E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

NAGAPATTINAM – 611002

(Affiliated to Anna University, Chennai | Accredited by NAAC with 'A++' Grade |Accredited by NBA T1(B.E. – CSE, CIVIL, ECE, EEE, MECH& B.Tech – IT) | Approved by AICTE, New Delhi)

B.E. – COMPUTER SCIENCE AND ENGINEERING R- 2023

THIRD YEAR

CURRICULUM AND SYLLABUS FOR FIFTH SEMESTER

SEMESTER V									
Course Code	Course Name	Category	L	T	P	C	MAX. MARKS		
							CA	ES	TOTAL
THEORY COURSES									
2302CS501	Object Oriented Software Engineering	PCC	3	0	0	3	40	60	100
2302CS502	Cloud Computing	PCC	3	0	0	3	40	60	100
2302CS503	Web Technology	PCC	3	0	2	4	50	50	100
2302CS504	Foundations of Data Science	PCC	3	0	0	3	40	60	100
	Elective I	PEC	3	0	0	3	40	60	100
	Open Elective I	OEC	3	0	0	3	40	60	100
LABORATORY COURSES									
2302CS551	Cloud Computing Laboratory	PCC	0	0	2	1	60	40	100
2304CS552	Case Tools Laboratory (Mini Project I)	EEC	0	0	2	1	50	50	100
2304GE501	Professional Development Course III	EEC	0	0	2	1	100	--	100
2301LS501	Life skill course 5#	LS	0	0	0	0	0	--	--
Total			**18**	**0**	**8**	**22**	**460**	**440**	**900**

L-Lecture |T –Tutorial |P- Practical |CA – Continuous Assessment |ES – End Semester

2302CS501 OBJECT ORIENTED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITES:

Object Oriented Analysis and Design and Software Engineering

COURSE OBJECTIVES:

1. To understand Software Engineering Lifecycle Models
2. To Perform software requirements analysis
3. To gain knowledge of the System Analysis and Design concepts using UML.
4. To understand software testing and maintenance approaches
5. To work on project management scheduling using DevOps

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Compare various software development life cycle models.
CO2: Evaluate project management approaches as well as cost estimation strategies.
CO3: Perform formal analysis on the evaluation of software design and performance.
CO4: Acquire the knowledge about the usage of an UML diagrams on testing.
CO5: Design and architect using architectural design and testing patterns.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1		-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	2	2	3	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	2	1	-	-	-	-	-	-	2	-

COURSE CONTENTS:

MODULE I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9 Hours

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models - Software Life Cycle Models Software Process Introduction - S/W Engineering Paradigm - life cycle models: waterfall, incremental, spiral, win-win spiral models - Introduction to Agility-Agile process- Extreme programming-XP Process-Case Study.

MODULE II REQUIREMENTS ANALYSIS AND SPECIFICATION 9 Hours

Requirement specification - Requirements gathering and analysis - Requirements Software Requirements: Functional & non-functional - user-system requirement engineering process - feasibility studies - elicitation - validation & management - software prototyping - S/W documentation - Analysis and modelling - Software Requirement Specification - Formal system specification - Finite State Machines - PETRINETS - Object modelling using UML - Use case Model - Class diagrams - Interaction diagrams - Activity diagrams - State chart diagrams - Functional modelling - Data Flow Diagram- CASE TOOLS.

MODULE III SOFTWARE DESIGN 9 Hours

Software design - Design process - Design concepts - Coupling - Cohesion - Functional independence - Design patterns - Model-view-controller - Publish-subscribe - Adapter - Command - Strategy - Observer - Proxy - Facade - Architectural styles - Layered - Client Server - Tiered Pipe and filter- User interface design-Case Study.

MODULE IV SOFTWARE TESTING AND MAINTENANCE 9 Hours

Testing - Unit testing - Black box testing- White box testing - Integration and System testing- Regression testing - Debugging - Program analysis - Symbolic execution - Model Checking- Traceability matrix. Case Study.

MODULE V PROJECT MANAGEMENT, COST ESTIMATION AND SCHEDULING 9 Hours

Software Project Management- Software cost estimation - Function point models - COCOMO model - Project Scheduling-Delphi method - Software challenges - Software Maintenance-Reliability - Reliability and availability models - Software Configuration Management - Project Scheduling- DevOps: Motivation- Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture Building and Testing- Deployment- Tools- Case Study

TOTAL : 45 HOURS

TEXT BOOKS :

1. Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, Reprint, 2020.
2. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, Reprint, 2019.

REFERENCES:

1. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, Second edition, PHI Learning Pvt. Ltd., 2010.
2. Craig Larman, Applying UML and Patterns, Thirded, Pearson Education, 2018.
3. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", Pearson Education, 2016
4. Rajib Mall, Fundamentals of Software Engineering, Third edition, PHI Learning Pvt. Ltd., 2019.
5. Stephen Schach, Object-Oriented and Classical Software Engineering, Eight ed, McGraw-Hill, 2019.

2302CS502 **CLOUD COMPUTING** **L T P C**
3 0 0 3

PREREQUISITES:

Computer Networks and Computer Architecture

COURSE OBJECTIVES:

1. To familiarize with the state of the art in cloud computing.
2. To impart knowledge on the architecture, infrastructure and delivery models of cloud computing.
3. To provide the main concepts, key technologies, strengths and limitations of cloud computing.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Make use of cloud service and deployment models while developing cloud environments.
CO2: Apply suitable virtualization concept for implementing the cloud services.
CO3: Establish cloud datacentre by incorporating appropriate cloud architecture and resource management techniques.
CO4: Practice development environments for service deployment
CO5: Use cloud infrastructure mechanism while developing cloud environments

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	3	3	-	-	-	-	-	3	-	3
CO3	3	3	3	3	3	-	-	-	-	-	3	-	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3
CO5	3	3	3	2	3	-	-	-	-	-	3	-	3

COURSE CONTENTS:

MODULE I INTRODUCTION TO CLOUD COMPUTING **9 Hours**

Defining Cloud Computing -Characteristic Of Computing- Assessing The Role Of Open Standards - Cloud Service Models - Cloud Deployment Models - Role Of Virtualization In Enabling The Cloud - Benefits And Challenges Of Cloud Computing.

MODULE II VIRTUALIZATION **9 Hours**

Data Center Technology - Virtualization - Characteristics Of Virtualized Environments - Taxonomy Of Virtualization Techniques - Compute Virtualization - Implementation Levels Of Virtualization - Tools And Mechanisms: Xen, VMware.

MODULE III CLOUD INFRASTRUCTURE **9 Hours**

Architectural Design: A Generic Cloud Architecture Design- Layered Cloud Architecture Development- Virtualization Support And Disaster Recovery- Inter Cloud Resource Management: Extended Cloud Computing Services- Resource Provisioning And Platform Deployment.

MODULE IV CLOUD APPLICATION ARCHITECTURES **9 Hours**

Development Environments For Service Deployment - Amazon AWS - Google App Engine- And Microsoft Azure - Cloud Software Environments: Eucalyptus, Nimbus, Open Nebula.

MODULE V CLOUD INFRASTRUCTURE MECHANISM **9 Hours**

Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – SpecializedCloud Mechanism: Load Balancer, Sla Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database.

TOTAL: 45 HOURS

TEXT BOOKS :

1. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad, Second Edition 2024.
2. Toby Velte, Anthony Velte, Robert C. Elsenpeter, “Cloud Computing, A Practical Approach”,Tata McGraw-Hill Edition, Reprint, 2019.

REFERENCES:

1. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi Second Edition 2024.
2. Cloud Computing by shailendra singh, Oxford HED 2018.
3. Cloud Computing: Concepts and Technologies by Sunil Kumar, Gopal Krishna, CRC Press 2021.
4. https://nptel.ac.in/courses/

2302CS503 **WEB TECHNOLOGY**

L	T	P	C
3	0	2	4

PREREQUISITES:

Fundamental of C and Java Programming

COURSE OBJECTIVES:

1. To understand different Internet Technologies
2. To learn java-specific web services architecture
3. To Develop web applications using frameworks

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Construct a basic website using HTML and Cascading Style Sheets.
CO2: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3: Develop server side programs using Servlets and JSP.
CO4: Construct simple web pages in PHP and to represent data in XML format.
CO5: Develop interactive web applications.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	3	3	-	-	-	1	3	3	3	2
CO2	2	2	2	1	2	-	-	-	2	2	1	2	2
CO3	1	1	3	2	3	-	-	-	1	2	1	1	2
CO4	2	3	3	1	2	-	-	-	3	1	2	2	2
CO5	1	2	3	2	2	-	-	-	2	1	3	1	1

COURSE CONTENTS:

MODULE I BASICS OF WEB PAGES (HTML,CSS) 9 Hours

Web Essentials: Clients, Servers and Communication-The Internet-World wide web-HTTP Request Message-HTTP Response Message-Web Clients-Web Servers-HTML5-Tables-Lists - Image - HTML5 control elements - Drag and Drop - Audio - Video controls - CSS3 - Inline, embedded and external style sheets-Rule cascading-Inheritance-Backgrounds-Border Images-Colors-Shadows-Text-Transformations-Transitions-Animations-Bootstrap Framework.

MODULE II CLIENT SIDE PROGRAMMING 9 Hours

Java Script: An introduction to JavaScript-JavaScript DOM Model-Exception Handling-Validation-Built-in objects-Event Handling-DHTML with JavaScript-JSON introduction-Syntax-Function Files.

MODULE III SERVER SIDE PROGRAMMING 9 Hours

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.

MODULE IV PHP and XML 9 Hours

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL.

MODULE V INTRODUCTION TO ANGULAR AND WEB APPLICATIONS FRAMEWORKS 9 Hours

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools - Firebase- Docker- Node JS- React- Django- UI & UX

TOTAL: 45 HOURS

LIST OF EXPERIMENTS:

1. Create a web page with the following using HTML.
   To embed an image map in a web page.
   To fix the hot spots.
   how all the related information when the hot spots are clicked.
2. Create a web page with all types of Cascading style sheets.
3. Client Side Scripts for Validating Web Form Controls using DHTML.
4. Installation of Apache Tomcat web server.

5. Write programs in Java using Servlets:
   a) To invoke servlets from HTML forms.
   b) Session Tracking
6. Write programs in Java to create three-tier applications using JSP and Databases
   a) For conducting on-line examination.
   b) For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7. Programs using XML - Schema - XSLT/XSL

REQUIREMENTS: (A batch of 30 students)

1. Hardware: Standalone desktops 30 Nos. (or) Server supporting 30 terminals or more.
2. Software:Java

TOTAL: 30 HOURS

TEXT BOOKS:

1. Stephen Wynkoop and John Burke “Running a Perfect Website”, QUE, Second Edition, Reprint, 2021
2. Chris Bates, Web Programming - Building Intranet Applications, Third Edition, Wiley Publications, 2019.

REFERENCES:

1. Gopalan N.P. and Akilandeswari J., “Web Technology”, Prentice Hall of India, Reprint, 2019
2. UttamK.Roy, “Web Technologies”, Oxford University Press, Reprint, 2019
3. Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, First edition, O′Reilly

2302CS504 FOUNDATIONS OF DATA SCIENCE

L	T	P	C
3	0	0	3

PREREQUISITES:

Data structures, Algorithms, Database Management Systems

COURSE OBJECTIVES:

1. Programming data science concepts and cloud computing.
2. Analyze Basic tools of EDA, Data science process with case studies and Differential algorithms.
3. Optimize & solve real life problems with different Data visualization techniques.
4. Explore Feature Generation and Feature Selection of Data Science

COURSE OUTCOMES :

Upon successful completion of this course, students will be able to:

CO1: Define the Data Science Process.
CO2: Understand the different types of date preprocessing techniques.
CO3: Gain knowledge of machine learning algorithms.
CO4: Use the clustering for Data Science Process.
CO5: Apply visualization libraries in Python to interpret and explore data.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	2	-	-	-	-	2	2	2	1	2
CO2	2	2	3	3	2	-	-	-	2	3	3	1	2
CO3	2	2	3	2	1	-	-	-	2	1	1	2	2
CO4	1	2	3	2	-	-	-	-	3	2	3	2	3
CO5	1	1	3	2	1	-	-	-	2	2	2	2	3

COURSE CONTENTS:

MODULE I INTRODUCTION **9 Hours**

Introduction: What is Data Science? Big Data and Data Science - Datafication - Current landscape of perspectives - Skill sets needed; Matrices - Matrices to represent relations between data, and necessary linear algebraic operations on matrices -Approximately representing matrices by decompositions (SVD and PCA) Statistics: Descriptive Statistics: distributions and probability - Statistical Inference: Populations and samples - Statistical modeling - probability distributions - fitting a model - Hypothesis Testing - Intro to R/ Python.

MODULE II DATA PREPROCESSING **9 Hours**

Data preprocessing: Data cleaning - data integration - Data Reduction Data Transformation and Data Discretization. Evaluation of classification methods - Confusion matrix, Students T-tests and ROC curves- Exploratory Data Analysis - Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA - The Data Science Process.

MODULE III BASIC MACHINE LEARNING ALGORITHMS **9 Hours**

Basic Machine Learning Algorithms: Association Rule mining - Linear Regression- Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means -Decision tree - Naive Bayes- Ensemble Methods - Random Forest. Feature Generation and Feature Selection - Feature Selection algorithms - Filters; Wrappers; Decision Trees; Random Forests.

MODULE IV CLUSTERING **9 Hours**

Clustering: Choosing distance metrics - Different clustering approaches - hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN - Relative merits of each method - clustering tendency and quality.

MODULE V DATA VISUALIZATION **9 Hours**

Data Visualization: Basic principles, ideas and tools for data visualization. Steps - Types of Data visualization - Stages of data visualization - text and annotation - customization - three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

TOTAL : 45 HOURS

TEXT BOOKS:

1. Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk From The Frontline", O'Reilly, Reprint, 2019.
2. Jiawei Han, MichelineKamber and Jian Pei, "Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2018.

3. Mohammed J. Zaki and Wagner MieraJr, “Data Mining and Analysis: Fundamental Concepts and Algorithms”, Cambridge University Press, 2016.

REFERENCES:

1. Matt Harrison, “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, O’Reilly, 2018.
2. Joel Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media, 2015.
3. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly Media, 2018.

2302CS551 CLOUD COMPUTING LABORATORY

L	T	P	C
0	0	2	1

PREREQUISITES:

Computer Networks and Computer Architecture

COURSE OBJECTIVES:

1. Be exposed to tools for setting up cloud environment
2. Learn to use virtual machines
3. Be familiar with cloud management applications.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Install and setup private cloud.
CO2: Design and Implement applications on cloud.
CO3: Manage and restore virtual machines from snapshots and clones.
CO4: Perform scaling of resources of virtual machines.
CO5: Administer migration process of virtual machines.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	-	3	-	-	-	-	-	3	-	3
CO2	3	3	3	2	3	-	-	-	-	-	3	-	3
CO3	3	3	3	2	3	-	-	-	-	-	3	-	3
CO4	3	3	3	2	3	-	-	-	-	-	3	-	3
CO5	3	3	3	2	3	-	-	-	-	-	3	-	3

LIST OF EXPERIMENTS:

1. Installation of VMware Workstation to setup a private cloud
2. Installation of operating systems in virtual machines
3. Create virtual machine of different configurations. Check how many virtual machines can be utilized at particular time
4. Attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine
5. Install a C compiler in the virtual machine and execute a sample program
6. Install a storage controller and interact with it.
7. Creation of snapshot of virtual machine and restore the state of virtual machine from snapshot
8. Create a clone from a virtual machine.
9. Installation and configuration of VMware ESXI server
10. Migration of virtual machine from one node to another.

REQUIREMENTS: (A batch of 30 students)

1. Hardware: Networked Desktops i5 with 8GB RAM 65 Nos.
2.Software:VMware Workstation Pro, VMware ESXI Server, ESXI Customizer, Windows OS ISO, Linux OS ISO

TOTAL: 45 HOURS

FURTHER READING

- VMware HoL Lab
- AWS Cloud Documentations

REFERENCES:

1. https://docs.vmware.com/
2. http://coursera.org/
3. http://nptel.ac.in/

2304CS552	CASETOOLSLABORATORY (MINIPROJECTI)	L	T	P	C
		0	0	2	1

PREREQUISITES:

Computer Programming Languages, Object Oriented Programming.

COURSE OBJECTIVES:

1. To capture the requirements specification for an intended software system.
2. To draw the UML diagrams for the given specification.
3. To map the design properly to code.
4. To test the software system thoroughly for all scenarios.
5. To improve the design by applying appropriate design patterns.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Design and implement SRS document for the given requirements.
CO2: Create and draw the UML diagrams for the given specification.
CO3: Test the software system for all scenarios and applying appropriate design patterns.
CO4: Create reports using objects, classes and use-cases.
CO5: Apply front-end and back-end tools for real time projects

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	2	2	-	-	-	-	1	1	2	2
CO2	2	3	2	3	2	-	-	-	2	2	3	3	2
CO3	2	3	2	1	1	-	-	-	2	2	3	2	3
CO4	2	3	2	2	3	-	-	-	2	2	3	2	3
CO5	2	3	1	2	2	-	-	-	-	-	-	3	2

LIST OF EXPERIMENTS:

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the use-case diagram
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
10. Implement the modified system and test it for various scenarios.

Sample list of Mini-Projects

1. e-Business system
2. Student attendance monitoring system
3. Biometric analysis system
4. Transport management system
5. E-Accounting system
6. Passport automation system.
7. Book bank system
8. Exam Registration system
9. Stock maintenance system.
10. Online course reservation system
11. Airline/Railway reservation system
12. Software personnel management system
13. Credit card processing system
14. e-book management system
15. Recruitment system
16. Foreign trading system
17. Conference management system
18. BPO management system

19. Library management system
20. Student Information system

REQUIREMENTS:

1. Hardware: Standalone desktops 30 Nos. (or) Server supporting 30 terminals or more.
2. Software:Front end: Visual Studio or Java or Equivalent
   Back end: Oracle / MySQL/ Sql Server DB2 or Equivalent.

TOTAL : 45 HOURS

REFERENCES:

1. Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, 2009.
2. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014.

2304GE501 PROFESSIONAL DEVELOPMENT COURSE III

L	T	P	C
0	0	2	1

PREREQUISITE:

Basic Mathematics & English Language Skills

COURSE OBJECTIVES:

1. Enhance Self-Awareness
2. Improve Communication Skills
3. Improve Problem-Solving Skills

COURSE OUTCOMES:

At the end of the course, the student should be able to

CO1: Workout concepts of Coding and Decoding, ability to visualize directions and understand the logic behind a sequence.

CO2: Workout family relationships concepts, ability to visualize clocks & calendar and understand the logic behind a Sequence.

CO3: Overcome their fear about interview

CO4: Students will not only learn to understand concepts accurately but also learn the correct application of them.

CO5: Students will know the rules of proper writing structure

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	3	3	3	1	-	-
CO4	-	-	-	-	-	-	-	3	3	3	1	-	-
CO5	-	-	-	-	-	-	-	3	3	3	1	-	-

COURSE CONTENTS:

MODULE I Logical Reasoning **10 Hours**

Coding and Decoding, Direction Sense, Blood Relations, Non Verbal Reasoning (Figures based), Ordering

MODULE II Interview skills Practice **10 Hours**

Self-Introduction - For core company, IT & Non-IT, Resume - Building creative resume, Domain specific resume, Handling interview questions, Group Discussion, Adaptability, Practice session - Peer to Peer mock interview, Mock Group Discussion

MODULE III Comprehension **10 Hours**

Reading for information - Theme Detection - Identification of Mood and Tone - Making Inferences, Translation.

Composition:

Jumbled Sentences, Para Jumbles, Paragraph Writing, Video Synthesis, EMail Drafting, Essay Writing.

TOTAL: 30 HOURS

TEXT BOOKS:

1. Arun Sharma, How to Prepare for Quantitative Aptitude for the CAT‘, Seventh edition, McGraw Hills publication, 2016.
2. R S Agarwal, Quantitative Aptitude for Competitive Examinations‘, revised edition, S.Chand publication, 2017.

REFERENCES:

1. Rajesh Verma, Fast Track Objective Arithmetic‖, Third edition, Arihant publication, 2018.
2. Objective General English by SP Bakshi.
3. A Modern approach to verbal and non verbal reasoning by R.S. Agarwal.
4. Complete reference campus recruitment book.
5. Grammar for IELTS by Hopkins.
6. English Grammar in use by Murphy.

2303CS009 **UI AND UX DESIGN**

L	T	P	C
3	0	0	3

PREREQUISITE:

Design Thinking

COURSE OBJECTIVES:

1. To provide a sound knowledge in UI & UX.
2. To understand the need for UI and UX.
3. To understand the various Research Methods used in Design.
4. To explore the various Tools used in UI & UX.
5. Creating a wireframe and prototype.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Build UI for user Application.
CO2: Evaluate UX design of any product or application.
CO3: Demonstrate UX Skills in product development.
CO4: Implement Sketching principles.
CO5: Create Wireframe and Prototype.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1	3	1	-	-	-	3	3	2	3	3
CO2	2	3	1	3	2	-	-	-	1	2	2	1	2
CO3	1	3	3	2	2	-	-	-	2	3	1	1	3
CO4	1	2	3	3	1	-	-	-	3	2	1	3	3
CO5	1	2	3	2	1	-	-	-	2	1	1	3	2

COURSE CONTENTS:

MODULE I FOUNDATIONS OF DESIGN **9 Hours**

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

MODULE II FOUNDATIONS OF UI DESIGN **9 Hours**

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

MODULE III FOUNDATIONS OF UX DESIGN **9 Hours**

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

MODULE IV WIRE FRAMING, PROTOTYPING AND TESTING **9 Hours**

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods- Synthesizing Test Findings - Prototype Iteration

MODULE V RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE **9 Hours**

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 HOURS

TEXT BOOKS:

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022.
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021.

REFERENCES:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature

2303CS012 **DEVOPS**

L	T	P	C
3	0	0	3

PREREQUISITES:

Programming Languages, Networking

COURSE OBJECTIVES:

1. To introduce DevOps terminology, definition & concepts.
2. To understand the different Version control tools like Git, Mercurial
3. To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4. To understand Configuration management using Ansible
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Understand different actions performed through Version control tools like Git.
CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3: Ability to Perform Automated Continuous Deployment.
CO4: Ability to do configuration management using Ansible.
CO5: Understand to leverage Cloud-based DevOps tools using Azure DevOps.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	-	-	-	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	2	2

COURSE CONTENTS:

MODULE I INTRODUCTION TO DEVOPS **9 Hours**

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

MODULE II COMPILE AND BUILD USING MAVEN & GRADLE **9 Hours**

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

MODULE III CONTINUOUS INTEGRATION USING JENKINS **9 Hours**

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.

MODULE IV CONFIGURATION MANAGEMENT USING ANSIBLE **9 Hours**

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

MODULE V BUILDING DEVOPS PIPELINES USING AZURE **9 Hours**

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

TOTAL : 45 HOURS

TEXT BOOKS:

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, Reprint 2019.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”,Kindle Edition, Reprint, 2018.

REFERENCES:

1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for... DevOps and Microsoft Azure (English Edition) Paperback–1 January 2020, by Mitesh Soni
2. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2018.
3. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2017.
4. Mariot Tsitoara, “Ansible Beginning Git and Git Hub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
5. https://www.jenkins.io/user-handbook.pdf
6. https://maven.apache.org/guides/getting-started/

2303CS015 INFORMATION STORAGE AND MANAGEMENT

L	T	P	C
3	0	3	3

PREREQUISITE:

Computer Networks and Computer Architecture

COURSE OBJECTIVES:

1. To provide information in growth , challenges, storage system , environment and the evolution of storage technology
2. To familiarize with the various storage options and protocols.
3. To impart the knowledge about business continuity, backup and recovery, and data replication.
4. To provide the details of storage security and storage infrastructure monitoring and management.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain data types with its architecture and infrastructure
CO2: Make use of various storage components and RAID levels in storage system
CO3: Group different network storage technologies
CO4: Employ appropriate backup and replication technologies for business continuity.
CO5: Apply various security and management technologies in data center

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	3	-	2
CO2	3	3	3	3	2	-	-	-	-	-	3	-	2
CO3	3	3	3	3	2	-	-	-	-	-	3	-	2
CO4	3	3	3	3	3	-	-	-	-	-	3	-	2
CO5	3	3	3	2	3	-	-	-	-	-	3	-	2

COURSE CONTENTS:

MODULE I INTRODUCTION TO STORAGE TECHNOLOGY 9 Hours

Introduction to information storage – Data - Types of Data - Evolution of Storage Technology and Architecture - Data Center Infrastructure: Core Elements, Managing Storage Infrastructure, Requirements for Data Center Elements - Key Challenges - Information Lifecycle : Information Lifecycle Management, Implementation, Benefits.

MODULE II STORAGE SYSTEMS ENVIRONMENT 9 Hours

Components of a Storage System Environment – Drive Components – Performance - Logical Components - Application Requirements and Disk Performance – Data Protection: Implementation of RAID – Components – Levels - Impact on Disk Performance.

MODULE III INTRODUCTION TO NETWORKED STORAGE 9 Hours

Types of DAS - Disk Drive Interfaces - Evolution of SCSI - The FC-SAN and Its Evolution – Components - FC Topologies - Network-Attached Storage: NAS File I/O – Components - NAS I/O Operations - IP SAN: Components of iSCSI - Topologies for iSCSI Connectivity - FCIP Topology.

MODULE IV BUSINESS CONTINUITY 9 Hours

Introduction - Information Availability – Terminology - Planning Lifecycle - Impact Analysis – Solutions - Backup and Recovery: Backup Purpose - Backup Considerations - Recovery Considerations - Backup Methods - Backup Technologies – Replication: Uses of Local Replicas - Local Replication Technologies - Remote Replication Technologies.

MODULE V STORAGE SECURITY AND MANAGEMENT 9 Hours

Securing the Storage Infrastructure: Framework - Risk Triad – Domains - Security Implementations in Storage Networking - Managing the Storage Infrastructure: Monitoring the Storage Infrastructure - Storage Management Activities.

TOTAL: 45 HOURS

TEXT BOOK :

1. Wiley ,"Information Storage and Management", EMC Corporation, India, 2019.
2. Gerardus Blokdyk "Storage and Data Management: The Ultimate Step-By-Step Guide", 5STARCooks, 2021.

REFERENCES:

1. Marc Farley, "Building Storage Networks", Tata McGraw Hill ,Osborne, 2019.
2. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2019.
3. www.emc.com/resource-library/resource-library.esp
4. https://nptel.ac.in/courses/

2303CS037 PRINCIPLES OF COMPUTER NETWORKS

L	T	P	C
3	0	0	3

PREREQUISITES:

Basic knowledge of computer science, programming, ComputerOrganization and Architecture

COURSEOBJECTIVES:

1. To provide a foundational understanding of computer networks and their components
2. To develop an understanding of the physical and data link layers
3. To learn about IP addressing, subnetting, NAT, and key network layer protocols
4. To study transport layer protocols, focusing on error control and congestion management
5. To identify the need of routing and its protocols

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Explain the fundamental principles of data communication, network models and protocols.
CO2: Describe the working of the physical and data link layers and error detection, correction techniques.
CO3: Perform sub-netting, configure network addressing using IPv4 and IPv6 and address modes.
CO4: Analyze and implement transport layer protocols and congestion control techniques and Internet directory services and how they support network applications layer protocols.
CO5: Analyze routing algorithms.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	3	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	1	-	-	-	-	-	-	2	-
CO5	3	2	2	-	1	-	-	-	-	-	-	2	-

COURSE CONTENTS:

MODULEI FUNDAMENTALS OF COMPUTER NETWORKS 8 Hours

Data Communication System: Components, Data Flow, Types of Connection,Topologies, Networking Devices, CategoriesofNetworks, Network Protocols and Standards,Network Models: OSI Models, TCP/IP Protocol Suite, Addressing.

MODULE II NETWORK ACCESS LAYER 10 Hours

Physical Layer: Transmission Medium, Multiplexing-Switching, Data Link Layer: Error Detection & Correction, Checksum, Forward Error Correction, DLC services: HDLC, Data Link Layer Protocols, Media Access Control: CSMA,CSMA/CD,CSMA/CA, Ethernet(IEEE 802.3),Wi-Fi(IEEE 802.11).

MODULE III NETWORKLAYER 8 Hours

Inter Network Communication: NAT , Subnetting, Logical Addressing-IP Addressing ,IPV4 Addresses, Network Layer, Protocols: IP, ICMP,ARP,DHCP , Addressing Mode, Multicast, Next Generation IP: IPv6 Addressing and Protocol.

MODULE IV TRANSPORT LAYER and APPLICATION LAYER 10 Hours

Introduction to Transport Layer: Simple Protocol, Stop-and-Wait Protocol, Reliable/Unreliable Transmission TCP, UDP, Stream Control Transmission Protocol: Congestion Control, Quality of Service. Applications Layer: Domain name System (DNS), Web Service: HTTP, E-Mail: (SMTP, POP3, IMAP), SNMP, Directory Service

MODULE V ROUTING 9 Hours

Routing and protocols: Unicast routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path vector routing, BGP, Multicast Routing: DVMRP - PIM

TOTAL : 45 HOURS

TEXT BOOKS :

1. Andrew S. Tanenbaum and David J. Wetherall “Computer Networks”, Fifth Edition, Reprint, 2019s
2. James F.Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Pearson Education, 2019
3. Larry L. Peterson and Bruce S. Davie "Computer Networks: A Systems Approach”,2024

REFERENCES:

1. William Stallings,"Data and Computer Communications”,Eighth Edition,2016
2. Behrouz A. Forouzan, Data Communication and Networking, Fifth Edition, McGraw Hill Education (India) Private Limited, 2019.
3. https://archive.nptel.ac.in/courses/106/105/106105183

2303CS038 FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

L	T	P	C
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PREREQUISITES:

Data structures and algorithms, problem solving and analytical thinking.

COURSE OBJECTIVES:

1. Understand the fundamentals of Artificial Intelligence.
2. Explore various AI techniques for problem-solving and decision-making.
3. Develop skills to implement AI models for real-world problems.
4. Learn ethical considerations and challenges in AI applications.
5. To understand the different models of reasoning and decision making.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: To know the basics of artificial intelligence and machine learning algorithms.
CO2: To learn how to solve the problem with various problem-solving techniques and search strategies.
CO3: To be familiar with knowledge representation and decision-making.
CO4: Understand the ethics in utilizing AI techniques.
CO5: Develop skills to implement AI models for real-world problems.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	2	-	-	-	-	2	2	2	1	2
CO2	2	2	3	3	2	-	-	-	2	3	3	1	2
CO3	2	2	3	2	1	-	-	-	2	1	1	2	2
CO4	1	2	3	2	-	-	-	-	3	2	3	2	3
CO5	1	1	3	2	1	-	-	-	2	2	2	2	3

COURSE CONTENTS:

MODULE I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9 Hours

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

MODULE II PROBLEM SOLVING AND SEARCH STRATEGIES 9 Hours

Problem solving: Problem Formulation- State Space, Goal State, Actions- Problem solving in AI- Characteristics of AI problems- Search strategies: Uninformed Search Strategies- Breadth-First Search (BFS)- Depth-First Search (DFS)- Uniform Cost Search- Informed Search Strategies- Heuristic Search, A* Algorithm, Greedy Search- Minimax Algorithm- Alpha-Beta Pruning.

MODULE III KNOWLEDGE REPRESENTATION AND REASONING 9 Hours

Logic-Based Representation- Propositional and Predicate Logic- Resolution and Unification- Ontologies and Semantic Networks- Frames and Scripts- Reasoning Techniques-Forward and Backward Chaining- Probabilistic Reasoning: Bayesian Networks.

MODULE IV AI AGENTS AND ETHICS 9 Hours

Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining - Argumentation among Agents - Trust and Reputation in Multi- Agent systems. The Ethics of AI - Lethal autonomous weapons, Surveillance, Security and privacy, Fairness and bias, Trust and transparency, Robot rights, AI Safety.

MODULE V ADVANCED AI AND APPLICATIONS 9 Hours

Artificial Superintelligence- Generative AI vs Predictive AI- Generative AI Applications-Predictive Analytics- Reactive Machines- Robotics, Natural Language Processing (NLP), Natural Language Understanding, Vision, Healthcare, Finance, Gaming, Speech Recognition and Home Security.

TOTAL : 45 HOURS

TEXT BOOKS :

1. StuartRussellandPeterNorvig,"ArtificialIntelligence–AModernApproach",Fourth Edition,PearsonEducation,2021.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Reprint, 2019.
3. Pattern Recognition and Machine Learning by Christopher M. Bishop

REFERENCES:

1. David Poole, Alan Mackworth, Randy Goebel," Computational Intelligence: a logical approach", Oxford University Press.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.
4. edX: AI for Everyone by Andrew Ng
5. Coursera: AI and ML specializations

2303CS041 COMPUTER VISION FOR ENGINEERS

L	T	P	C
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PREREQUISITES:

Computer Programming Languages, Linear Algebra, Vector Calculus, Data structures

COURSE OBJECTIVES:

1. To understand the fundamental concepts related to Image formation, transformation and processing.
2. To understand the concepts of image segmentation and enhancements.
3. To become familiar with motion estimation and image recognition.
4. To develop skills on 3D reconstruction.
5. To gain hands-on experience on image recognition with computer vision applications.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1: Understand the basic principles of image processing and its significance in real world.
CO2: Implement various approaches for image enhancements, segmentation and restoration.
CO3: Analyze images and videos for problems such as tracking and structure from motion.
CO4: Apply 3D image reconstruction techniques.
CO5: Apply computer vision techniques to real-world problems.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	2	3	1	2
CO2	2	2	2	3	-	-	-	-	-	2	2	1	2
CO3	2	2	2	3	3	-	-	-	2	1	3	2	2
CO4	2	2	2	3	3	-	-	-	2	2	3	2	2
CO5	1	1	3	3	2	-	-	-	1	2	2	2	3

COURSE CONTENTS:

MODULE I IMAGE FORMATION AND TRANSFORMS 9 Hours

Image Formation: Image Processing Fundamentals - Image Models - Image Acquisition - Sampling and Quantization - Relationship between pixels - Digital Image Processing Systems.

Image Transforms: Fourier Transform - Extension to 2D - Properties of Fourier transformations - Convolution and Linear Filtering.

MODULE II IMAGE ENHANCEMENTS AND FEATURE BASED ALIGNMENT 9 Hours

Image Enhancements: Histogram Equalization - Image Smoothing - Image Sharpening - Edge Detection - Segmentation: Active Contours - Split and Merge - Mean Shift - Mode Finding - Normalized Cuts.

Feature Based Alignment: 2D and 3D Feature Based Alignment - Pose Estimation.

MODULE III MOTION ANALYSIS 9 Hours

Structure from Motion: Triangulation - Two-Frame Structure from Motion - Factorization - Bundle Adjustment - Constrained Structure and Motion.

Dense Motion Estimation: Translational Alignment - Parametric Motion - Spline-Based Motion - Optical Flow - Layered Motion.

MODULE IV 3D RECONSTRUCTION 9 Hours

3D Reconstruction: Stereo Vision -Shape from Shading - Shape from Texture - Shape from Focus- Projection Schemes - Active Range Finding - Surface Representations: Point-Based Representations - Volumetric Representations - Mesh-Based Representations - Model-Based Reconstruction: CAD-Based Reconstruction - Template-Based Reconstruction.

MODULE V RECOGNITION 9 Hours

Recognition: Object Detection - Face Recognition - Instance Recognition - Category Recognition - Context and Scene Understanding - Computer Vision Applications.

TOTAL : 45 HOURS

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. R. C. Gonzalez and R. E. Woods "Digital Image Processing", Fourth Edition, Pearson Education, 2018.

REFERENCES:

1. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Second Edition, Pearson Education, 2019.
2. E. R. Davies: Computer and Machine Vision - Theory, Algorithms and Practicalities, Elsevier (Academic Press), Fourth edition, 2018.
3. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2019.
4. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2017..
5. https://onlinecourses.nptel.ac.in/noc19_cs58/preview