DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Curriculum and Syllabus for Minor Degree Programme

Name of the Minor Degree	**Full Stack web Development**
Minor Degree Offering Department	**CSE**
Eligible Departments	**ECE, EEE, Mech, Civil**

Sl. No.	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
1	U23MDCS01	Principles of Programming Languages	3	0	0	3	3
2	U23MDCS02	Web Essentials	2	0	2	3	3
3	U23MDCS03	Cloud Services Management	2	0	2	3	3
4	U23MDCS04	Stream Processing	2	0	2	3	3
5	U23MDCS05	Devops	2	0	2	3	3
6	U23MDCS06	Design of UI / UX	3	0	0	3	3
TOTAL CREDITS							**18**

U23MDCS01 PRINCIPLES OF PROGRAMMING LANGUAGES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand and describe syntax and semantics of programming languages.
- To understand call-return architecture and ways of implementing them
- To learn programs in non-procedural programming paradigms

UNIT I SYNTAX AND SEMANTICS 9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom-up parsing

UNIT II DATA, DATA TYPES, AND BASIC STATEMENTS 9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS 9

Subprograms – design issues – local referencing – parameter passing – overloaded methods generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping.

UNIT IV OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING 9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads - statement level concurrency – exception handling – event handling.

UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9

Introduction to lambda calculus– fundamentals of functional programming languages– Programming with Scheme – Programming with ML– Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Robert W Sebesta, "Concepts of Programming Languages", 12th Edition, Pearson Education, 2022.

2 Rajiv Chopra, "Principles of Programming Languages", 9th Edition, Elsevier, 2019.

REFERENCES:

1 Bruce J MacLennan, "Principles of Programming Languages: Design, Evaluation, and Implementation", 1st Edition, Oxford University Press, 2019.

2 Gilles Dowek, "Principles of Programming Languages", 1st Edition, Springer Publications, 2020.

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3 Saverio Perugini, "Programming Languages: Concepts and Implementation", 4th Edition, Jones & Bartlett Learning, 2021.

ONLINE RESOURCES:

1 http://digimat.in/nptel/courses/video/106102067/L40.html

2 http://acl.digimat.in/nptel/courses/video/106102067/L25.html

3 https://www.youtube.com/watch?v=e4fwY9ZsxPw

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe syntax and semantics of programming languages

CO2 Summarize data, data types, and basic statements of programming languages

CO3 Describe about functions and overloading

CO4 Comprehend about object-oriented concepts

CO5 Summarize and adopt new programming languages

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	1	-	-	-	1
CO3	2	2	1	1	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-	1	-	-	-	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1

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U23MDCS02 **WEB ESSENTIALS** L T P C
2 0 2 3

COURSE OBJECTIVES:

- To learn the basic concepts of web programming and internet protocols
- To learn the uses of scripting languages, write simple scripts for the creation of web sites
- To learn how to create database applications

UNIT I **WEBSITE BASICS** 6

Internet Overview - Fundamental computer network concepts - Web Protocols - URL – Domain Name- Web Browsers and Web Servers- Working principle of a website – Creating a Website - Client-side and server-side scripting

UNIT II **WEB DESIGNING** 6

HTML – Form Elements - Input types and Media elements - CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

UNIT III **CLIENT-SIDE PROCESSING AND SCRIPTING** 6

JavaScript Introduction – Variables and Data Types-Statements – Operators - Literals-Functions- Objects-Arrays-Built-in Objects- Regular Expression, Exceptions, Event handling, Validation - JavaScript Debuggers.

UNIT IV **SERVER-SIDE PROCESSING AND SCRIPTING – PHP** 6

PHP - Working principle of PHP - PHP Variables - Constants - Operators – Flow Control and Looping - Arrays - Strings - Functions - File Handling - File Uploading – Email Basics - Email with attachments - PHP and HTML - Simple PHP scripts - Databases with PHP

UNIT V **SERVLETS AND DATABASE CONNECTIVITY** 6

Servlets: Java Servlet Architecture – Servlet Life cycle- Form GET and POST actions - Sessions – Cookies – Database connectivity – JDBC Creation of simple interactive applications - Simple database applications

30 PERIODS

PRACTICAL EXERCISES:

1. Form validation using JavaScript
2. Creation of simple PHP scripts
3. Handling multimedia content in web sites
4. Write programs using Servlets:
   i) To invoke servlets from HTML forms
   ii) Session tracking using hidden form fields and Session tracking for a hit count
5. Creation of information retrieval system using web, PHP and MySQL
6. Creation of personal Information System

30 PERIODS

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Terry Felke Morris, "Web Development and Design Foundations", 8th Edition, Pearson Education, 2022.

2 Jon Duckett, "HTML and CSS: Design and Build Websites", 2nd Edition, John Wiley & Sons, 2020.

REFERENCES:

1 Jonathan Petersen, Richard Petersen," Web Applications: Concepts and Real-World Design", 2nd Edition, John Wiley & Sons, 2020.

2 Wendy Willard, "Web Design: A Beginner's Guide", 5th Edition, Tata McGraw Hill, 2020.

3 Roger Pressman, David Lowe, "Web Engineering: A Practitioner's Approach", 2nd Edition, Tata McGraw Hill, 2020.

ONLINE RESOURCES:

1 https://www.nptelvideos.com/php/php_video_tutorials.php

2 http://www.digimat.in/nptel/courses/video/106106156/L09.html

3 https://www.youtube.com/watch?v=h_RftxdJTzs

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the basic concepts of internet and website.

CO2 Design simple HTML programs

CO3 Write simple JavaScript programs for client side scripting

CO4 Write simple PHP programs for server side scripting

CO5 Create database connectivity

CO-PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	2	2	2	-	2
CO2	3	3	3	3	-	-	-	2	2	2	-	2
CO3	3	3	3	3	1	-	-	2	2	2	-	2
CO4	3	3	3	3	1	-	-	2	2	2	-	2
CO5	3	3	3	3	1	-	-	2	2	2	-	2

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U23MDCS03	CLOUD SERVICES MANAGEMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the Cloud Service Management terminology with traditional IT service management
- To learn the strategies to reduce risk and eliminate issues associated with adoption of cloud services select
- To understand the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 6

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II CLOUD SERVICES STRATEGY 6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III CLOUD SERVICE MANAGEMENT 6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV CLOUD SERVICE ECONOMICS 6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V CLOUD SERVICE GOVERNANCE & VALUE 6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

30 PERIODS

PRACTICAL EXERCISES:

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open-Source cloud software's like OpenStack, Eucalyptus, Open Nebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one

30 PERIODS

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era ", 1st Edition, Enel Publication, 2023.

2 Thomas Erl, Ricardo Puttini, Zaigham Mohammad, "Cloud Computing: Concepts, Technology & Architecture", 1st Edition, Prentice Hall of India, 2020.

REFERENCES:

1 S S Iyengar, G S Sanyal, S K Ghosh, "Cloud Computing Management: A Systematic Review", 1st Edition, Pearson Education, 2020.

2 Enamul Haque, "Cloud Service Management and Governance", 2nd Edition, Lulu Press, 2023.

3 Nayan B. Ruparelia , "Cloud Computing", 2nd Edition, The MIT Press, 2023

ONLINE RESOURCES:

1 http://digimat.in/nptel/courses/video/106105167/L01.html

2 http://kcl.digimat.in/nptel/courses/video/106101234/L46.html

3 https://onlinecourses.nptel.ac.in/noc25_cs12/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend cloud-design skills to build service models.

CO2 Analyze cloud service strategy using business solutions.

CO3 Describe cloud operation service management.

CO4 Apply economics towards adoption of cloud-based services

CO5 Solve the real-world problems using Cloud services and technologies.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	-	-	2	2	2	-	-
CO2	3	3	2	2	2	-	-	2	2	2	-	1
CO3	2	2	1	1	3	-	-	2	2	2	-	-
CO4	3	2	1	2	3	-	-	2	2	2	-	1
CO5	3	2	1	2	2	-	-	2	2	2	-	1

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U23MDCS04 **STREAM PROCESSING** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To learn the foundations of data systems
- To explain the concepts of Real-time Data processing and select appropriate structures for designing
- To learn the benefits and drive the adoption of real-time data services to solve real-world problems

UNIT I **FOUNDATIONS OF DATA SYSTEMS** **6**

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

UNIT II **REAL-TIME DATA PROCESSING** **6**

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT III **DATA MODELS AND QUERY LANGUAGES** **6**

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

UNIT IV **EVENT PROCESSING WITH APACHE KAFKA** **6**

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

UNIT V **REAL-TIME PROCESSING USING SPARK STREAMING** **6**

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

30 PERIODS

PRACTICAL EXERCISES:

1. Install MongoDB and Design and Implement Simple application using MongoDB
2. Query the designed system using MongoDB
3. Create a Event Stream with Apache Kafka
4. Create a Real-time Stream processing application using Spark Streaming
5. Build a Micro-batch application
6. Real-time Fraud and Anomaly Detection
7. Real-time personalization, Marketing, Advertising

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

1. Hubert Dulay, Ralph Matthias Debusmann, "Streaming Databases: Unifying Batch and Stream Processing", 1st Edition, O'Reilly Media, 2024.
2. Fabian Hueske, Vasiliki Kalavri," Stream Processing with Apache Flink Fundamentals, Implementation, and Operation of Streaming Applications", 1st Edition, O'Reilly Media, 2019.

REFERENCES:

1. Tyler Akidau, Slava Chemyak, Reuven Lax," Streaming Systems: The What, Where, When and How of Large-Scale Data Processing ", 2nd Edition, O'Reilly Media, 2023.
2. Shilpi Saxena, Saurabh Gupta, "Practical Real-time Data Processing and Analytics Distributed Computing and Event Processing using Apache Spark, Flink, Storm, and Kafka", 1st Edition, Kindle Edition, 2019.
3. Gerard Maas & François Garillot, "Stream Processing mit Apache Spark", 2nd Edition, O'Reilly Media, 2024.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/127/101/106101224/
2. http://kcl.digimat.in/nptel/courses/video/106106093/L07.html
3. https://archive.nptel.ac.in/courses/106/104/106104189/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the applicability and utility of different streaming algorithms.

CO2 Describe about current research trends in data-stream processing.

CO3 Analyze the suitability of stream mining algorithms for data stream systems.

CO4 Create simple stream processing systems.

CO5 Solve problems in real-world applications that process data streams.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	-	-	1	1	1	-	1
CO2	2	2	1	1	1	-	-	1	1	1	-	1
CO3	3	3	2	2	1	-	--	1	1	1	-	2
CO4	3	3	3	3	2	-	-	1	1	1	-	2
CO5	3	2	1	2	2	-	-	1	1	1	-	2

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U23MDCS05 **DEVOPS** L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand DevOps terminology, and the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment) and Configuration management using Ansible
- To learn the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I **INTRODUCTION TO DEVOPS** 6

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II **COMPILE AND BUILD USING MAVEN & GRADLE** 6

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III **CONTINUOUS INTEGRATION USING JENKINS** 6

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV **CONFIGURATION MANAGEMENT USING ANSIBLE** 6

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V **BUILDING DEVOPS PIPELINES USING AZURE** 6

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

30 PERIODS

PRACTICAL EXERCISES:

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

30 PERIODS

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Gene Kim , Jez Humble , "The Devops Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations", 1st Edition, IT revolution Press, 2021.

2 Yevgeniy Brikman," Fundamentals of DevOps and Software Delivery", 1st Edition, O'Reilly Media, 2025.

REFERENCES:

1 Stefano Demiliani, Nemanja Jovic, Amit Malik, "Azure DevOps Explained", 2nd Edition, Packt Publishing, 2025.

2 Gaurav Agarwal," Modern DevOps Practices", 2nd Edition, Packt Publishing, 2024.

3 Sujeevan Vijayakumaran, "DevOps Frameworks, Techniques, and Tools", 1st Edition, SAP PRESS , 2025

ONLINE RESOURCES:

1 https://www.jenkins.io/user-handbook.pdf

2 https://maven.apache.org/guides/getting-started/

3 http://digimat.in/nptel/courses/video/106104182/L01.html

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 : Comprehend about different kinds of cloud environment.

CO2 Apply maven and gradle tools for building and compiling projects.

CO3 Apply Jenkins for Automated Continuous Deployment

CO4 Apply Ansible for configuration management

CO5 Create Pipelines in Devops using Azure

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	-	-	2	2	2	-	1
CO2	3	2	1	2	3	-	-	2	2	2	-	-
CO3	3	2	1	2	3	-	-	2	2	2	-	-
CO4	3	2	1	2	3	-	-	2	2	2	-	-
CO5	3	3	3	3	3	-	-	2	2	2	-	-

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U23MDCS06 **UI AND UX DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design

UNIT I **FOUNDATIONS OF DESIGN** **9**

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II **FOUNDATIONS OF UI DESIGN** **9**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviours and Principles – Branding - Style Guides

UNIT III **FOUNDATIONS OF UX DESIGN** **9**

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV **WIREFRAMING, PROTOTYPING AND TESTING** **9**

Sketching Principles - Sketching Red Routes - Responsive Design – Wire framing - Creating Wire flows - Building a Prototype - Building High-Fidelity Mock-up's - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V **RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE** **9**

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Joel Marsh, "UX for Beginners", 1st Edition, O'Reilly Media, 2022.

2 Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services", 1st Edition, O'Reilly Media, 2021.

REFERENCES:

1 Steve Schoger, Adam Wathan, "Refactoring UI", 2nd Edition, Pearson Education, 2022.

2 David Travis, Philip Hodgson, "Think Like a UX Researcher", 1st Edition, CRC Press, 2019.

3 Aditi, "Ultimate Figma for UI/UX Design", 2nd Edition, Orange Education Pvt Ltd, 2025.

ONLINE RESOURCES:

1 https://enine.digimat.in/nptel/courses/video/124107008/L08.html

2 https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ar02

3 https://www.youtube.com/watch?v=GDcOKMTxAq4

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COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe UI for user Applications

CO2 Summarize the UI design of any product or application

CO3 Describe UX Skills in product development

CO4 Comprehend Sketching principles and build prototype

CO5 Describe the various Research Methods used in Design

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	1	-	-	-	1
CO3	2	2	1	1	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-	1	-	-	-	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1

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