchain peer-to-peer networks. Case Study - Attack path modelling using graphs.

Lab Assignments

1. Implement recursive functions and analyze their complexity.

a) Write a recursive function to generate all permutations of a string (e.g., password generator / anagram tool)

OR

b) Implement recursive solution to solve Tower of Hanoi and display moves + analyze time complexity.

2. a) Create employee/ student database using array of structures. Implement linear and binary search techniques (recursive and iterative) on the created database. Compare time complexity of both.

OR

b) Implement a phone contact search: use binary search (recursive and iterative) to find contact names starting with given prefix)

3. Create array of movie names and sort the array in ascending order (using selection sort) and descending order (using insertion sort). Display pass-wise output. Compare their time complexity.

4. Implement and compare merge sort and quick sort algorithms: Sort large datasets (e.g., city temperatures over a month) and plot running time of both algorithms.

5. Implement singly, doubly, and circular linked list for a music playlist manager. Create: add song/ delete song/ skip song/ next song/ previous song with suitable types of linked lists.

6. Implement stack ADT operations:

a) Evaluate postfix expressions (as used in calculator application)

OR

b) Check if a given HTML/XML tag sequence is balanced (valid nesting).

7. Implement linear queue, circular queue, and dequeue:

a) Simulate a print queue where print jobs arrive and are processed in FIFO order

b) Simulate railway ticket booking using circular queue and dequeue (add, cancel, re-add)

8.Construct an expression tree from postfix/ prefix expression and perform recursive inorder, preorder and post order traversals. For expression tree, perform non-recursive inorder, preorder and post order traversals.

9. Create a binary search tree (BST) of and perform following operations: i) Insert ii) Display inorder iii) Search a node iv) Find height of the tree v) level wise display iv) Delete v) Mirror

10. Create a graph using adjacency matrix and adjacency list representation. Perform graph traversal using BFS and DFS.

11.Course Project

Course Outcomes

By the end of this course, students will be able to:

CO1: Analyze and compute time and space complexity of algorithms

CO2: Apply searching and sorting algorithms to solve computational problems

CO3: Implement and apply stack and queue operations in applications

CO4: Develop and use various types of linked lists to manage dynamic data

CO5: Apply tree data structures for hierarchical data representation and operations

CO6: Demonstrate understanding of graph and their applications

Textbooks (Print)

1. E. Horowitz, S. Sahni, D. Mehta; *Fundamentals of Data Structures in C*; 2nd Edition; Universities Press; 2008

2. Y. Langsam, M. Augenstein, A. Tannenbaum; *Data Structures Using C and C++*; 2nd Edition; Pearson Education; 2006

Reference E-Books (Open Source / Freely Available)

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein; *Introduction to Algorithms*; 3rd Edition; MIT Press; https://mitpress.mit.edu/9780262033848/
2. Brad Miller, David Ranum; *Problem Solving with Algorithms and Data Structures using Python*; Open Book Project; Accessed: May 2025; https://runestone.academy/ns/books/published/pythonds/index.html

MOOCs and Learning Resources

1. Data Structures and Algorithms Design By Prof. Nitin Saxena ; IIT Kanpur; https://onlinecourses.nptel.ac.in/noc25_cs81/preview
2. UC San Diego, National Research University Higher School of Economics; *Data Structures*; Coursera; https://www.coursera.org/learn/data-structures

CO – PO / PSO Articulation Matrix

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

CO	Program Outcome (PO)											PSO	
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	1	-	-	-	-	-	-	3	2
CO3	3	2	2	-	2	-	-	-	-	-	-	3	2
CO4	3	2	2	-	2	-	-	-	-	-	-	3	2
CO5	3	3	2	-	2	-	-	-	-	-	-	3	3
CO6	3	3	2	-	3	-	-	-	-	-	-	3	3
Avg	3	2.5	2	-	1.7	-	-	-	-	-	-	3	2.3

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	✓	✓	-	-	-	-	-

CO2	✓	✓	✓	✓	✓	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-
CO5	✓	✓	✓	✓	✓	-	-	-	-
CO6	✓	✓	✓	✓	✓	-	-	-	-

CO – WP Mapping (Complex Engineering Problems) Sample Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓	-	-	-	-
CO2	✓	✓	✓	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-
CO4	✓	✓	✓	✓	-	-	-
CO5	✓	✓	✓	✓	✓	-	-
CO6	✓	✓	✓	✓	✓	-	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	-	-	-	-	-
CO2	-	-	-	-	-
CO3	-	-	-	-	-
CO4	-	-	-	-	-
CO5	-	-	-	-	-
CO6	-	-	-	-	-

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Develops algorithm analysis and computational thinking, strengthening quality education (SDG 4) and innovation in software systems (SDG 9).
CO2	9	Searching and sorting algorithms improve computational efficiency for industrial and software applications (SDG 9).
CO3	9	Stack and queue data structures support operating systems, scheduling, networking, and real-time computing applications (SDG 9).
CO4	9	Linked lists enable efficient dynamic memory management and scalable software solutions used in modern computing systems (SDG 9).
CO5	9, 11	Tree data structures support databases, file systems, decision-making, and intelligent digital infrastructure contributing to smart systems (SDGs 9, 11).
CO6	9, 11	Graph algorithms enable communication networks, routing, social media analysis, and smart-city applications through efficient connectivity and resource management (SDGs 9, 11).

FF No. : 654

CB2004: Data Communication & Networking

Credits: 3 **Teaching Scheme:** Theory: 2 Hours/Week, Lab:1 Hours/Week

Prerequisites:

1. Working of computer
2. Number System

Course Objectives:

1. To understand the functioning of data communication and computer network.
2. To provide an in-depth understanding of the OSI reference model.
3. To provide an in-depth understanding of the TCP/IP reference model.
4. To develop practical skills in designing and implementing different types of networks using IP addressing

Course Relevance:

This course equips students with hands-on skills in computer communication and Network system. It emphasizes real-time tool usage and applications of computer network.

SECTION I

Unit 1: Data communication and its components (7 Hours)

Process of data communication and its components: Transmitter, Receiver, Medium, Message. Protocols, Standards, Standard organizations. Bandwidth, Data Transmission Rate, Baud Rate and Bits per second. Modes of Communication (Simplex, Half duplex, Full Duplex). Signal & its properties. Types of Errors: Single Bit Error and Burst Error, Redundancy Error Detection: Longitudinal Redundancy Check (LRC), Vertical Redundancy Check (VRC), Cyclic Redundancy Check (CRC), EEE standards: 802.1, 802.2, 802.3, 802.4, 802.5 & Wireless LANs: 802.11 Architecture, MAC Sublayer

Unit 2: OSI Reference Model (7 Hours)

Layered Architecture, Peer-to-Peer Processes- Interfaces between Layer, Protocols, Organization of the Layers, Encapsulation. Layers of the OSI Reference Model (Functions and features of each Layer) - Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer

SECTION II

Unit 3: IP addressing (7 Hours)

Addressing mechanism in the Internet IP Addressing - IP Address classes, IP addressing, Subnetting, super netting, Masking. IPv4 addressing.
IPv6 addressing – representation, address space allocation, Auto configuration

Unit 4: TCP/IP Model (7 Hours)

Layered Architecture, Data Link Layer: Nodes and links, services, categories of links, sub layers, Link layer addressing: three types of addresses, address resolution protocol (ARP).

Transport layer protocol: transport layer services, connectionless and connection-oriented protocol. TCP & UDP

List of Practical's:

1. Study of Number System
2. Network Topologies: Introduction, Definition, Selection, Criteria, Types of Topology- i) Bus ii) Ring iii) Star iv) Mesh v) Tree vi) Hybrid
3. Network Connecting Devices: Hub, Switch, Router, Repeater, Bridge, Gateway, Modem, Wireless infrastructure Components
4. Create desired standard network cable including cross cable and test by using cable Tester.
5. Connect Computers using given topology with wired media.
6. Connect Computers using wireless media.
7. Configure Static and Dynamic IP addresses
8. Configure DHCP server.
9. Run TCP/IP Utilities and Network commands: ipconfig, ping, tracer, netstat, pathing, route
10. Install Wireshark and configure as packet sniffer

List of Project areas:

1. Network Simulation & Configuration (Using Cisco Packet Tracer/GNS3)
2. Network Security & Monitoring

Textbooks :

1. B. A. Forouzan, *Data Communications and Networking*. New Delhi, India: Tata McGraw-Hill, 2006.
2. J. F. Kurose and K. W. Ross, *Computer Networking: A Top-Down Approach*. Upper Saddle River, NJ, USA: Pearson, 2021.

Reference Books:

1. A. Godbole, *Data Communication and Networking*. New Delhi, India: Tata McGraw-Hill, 2002.
2. A. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 5th ed. Delhi, India: PHI Learning Pvt. Ltd., 2011.

e Learning Resources:

CCNA: Introduction to Networks: https://www.netacad.com/courses/ccna-introduction-networks?courseLang=en-US

Course Outcomes:

The student will be able to –

CO1: Explain and apply the fundamentals of data communication and networking concepts such as transmission media, protocols, and network devices.
CO2: Analyze and differentiate the functions of each layer in the OSI reference model using real-world examples and scenarios.
CO3: Analyze the TCP/IP network communication model and evaluate its layered structure through case studies and configuration exercises.
CO4: Design and implement a small computer network by assigning and configuring IP addresses, subnet masks, and basic routing.

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	PSO1	PSO2
CO1	3	2	3	-	2	2	1	-	2	2	-	2	3
CO2	3	2	3	-	3	-	-	-	-	-	2	-	3
CO3	2	3	-	3	3	2	-	-	-	-	-	2	-
CO4	2	2	-	-	3	2	-	-	-	-	-	-	3
Avg	2.5	2.25	3	3	2.75	2	1	-	2	2	2	2	3

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	-	✓	-	-	-	-	-
CO2	✓	✓	-	✓	-	-	-	-	-
CO3	✓	✓	-	✓	-	-	-	-	-
CO4	-	✓	✓	✓	✓	-	-	-	-

CO – WP Mapping (Complex Engineering Problems) Sample Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓					
CO2	✓	✓	✓				
CO3	✓	✓	✓				
CO4	✓	✓	✓	✓	✓		✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓		
CO4	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Provides foundational knowledge in communication technologies that supports quality education and digital infrastructure.
CO2	4, 9	Enhances technical knowledge required for building reliable communication systems and digital innovation.
CO3	4, 9	Develops understanding of Internet technologies that enable global connectivity and resilient infrastructure.
CO4	4, 8, 9	Builds employability skills, promotes innovation, and supports development of modern communication infrastructure.

FF No.: 654

CB2005: Basics of IoT

Credits: 3 **Teaching Scheme:** Theory: 2 Hours/Week, Lab: 2 Hours/Week

Prerequisites:

1. Digital System Design
2. Electronics Workshop
3. Fundamentals of IoT

Course Objectives:

1. To study fundamental concepts of IoT
2. To Learn different protocols used for IoT design
3. To be familiar with data handling and analytics tools in IoT.
4. To give an overview of 8 bit architecture of Microcontroller.

Course Relevance:

This course equips students with hands-on skills in Internet of things concepts and Network applications. It emphasizes real-time tool usage and applications of IoT

SECTION I

Unit 1: Introduction to IoT **(7 Hours)**

Introduction, Definitions & Characteristics of IoT, History of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

Unit 2: Introduction of Microprocessor & Microcontroller **(7 Hours)**

Basics of Microprocessor, Types & evolution, Block diagram & functioning, Evolution of microcontrollers, Microcontroller selection criteria for particular application, MCS-51 architecture, family devices & its derivatives. Pin configuration, Port architecture, memory organization, external memory interfacing.

SECTION II

Unit 3: IP based Protocols for IOT **(7 Hours)**

IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.
Authorization and Access Control in IOT

Unit 4: IoT Security and Privacy **(7 Hours)**

Challenges and threats to IoT security, Encryption and authentication techniques, Privacy concerns and regulations, Best practices for securing IoT devices

List of Practical:

1. Study& Survey of various development boards for IoT.
2. Study & Survey of various IoT platforms.
3. Interfacing sensors and actuators with Arduino Uno
4. Build a cloud-ready temperature sensor with the Arduino Uno and the any IoT Platform: This project shows the building of a temperature sensor.
5. Interfacing Sensors and actuators with Arduino Uno
6. IoT based Stepper Motor Control with Raspberry Pi.
7. IoT based Web Controlled Home Automation using Arduino Uno
8. A Simple IoT Project with the ESP8266 WiFi module
9. Implement a RFID Based IoT Project

List of Project areas:

1. Smart Agriculture
2. Smart Home Automation
3. Healthcare & Medical IoT
4. Smart City Projects
5. Security & Surveillance

Course Outcomes:

After completion of the course, students will be able to:

CO1: Explain and demonstrate the use of concepts, terminologies, and architecture of IoT systems through case studies and system design examples.

CO2: Compare and analyze the working principles of microprocessors and microcontrollers through practical experiments and simulations

CO3: Apply appropriate communication protocols for the design and implementation of IoT systems in real-world scenarios.

CO4: Identify and apply IoT security and privacy methods to secure IoT devices, data, and communication channels in given problem statements.

Textbooks :

1. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", WileyPublications
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications

Reference Books:

1. A. Bahga and V. Madisetti, *Internet of Things : a hands on approach*. S.L.: Vpt, 2014.

e Learning Resources:

1. Introduction To Internet of Things, NPTEL course By Prof. Sudip Misra, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. IoT Devices, Infosys Springboard course, https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0142354096914759682649/overview

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	PSO1	PSO2
CO1	3	2	2	2	2	1	1	-	2	2	1	3	1
CO2	3	3	2	2	3	1	-	-	2	1	2	3	1
CO3	3	3	3	2	3	2	1	-	2	2	2	3	2
CO4	3	3	3	3	3	2	1	2	2	2	2	2	3
Avg	3.0	2.75	2.50	2.25	2.75	1.50	0.75	0.50	2.0	1.75	1.75	2.75	1.75

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓	✓	✓		✓
CO2	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓	✓		✓	✓
CO2	✓		✓	✓			✓
CO3	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	9	Understanding IoT concepts, architectures, and system design supports the development of smart, connected, and innovative technological infrastructure.
CO2	9	Knowledge of microprocessors and microcontrollers enables the development of embedded and intelligent systems that form the foundation of modern IoT infrastructure.
CO3	9, 11	Application of IoT communication protocols enables connected systems for smart homes, smart cities, intelligent transportation, environmental monitoring, and efficient infrastructure management.
CO4	9, 16	IoT security and privacy methods help protect connected devices, data, and communication channels, promoting secure digital infrastructure, data protection, and trustworthy connected systems.

FF No. : 654

CB2006: Object Oriented Programming

Credits: 3 **Teaching Scheme:** Theory: 2 Hours/Week, Lab: 2 Hours/Week

Prerequisites:

1. Basic Programming such as C language

Course Objectives:

1. To develop a strong foundation in object-oriented programming using C++.
2. To enable students to apply advanced object-oriented programming concepts skills in C++.
3. To develop a strong foundation of java programming in event-driven graphical user interface (GUI) applications using Java AWT and Swing.
4. To provide hands-on experience in developing database-driven Java applications using the Collections Framework and JDBC connectivity.

Course Relevance:

This course equips CSE-IoTCSBT students with essential object-oriented programming skills using C++, which are crucial for developing efficient, modular, and reusable software for IoT systems. Concepts like classes, inheritance, and polymorphism help in designing hardware-abstracted and scalable code. File handling and exception management enable robust data processing and error control in real-time IoT applications. Templates promote reusable code for drivers and protocols. Overall, it builds a strong foundation for embedded programming and advanced IoT development.

SECTION I

Unit 1: Introduction to OOP (7 Hours)

Fundamentals of OOPS, Introduction to Programming and C++, How C++ differs from C, Variables, Data Types, and Operators, Control Structures, Loops and Iteration, Functions and Modular Programming, Basics of Console Input and Output Class, Dynamic Memory Allocation , Introduction to classes & objects, Creation & destruction of objects, Data Members, Member Functions, Access Specifier, this Pointer, Constructor &Destructor, Static class member, Friend class and functions, Function Overloading, Operator Overloading.

Unit 2: OOP Principles (7 Hours)

Introduction to inheritance, Base and Derived class Constructors, Types of Inheritance, Down casting and up casting, Function overriding, Virtual functions, Polymorphism, Pure virtual functions, Virtual Base Class,

C++ Class Hierarchy, File Stream, Text File Handling, Binary File Handling, Function Templates, Class Templates, STL

SECTION II

Unit 3 : Fundamentals of Java Programming and Object-Oriented Concepts (7 Hours)

Introduction to Java, History and features of Java, Comparison with C and C++, JDK, JRE, and JVM, First Java Program , Data types, variables ,constants, literals, and Operators ,String, Array, Control Flow statements, OOPS and its application in Java-Classes and Objects, Getters/Setters, Methods, Scanner class, Constructors, Super and this keyword, Modifiers, Static keyword, Encapsulation, Protection of data, Inheritance, Types of inheritance, extends and implements keywords, Polymorphism Compile time polymorphism -- Overloading of methods, Run time polymorphism -- Overriding of methods, Static and Dynamic Binding, Abstraction, Interfaces and Abstract classes, Abstract and non-abstract methods, Memory management in Java, Heap, Stack, Packages.

Unit 4 : Exception Handling, GUI and Database Programming in Java (7 Hours)

Exception Handling-Try-catch block, Multiple Catch Block, Nested try block, Finally block, Throw and Throws Keyword, Final vs Finally vs Finalize, Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package),Event-Driven Programming in Java, Event- Handling Process, Event Handling Mechanism, The Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, , JDBC-JDBC Drivers, steps to connect to Database, Connectivity with Oracle, Connectivity with MySQL, Driver Manager, Types of JDBC statements: Statement, Prepared statement, Callable statement, Result Set, CURD operations using Java. The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, Use of Array List and vector

List of Practical:

Part 1: C++

1. Basics of C++
   - Write a C++ program to calculate the area of a rectangle given its length and width.
   - Develop a C++ program that converts temperature from Celsius to Fahrenheit using the formula: Fahrenheit = (Celsius * 9/5) + 32.
   - Create a program that takes a user's age as input and determines if they are eligible to vote or not.
   - Implement a C++ program that generates the Fibonacci sequence up to a given number 'n' using loops.
   - Design a program that calculates the factorial of a given positive integer using a recursive

function.

- Develop a modular program that checks whether a given number is prime or not, utilizing a function for prime number testing.

2. Constructors (OOP)

- Create a C++ class named Rectangle that has attributes for length and width. Implement methods to calculate the area and perimeter of the rectangle using a constructor.
- Design a program using OOP concepts to simulate a basic banking system. Implement classes for customers and accounts, allowing for deposits and withdrawals using constructor

3. Static

- Write a program to use static data members and member functions.
- Use this pointer to resolve naming conflicts.

4. Overloading

- Create a program to overload arithmetic operators using friend functions

5. Inheritance

- Build a hierarchy of classes representing different shapes (e.g., Circle, Triangle, Rectangle) with a common base class. Implement a virtual function for calculating the area of each shape.

6. Polymorphism

- Extend the banking system to include different types of accounts (Savings, Checking) that inherit from a common Account class. Implement polymorphic behavior for interest calculations. (Practice)

7. Write a function template for finding the maximum of two values.

Part II: Java

1. Design a bank account class with constructor and methods to deposit, to withdraw from, change the name, charge a fee and print a summary of the account using to String() method. Use scanner class.

2. Design a class hierarchy to implement different kinds of inheritance. Use Super, this, static, Final keywords. Also implement Polymorphism

3. Implement the concepts of Abstract class, Interface on Document class. Implement multiple interfaces through interfaces.

4. Implement Java application connectivity with MySQL/Oracle database for any application and perform CURD operations.

5. Implement GUI Java application with event handling and swings.

List of Project areas:

1. Data Structures & Algorithm Visualizers
2. Blockchain-Based Applications
3. IoT & Real-Time Systems
4. Game Development
5. Cybersecurity and Blockchain Applications
6. Healthcare Applications

Students have to develop a course project in a group.

Textbooks :

1. E. Balagurusamy -- Object-oriented programming with C++, fourth edition, Mc Hill Professional,2008, ISBN 978-0-07-066907-9
2. Bjarne Stroustrup, ― The C++ Programming language‖, Third edition, Pearson Education. ISBN 9780201889543
3. Jeff Friessen; "Beginning java 6 platform from Novice to Professional", Apress/Springer,9788181288769
4. Gallardo, Burnette, McGrovern ," Eclipse in action: a guide for java Developers", Manning,9788177224986

References Books :

1. Herbert Schildt, ―C++ The complete reference‖, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
2. Robert Lafore, ―Object-Oriented Programming in C++, fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089
3. Khalid A Mughal, "A programmer's guide to Java SCJP Certification", Third Edition, Pearson Education ,978-81-317-2688-4

e Learning Resources:

1. Swayam Course -Programming in Modern C++, By Prof. Partha Pratim Das | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_cs144/preview
2. Infosys Springboard course- Programming Using C++, By Malarvizhi Rathinam, Bala Sundari Vaidyanathan https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0129720024067194883 7_shared/overview

Course Outcomes:

After completion of the course, student will be able to

CO1: Understanding and Implementation of OOP Fundamentals
CO2 : Apply inheritance, templates, and STL to develop C++ programs.
CO3 : Demonstrate the use of Java syntax, OOP principles, and packages to develop applications.
CO4 : Design Java applications using exception handling, event handling, collections, and JDBC.

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	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	1	
CO2	3	3	3	2	3	-	-	1	-	-	2	3	2	
CO3	2	2	3	-	3	-	-	-	-	1	-	3	2	
CO4	3	3	3	2	3	-	-	-	-	2	2	3	3	
Avg	2.75	2.50	2.75	2.00	2.75	-	-	1	-	1.50	2	2.75	2.00	

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	-	-	✓
CO3	-	✓	✓	✓	✓	-	-	-	-
CO4	-	✓	✓	✓	✓	-	-	-	✓

CO – WP Mapping (Complex Engineering Problems) Sample Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	✓
CO3	✓	✓	✓	-	✓	-	-
CO4	✓	✓	✓	✓	✓	-	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓	-	-	-

CO	EA1	EA2	EA3	EA4	EA5
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	-	✓
CO4	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Builds a strong foundation in Java and OOP, contributing to quality technical education and software infrastructure.
CO2	4, 8, 9	Develops advanced software engineering skills that enhance employability and support innovative software solutions.
CO3	4, 8, 9	Strengthens practical programming skills required by the software industry and promotes innovation through application development.
CO4	4, 8, 9	Enables students to design robust database-driven Java applications using industry-standard technologies, improving professional competency and supporting digital infrastructure.

FF No. : 654

MM0501 : Probability and Statistics

Credits: 3 **Teaching Scheme:** Theory: 2 Hours/Week, Tut: 1 Hours/Week

Prerequisites

Basic algebra, Calculus, Logical reasoning and basic problem solving skills

Course Relevance

This course provides the mathematical foundation needed to analyze data, quantify uncertainty, and make evidence-based engineering decisions. It enables students to work effectively in fields such as data science, quality control, machine learning, reliability engineering, and research.

Course Objectives

1. To introduce students to basic statistical concepts and probability theory.
2. To enable students to model real-world uncertainty using probability distributions.
3. To train students in inferential techniques such as estimation and hypothesis testing.
4. To build foundational skills in analyzing relationships between variables using correlation and regression.

SECTION I

Unit 1: Descriptive Statistics (6 Hours)

Types of data: qualitative, quantitative, discrete, continuous, Frequency distribution; visualizations (histogram, bar chart, box plot), Measures of central tendency: mean, median, mode, Measures of dispersion: variance, standard deviation, coefficient of variation.

Unit 2: Probability Basics and distributions (8 Hours)

Basic probability rules: axioms, complement rule, addition rule, Conditional Probability & Independence, Bayes' theorem ,Random Variables & Common Distributions: Random variables: discrete & continuous, Probability Mass Function (PMF), Probability Density Function (PDF), Cumulative Distribution Function (CDF), Expectation, variance, and properties, Discrete distributions: Bernoulli, Binomial, Poisson, Continuous distributions: Uniform and Exponential, Applications in Engineering.

SECTION II

Unit 3: Normal Distribution & Sampling Theory (6 Hours)

Normal distribution: standard normal, Z-scores, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value, Special Applications of normal distribution (tolerances, quality control), Normal approximation to binomial & Poisson,
Sampling: random sampling, sample mean, sample variance, Sampling distribution of sample mean, Standard error, Central Limit Theorem (CLT) – intuitive explanation with examples

Unit 4: Estimation, Hypothesis Testing, Correlation & Regression (8 Hours)

Point estimation: properties of good estimators, Interval estimation: confidence interval for mean (σ known/unknown), Hypothesis testing: Null & alternative hypothesis, Type I & II errors, One-sample Z-test and t-test, Chi-Square (χ^2) Tests, Test for goodness of fit, Test for independence of attributes, Applications in quality inspection and survey data, Analysis of Variance (ANOVA):One-way ANOVA, F-test and interpretation, Engineering and experimental applications.
Introduction of Correlation & Regression , correlation analysis, regression analysis, line of regression, standard error of estimate, Rank of correlation. single and multiple regression, linear regression, Curve fitting by method of least squares .

List of Tutorial:

1. Descriptive Statistics for Factory Production A small factory records the daily production output of its machines for one week. Using the given data, students calculate the mean, median, and mode to understand the typical production level. Measures such as variance, standard deviation, and coefficient of variation are also computed to study how much the production varies from day to day and whether the process is stable.

2. Probability in Electrical Component Failure An electrical system uses components that may fail during operation. The probability of failure under normal and overloaded conditions is provided. Students solve numerical problems using basic probability rules and conditional probability to determine the chances of system failure. Bayes' theorem is used to update probabilities when additional information about operating conditions is known.

3. Modeling Call Arrivals Using Discrete Distributions A customer support center receives a fixed number of calls during office hours. Students use Binomial and Poisson distributions to calculate the probability of receiving a certain number of calls in a given time period. The results are interpreted to understand workload planning and staffing requirements.

4. Reliability Analysis Using Exponential Distribution The lifetime of a machine part follows an exponential distribution. Students calculate the probability that the part fails within a specific time and find the expected life of the component. The numerical results are used to explain maintenance scheduling and replacement planning in engineering systems.

5. Normal Distribution in Quality Control The weights of packaged products follow a normal distribution with a known mean and standard deviation. Students calculate Z- scores and determine the percentage of products that fall outside acceptable limits. Based on the numerical results, they analyze whether the packaging process meets quality standards.

6. Hypothesis Testing for Process Verification A company claims that the average time taken to complete a manufacturing task meets a given standard. Using sample data, students frame the null and alternative hypotheses and perform a one-sample Z-test or t- test. The decision is made based on the calculated test statistic and significance level, and the result is interpreted in a practical context.

7. Chi-Square Test for Inspection Data (Tool-Based) A quality inspection department records the number of defective and non-defective items produced by different machines. Students use a statistical tool such as Excel or Python to perform the chi-square test for independence. The output from the tool is analyzed to decide whether product quality depends on the machine used.

8. One-Way ANOVA for Comparing Manufacturing Methods (Tool-Based) Three different manufacturing methods are tested to compare their average output. Students apply oneway ANOVA using Excel or Python to analyze the data. Based on the F-value and p- value obtained from the tool, they conclude whether there is a significant difference between the methods.

Textbooks :

1. Sheldon M. Ross, "Probability and Statistics for Engineers and Scientists", Fifth Edition, ELSEVIER Publication.
2. Schaum's outline of " Probability and Statistics", Fourth Edition.
3. J. L. Devore, Probability and Statistics for Engineering and the Sciences, 9th ed., Boston,MA, USA: Cengage Learning, 2016.

Reference books:

1. Johnson Richard A., Miller I., Freund J.E., (2016), "Probability and Statistics for Engineers", 9th edition, PHI publications
2. Rao G. S., (2018), "Probability and Statistics for Science and Engineering", 11th edition, Universities press publication – G Shankar Rao
3. R. E. Walpole, R. H. Myers, S. L. Myers and K. Ye, Probability and Statistics for Engineers and Scientists, 9th ed., Boston, MA, USA: Pearson, 2012

e Learning Resources:

NPTEL

1. Probability and Statistics by Prof. Somesh Kumar – IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ma83
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ge25
3. Introduction to Probability by Prof. G. Srinivasan – IIT Madras:https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg35

edX-

1. HarvardX: Introduction to Probability https://www.edx.org/learn/probability/harvard-university-introduction-to-probability

Course Outcomes:

After completion of the course, students will be able to:

CO1: Use descriptive statistics, probability concepts, and random variables to process data.

CO2: Apply discrete and continuous probability distributions to engineering problems.

CO3: Perform statistical inference using estimation and hypothesis testing.

CO4: Analyze and interpret relationships in data using correlation and regression.

CO – PO / PSO Articulation Matrix
Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcomes (PO)											PSO	
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PSO1	PSO2
CO1	3	2	-	2	2	-	-	-	-	1	1	1	1
CO2	3	3	1	2	1	-	-	-	-	-	1	2	2
CO3	3	3	1	3	2	-	-	-	-	-	1	2	1
CO4	3	3	2	3	2	-	-	-	1	1	2	2	2
Average	3.0	2.75	1.33	2.50	1.75	-	-	-	1.0	1.0	1.25	1.75	1.50

CO – WK Mapping (Knowledge & Attitude Profiles) Table
'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO 1	✓	✓	✓						
CO 2	✓	✓	✓	✓					
CO 3	✓	✓	✓	✓		✓			
CO 4	✓	✓	✓	✓	✓	✓		✓	

CO – WP Mapping (Complex Engineering Problems) Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO 1	✓						
CO 2	✓	✓			✓		
CO 3	✓	✓	✓	✓	✓		
CO 4	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA 1	EA2	EA3	EA4	EA5
CO1	-	-	-	-	-
CO2	-	-	-	-	-
CO3	-	-	-	-	-
CO4	✓	-	-	✓	✓

CO – SDG Mapping (Sustainable Development Goals) Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4	Builds quantitative reasoning and data interpretation skills essential for engineering education.
CO2	9	Probability models support reliability analysis, industrial systems and engineering innovation.
CO3	9	Statistical inference and quality control improve engineering processes and industrial decision making.
CO4	8, 9	Estimation, hypothesis testing, ANOVA and regression improve industrial productivity, quality assurance and evidence-based engineering decisions.

FF No. : 654

HS2002: From Campus To Corporate – 1

Credits:2 **Teaching Scheme:** Theory: 2 hours/Week

Course Objectives:

- Understand the organizational structure, business domains, financial concepts, and functioning of companies in the corporate environment.
- Develop knowledge of product management, user experience, quality assurance, customer success, security, and emerging technologies used in modern industries.
- Apply analytical thinking, problem-solving, and decision-making techniques to address industry-oriented challenges through case studies and practical scenarios.
- Enhance professional competencies including communication, presentation, teamwork, leadership, and interpersonal skills required in multidisciplinary work environments.
- Develop project management, planning, prioritization, and execution skills for effective management of professional tasks and projects.
- Cultivate professional ethics, adaptability, critical thinking, and lifelong learning to achieve continuous personal and professional growth.

Vertical 1: COMPANIES & INDUSTRY

Topic 1: Understanding Companies

- Understand how to analyse a company-based domains, customers, offering and strategy
- Understand how to use this knowledge to contribute earlier and faster.

Topic 2: Understanding Company Financials (and AOP Budgeting)

- Understand components of company P&L and Balance Sheet
- Be able to assess financial health of a company
- How do companies build AOP. Top down and bottom up
- Understand the funding avenues

Vertical 2: Application Of Knowledge

Topic 1: Product Management

- Understand product roadmap creation
- Understand product growth strategies
- Understand product discovery techniques
- Understand backlog prioritization techniques
- Be able to write requirements in detail

Topic 2: Understanding UX And UI

- Understand what usability, user interaction design and consumer journeys mean
- Compare and contrast UX with user interface. Use several industry examples
- technique of building a good UX

Topic 3: Releasing A Product To The Market

- Understand what it takes to release a product to the market by product and engineering teams

- Understand what it takes for a product to be successful with the customer from external go-to market perspective.

Topic 4: Quality – Understanding Beyond The Theory

- Understand how to look at product quality
- Understand how to approach building a good quality product
- Understanding Testing and Test Automation
- Build a Test Plan
- Career options in Quality

Topic 5: Customer Success Management

- Concept of Customer Success
- What is CSAT , NPS , RATING, REVIEWs and how should one track Customer Value
- Understand what issues mean in the industry
- Understand how to identify and prioritize issues and ways to resolve them.

Topic 6: Security And Privacy

- Understand Security concepts (Threat, Vulnerability, Risk)
- Understand about Threat Modelling
- Understand about Security Engineering Approach
- Be able to prepare security test plan

Topic 7: Artificial Intelligence (AI) – The Evolution

- Introduction to AI. AI is pervasive today. Origins of AI and ML Potential and possibilities
- Machine Learning. How is it different from traditional programs? Extensive practical applications over the last decade or so
- Deep Learning. Computer Vision and Natural Language Processing

Vertical 3: PROFESSIONAL SKILLS

Topic 1: Curiosity And Inquisitiveness

- What is Curiosity and Understand the importance of asking questions
- Review Industry Examples
- Understand techniques of asking thought provoking questions
- Tips and tricks to ask effective questions

Topic 2: Articulation And Communication

- Understand different types of communications
- Understand barriers to communications
- Understand why articulation is important
- How do you make Impactful Introductions

Topic 3: Problem Breakdown and Resolution Using Mind Maps

- What are mind maps
- Tips on creating Mind Maps
- Real-life case of Problem Breakdown
- Prioritizing a long list. Concept and Technique
- Live workshop on understanding constraints and prioritizing and long to-do list

Topic 4: Effective Project And Program Management

- Understand the key concepts within project management
- Understand key aspects of planning
- Understand the link between planning and execution
- Case study based Proj and Prog Management hands on workshop

Topic 5: Developing Critical Thinking Using Mental Models

- Why Critical Thinking
- What are the barriers to Critical Thinking
- Technique and Steps in Critical Thinking
- Why Mental Models

Using Mental Models for sharper decisions

Course Outcomes:

After completion of the course, student will be able to

CO1 : Explain the organizational structure, business processes, financial concepts, and product development lifecycle in the corporate ecosystem.

CO2 : Analyse workplace problems and recommend suitable solutions using concepts of product management, quality, customer success, security, and emerging technologies.

CO3 : Apply critical thinking, problem-solving techniques, AI awareness, and project management principles to solve industry-oriented case studies.

CO4 : Demonstrate effective communication, teamwork, leadership, and presentation skills while working in professional and multidisciplinary environments.

CO5 : Apply project planning, prioritization, and management techniques for successful execution of professional assignments and collaborative projects.

CO6 : Demonstrate professional ethics, social responsibility, adaptability, and lifelong learning necessary for continuous professional development in a dynamic corporate environment.

CO-PO Mapping

CO	Program Outcomes (PO)											PSO	
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	–	–	1	–	–	–	1	–	1	1	1
CO2	2	3	2	1	2	2	1	1	–	–	1	2	3
CO3	1	3	2	2	2	1	–	2	1	2	2	2	2
CO4	–	1	–	–	–	–	2	3	3	2	1	1	1
CO5	–	1	2	1	1	1	3	2	2	3	2	2	2
CO6.	–	–	–	–	1	2	3	2	2	1	3	1	1
Average	1.67	2.00	2.00	1.33	1.40	1.50	2.25	2.00	1.80	2.00	1.67	1.5	1.67

CO – WK Mapping (Knowledge & Attitude Profiles) Table

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	-	-	-	-	-	-	-
CO2	-	✓	-	✓	-	✓	-	-	-
CO3	-	✓	-	✓	-	-	-	✓	-
CO4	-	-	-	-	-	-	-	-	✓
CO5	-	-	-	-	-	-	-	✓	✓
CO6	-	-	-	-	-	-	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems) Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	-	✓	-	-	-	-	✓
CO2	-	✓	-	✓	-	✓	-
CO3	-	-	✓	✓	-	-	-
CO4	-	-	-	-	-	-	-
CO5	-	✓	-	-	-	-	✓
CO6	-	✓	-	-	-	-	-

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	-	-	-	-
CO2	-	-	-	-	-
CO3	-	✓	✓	-	-
CO4	✓	✓	-	-	✓

CO5	✓	✓	-	-	-
CO6	-	-	-	✓	✓

CO – SDG Mapping (Sustainable Development Goals) Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 8, 9	Builds foundational understanding of organizational, financial, and product-lifecycle knowledge that prepares students for productive employment and industry participation.
CO2	8, 9	Analyzing workplace problems via product management, quality, security, and emerging technology supports innovation-driven, industry-relevant solutions.
CO3	4, 9	Develops critical thinking, problem-solving, and AI awareness through case studies — building future-ready skills and innovation capability.
CO4	4, 5, 17	Builds communication, teamwork, and leadership for inclusive, multidisciplinary collaboration and stronger partnerships across diverse teams.
CO5	8, 17	Develops project planning and management skills for successful execution of collaborative professional work.
CO6	4, 8, 16	Cultivates professional ethics, social responsibility, and lifelong learning — reinforcing responsible conduct and good practice in the workplace.

FF No. : 654

HS2001: Reasoning and Aptitude Development - 3

Credits: 1 **Teaching Scheme:** 1 Hour/Week

Prerequisites:
Basic English language proficiency (grammar, vocabulary, and reading comprehension).
Fundamental knowledge of mathematics (arithmetic and elementary algebra).
Basic logical and analytical reasoning ability.
Interest in developing problem-solving, critical thinking, and communication skills.

Course Objectives:

- Develop proficiency in English language skills, including grammar, vocabulary, sentence construction, and reading comprehension for effective communication.
- Strengthen logical, analytical, and critical reasoning abilities to solve verbal and non-verbal aptitude problems systematically.
- Apply quantitative aptitude concepts and mathematical reasoning to solve numerical and real-world problems accurately.
- Enhance problem-solving speed and accuracy by employing appropriate aptitude-solving techniques and shortcut methods.
- Improve teamwork, communication, and collaborative learning skills through structured group activities and discussions.
- Prepare students for competitive examinations, placement assessments, and professional aptitude tests by developing comprehensive aptitude and reasoning skills.

SECTION I

English Language and Communication Skills: English tenses (Present, Past, Future), correct tense usage, active–passive voice, sentence correction, grammar and syntax, parts of speech, sentence structure, subject–verb agreement, reading comprehension, skimming and scanning, inference, contextual vocabulary, identification of tone, theme and intent, group activity on English reasoning techniques and problem-solving strategies.

Logical and Analytical Reasoning : Deductive reasoning including syllogisms, coding–decoding, statement–conclusion, data sufficiency, directional sense and logical sequencing; inductive reasoning including analogy, classification, number series and sequence completion; abductive and critical reasoning including assumptions, arguments, cause–effect analysis, logical evaluation and decision-making; information gathering, interpretation and synthesis using graphs, charts and tables; group activity on logical reasoning techniques and shortcut methods.

SECTION II

Quantitative Aptitude Fundamentals: Number system, integers, decimals, fractions, divisibility rules, HCF & LCM, prime and rational numbers; algebraic applications including linear equations, inequalities, direct and inverse proportion; quantitative problem solving involving percentages, averages, profit & loss, speed–time–distance, age, mixtures and related applications.

Advanced Quantitative and Spatial Reasoning: Permutations and combinations, probability, geometry fundamentals, spatial visualization, missing figures and series, advanced quantitative reasoning, integrated aptitude problem-solving strategies, and collaborative group activity focusing on quantitative reasoning techniques, shortcut methods and competitive aptitude practice.

Text Books:

1. R. S. Aggarwal, *Quantitative Aptitude for Competitive Examinations*, Revised and Enlarged Edition. New Delhi, India: S. Chand and Company Ltd., 2017.
2. R. S. Aggarwal, *A Modern Approach to Verbal & Non-Verbal Reasoning*. New Delhi, India: S. Chand Publishing.
3. Dr. M. B. Lal and A. Gupta, *CSAT Logical Reasoning & Analytical Ability*. Agra, India: Upkar Prakashan.

Reference Books:

1. B. H. Dowden, *Logical Reasoning*. California State University, Sacramento, CA, USA, 2011.
2. 501 Challenging Logic and Reasoning Problems, 2nd ed. New York, NY, USA: Learning Express, LLC, 2005.
3. Logic and Reasoning Problems. LearningExpress Practice Series.

Link:

https://drive.google.com/drive/folders/1fXLzuofNhMFq7skonrC0TpCdaCoT7_i0?usp=sharing

Course Outcomes:

After completion of the course, student will be able to

CO1: Explain and Apply English language skills, including grammar, vocabulary, sentence construction, and reading comprehension, to solve verbal aptitude problems and communicate effectively.

CO2: Analyze logical, deductive, inductive, abductive, and critical reasoning problems to draw valid conclusions and make informed decisions.

CO3: Apply quantitative aptitude concepts, including number systems, arithmetic, algebra, and proportional reasoning, to solve numerical and real-world problems accurately.

CO4: Evaluate advanced quantitative and spatial reasoning problems by selecting appropriate mathematical and analytical techniques for competitive aptitude and placement examinations.

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

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
Avg	2.67	2.00	1.00	–	–	–	–	2.00	2.00	3.00	2.00	2.50	2.25	2.33

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	–	✓	–	–	–	–	–	✓	✓
CO2	–	✓	–	–	–	–	–	✓	✓
CO3	–	✓	–	–	–	–	–	✓	✓
CO4	–	✓	✓	–	–	✓	–	✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	–	–	–	–	–	–	–
CO2	✓	–	✓	✓	–	–	–
CO3	✓	–	✓	✓	–	–	–
CO4	✓	–	✓	✓	–	–	–

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

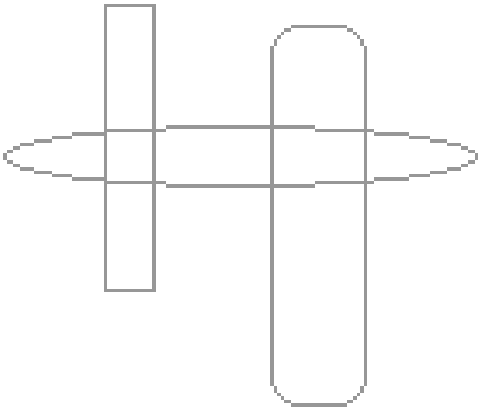
CO	EA1	EA2	EA3	EA4	EA5
CO1	–	–	–	–	–
CO2	–	–	✓	–	✓
CO3	–	–	✓	–	✓
CO4	–	–	✓	–	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	SDG 4	Develops English language proficiency, communication, and comprehension skills that promote quality learning and lifelong education.
CO2	SDG 4	Enhances logical reasoning, critical thinking, and analytical decision-making skills essential for quality education and problem-solving.
CO3	SDG 4, 8	Strengthens quantitative aptitude and analytical skills required for higher education, competitive examinations, and employment opportunities.

CO	SDG(s) Addressed	Justification / Linkage
CO4	SDG 4, 8, 17	Develops advanced aptitude, collaborative problem-solving, and teamwork skills to improve employability and foster effective collaboration in professional environments.

- SDG 4: Quality Education
- SDG 8: Decent Work and Economic Growth
- SDG 17: Partnerships for the Goals (Teamwork and Collaboration)



FF No. : 654

CB2001: Design Thinking - 1

Credits: 1 **Teaching Scheme:** Tutorial: 1 Hour/Week

Course Prerequisites: Problem Based Learning, Project Centric Learning

Course Objective:
To provide ecosystem for students and faculty for paper publication and patent filing

Section 1: Topics/Contents

What is research?
Importance of Paper Publication and Patents
Importance of Paper Publication and Patents Structure of Paper
Journal Publication in conference Literature Review Research Paper Writing
Journal Ratings and Evaluation How to rate a Journal?
Intellectual property (IP) Research Ethics Entrepreneurship

Section 2: 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

Course Outcomes: **[**Publication of paper or patent]
The 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 the Entrepreneurship and Business Planning

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	PO 11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1							1	2	2
CO2	1	1	1	1	1							1	2	2
CO3	2	2	3	3	2	2	1	2	2	3		1	3	3
CO4	3	3	3	3	3	2	1	2	2	3	1	1	3	3
CO5	1	1	1	1	1							1	2	2
CO6	2	2	2	2	2	2	1	3	2	3		1	3	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	2.5	2.5

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓		✓					✓
CO2		✓	✓	✓	✓				
CO3		✓	✓	✓	✓	✓			
CO4			✓	✓	✓	✓	✓		
CO5				✓	✓	✓	✓	✓	
CO6	✓			✓		✓		✓	✓

CO – WP Mapping (Complex Engineering Problems) Sample Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓		✓		✓
CO2	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓
CO6			✓		✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	
CO4		✓	✓	✓	✓
CO5			✓	✓	✓
CO6				✓	✓

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Understanding the importance of research promotes quality education, scientific inquiry, innovation, and technological advancement for solving real-world problems.
CO2	4, 9	Knowledge of research terminology and concepts strengthens analytical thinking, research competency, and innovation capabilities.
CO3	9, 17	Applying research methodology and publishing research fosters innovation, knowledge dissemination, and collaboration among researchers and institutions.
CO4	4, 9, 17	Writing research papers develops scientific communication, promotes lifelong learning, and contributes to global knowledge sharing through collaborative research.
CO5	9,12	Understanding Intellectual Property Rights encourages innovation, protection of inventions, responsible use of knowledge, and sustainable technological development.
CO6	4, 16	Applying research ethics promotes academic integrity, responsible conduct of research, transparency, fairness, and ethical decision-making.
	8, 9	Entrepreneurship and business planning encourage innovation, job creation, sustainable economic growth, and technology-based enterprises.

FF No. : 654

ML2002: Engineering Design & Innovation

Credits:2 **Teaching Scheme:** Lab - 2 Hours/Week

Course Prerequisites: Problem Based Learning

Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Along with course based projects, curriculum can be enriched with semester long Engineering Design and Development courses, in which students can solve socially relevant problems using various technologies 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 projects, students can select relevant online courses and acquire skills from numerous sources under guidance of facultyand enrich their knowledge in the project domain, thereby achieving project centric learning. Modern world sustained and advanced through the successful completion of projects. In short, if students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. Project centric learning will also redefine the role of teacher as mentor in the learning process. The PCL model focuses the student on a big openended 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:

1. To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
6. To develop an ecosystem to promote entrepreneurship and research culture among the students

SECTION I:

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 ED, laboratory course contents of "Engineering Design" are designed as a ladder to extend connectivity of software technologies to solve real word problem using interdisciplinary approach. The ladder in the form of gradual steps can be seen as below:

Industry Communication Standards, Single Board Computers and IoT, Computational Biology (Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence, Human Computer Interfacing, 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 Project/Problem:
● 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 PCL:
● 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 PCL:
● Students must have ability to initiate the task/idea, they should not be mere imitators.
● They must learn to think.
● Students working in PCL must be responsible for their own learning.
● Students must quickly learn how to manage their own learning, instead of passively receiving instruction.
● Students in PCL are actively constructing their knowledge and understanding of the situation in groups.
● Students in PCL 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

SECTION II:

EDD Sample Case Studies: -

With the adaptation of industry communication standards, Raspberry Pi and Sensors, the following projects can be taken up:

1) Design a deployable product for soil moisture detection
2) Design a deployable product for temperature detection
3) Design a deployable product for pressure detection
4) Design a deployable product smoke detection
5) Design a deployable product for motion detection
6) Design a deployable product for collision detection
7) Design a deployable product for sound detection

...**not limited to.....Faculty and students are free to include other areas which meet society's requirements at large.**

Text Books:

1.A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2.Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3. Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Robart Capraro, Mary Margaret Capraro
4. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

Reference Books:

1.De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2.Project management core textbook, second edition, Indian Edition , by Gopalan.
3. The Art of Agile Development. By James Shore & Shane Warden.

Course Outcomes:

On completion of the course, learner will be able to–

1. Identify the real-life problem from societal need point of view
2. Choose and compare alternative approaches to select most feasible one
3. Analyze and synthesize the identified problem from technological perspective
4. Design the reliable and scalable solution to meet challenges
5. Evaluate the solution based on the criteria specified
6. Inculcate long life learning attitude towards the societal problems

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	PO 11	PSO1	PSO2	PSO3
CO1	2	2	2	2					3		2	3	3	2
CO2	2	2	3	2	2		2		3		2	3	3	2
CO3	2	2	3	2	3		2		3		2	3	3	2
CO4	2	2	3	2	3	3		2	3		2	3	3	2
CO5	2	2	3	2	3	2			3		2	3	3	2
CO6	2	2	3	3	2				3		3	3	3	2
Avg	2.0	2.0	2.83	2.83	2.6	2.5	2.0	2.0	3.0	1.0	2.16	3.0	3.0	2.0

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓			✓	
CO2		✓	✓	✓	✓	✓		✓	
CO3		✓	✓	✓	✓	✓		✓	
CO4		✓	✓	✓	✓	✓	✓	✓	✓
CO5		✓	✓	✓	✓	✓	✓	✓	
CO6		✓	✓	✓	✓	✓		✓	

CO – WP Mapping (Complex Engineering Problems) Sample Table

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓			✓		✓	✓
CO2	✓	✓				✓	
CO3	✓		✓		✓		
CO4	✓				✓	✓	
CO5	✓	✓	✓				
CO6	✓					✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓		✓

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4,9	Identifies real-life societal problem and develops engineering knowledge for innovative solutions

CO	SDG(s) Addressed	Justification / Linkage
CO2	4,9,12	Evaluates and compares alternative solutions to select sustainable and resource efficient approaches
CO3	4,9,11	Analyze engineering problems and synthesizes technological solutions for societal needs
CO4	4,9,11,13	Designs reliable,scalable and sustainable engineering solutions addressing environmental and societal challenges
CO5	4,9,16	Evaluates engineering solutions based on defined technical, ethical,and quality criteria to ensure reliability and accountability
CO6	4,17	Promotes lifelong learning,professional development,collaboration and commitment to solving societal problems