BTech CSD detailed syllabus for Semester V to VIII

SEMESTER V						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
ESC-CS 501	Artificial Intelligence	3	0	2	5	4
ESC-CS 502	Operating System	3	0	2	5	4
ESC-CS 503	Animation Design Principles	3	0	2	5	4
ESC-CS 504	Machine Learning	2	0	2	5	4
PCC-CS-501	Engineering Design & Innovation-III	0	0	4	4	2
PCC-CS-502	Design & Thinking	0	2	0	2	2
PEC-CS 501	Skill Enhancement Course-III	2	0	0	2	2
	Total	**13**	**2**	**12**	**28**	**22**

SEMESTER VI						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
ESC-CS 601	Cloud Computing	3	0	2	5	4
ESC-CS 602	Multimedia Techniques & Tools	3	0	2	5	4
ESC-CS 603	Complexity and Algorithms	3	0	2	5	4
ESC-CS 604	Software Design and Methodologies	2	0	2	5	4
PCC-CS-601	Engineering Design & Innovation-IV	0	0	4	4	2
PCC-CS-602	Design Thinking	0	2	0	2	2
PEC-CS 601	Skill Enhancement Course-IV	2	0	0	2	2
	Total	**13**	**2**	**12**	**28**	**22**
Skill Enhancement Course-III-Language-I: (Foreign Language (French / German / Japanese) / Hindi / Marathi) Skill Enhancement Course-IV-Language-II: (Foreign Language (French / German / Japanese) / Hindi / Marathi)						

SEMESTER VII						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
PEC-CS 701	Skill Enhancement Course-V	2	0	0	2	2
PCC-AI 702	Project- I/ Internship	0	0	28	28	14
	Total	**2**	**0**	**28**	**30**	**16**
Skill Enhancement Course-V: Graphics Design UI/UX/Computer Vision/Computer Game Design/Application Development Augmented using Reality & Virtual Reality/ Computer Game Design						

SEMESTER VIII						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
PEC-CS 801	Skill Enhancement Course-VI	2	0	28	2	2
PCC-AI 802	Project- II/ Internship	0	0	28	28	14
	Total	**2**	**0**	**28**	**30**	**16**
Skill Enhancement Course-VI: R programming / tableau / PowerBI / SAS / Google Analytics						
TOTAL CREDITS - 168						

SEMESTER V						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
ESC-CS 501	Artificial Intelligence	3	0	2	5	4
ESC-CS 502	Operating System	3	0	2	5	4
ESC-CS 503	Animation Design Principles	3	0	2	5	4
ESC-CS 504	Machine Learning	2	0	2	5	4
PCC-CS-501	Engineering Design & Innovation-III	0	0	4	4	2
PCC-CS-502	Design & Thinking	0	2	0	2	2
PEC-CS 501	Skill Enhancement Course-III	2	0	0	2	2
	Total	**13**	**2**	**12**	**28**	**22**

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

ESC-CS 501: Artificial Intelligence

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	**4**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Students need to have basic knowledge of probability, Propositional Logic & python programming.

Companion Course, if any:

Course Objectives:

- To impart artificial intelligence principles, techniques and its history.
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
- To develop intelligent systems by assembling solutions to concrete computational problems.

Course Outcomes:

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

CO1: Evaluate Artificial Intelligence (AI) methods and describe their foundations.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.

CO3: Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.

CO4: Analyze and illustrate how search algorithms and planning play a vital role in problem solving.

CO5: Discuss current scope and limitations of AI and societal implications.

CO6: Illustrate and implement the construction of basic AI models and expert systems.

Course Contents

Unit I	**Introduction, Overview of Artificial intelligence**	**(06 Hours)**

Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents.

#Exemplar/Case Studies	Autonomous Vehicle Routing with Utility-Based Agents
Mapping of Course Outcomes for Unit I	CO1

Unit II	**Problem Solving & search techniques**	**(08 Hours)**

Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs. Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search.

#Exemplar/Case Studies	Pathfinding in video games using A* search
Mapping of Course Outcomes for Unit II	CO2, CO3

Unit III	Constraint satisfaction problems	(06 Hours)
Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.		
#Exemplar/Case Studies	Developing an efficient AI for playing chess requires evaluating a vast number of possible move sequences	
Mapping of Course Outcomes for Unit III	CO3, CO4	
Unit IV	**Knowledge and Reasoning**	**(08 Hours)**
Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching, control knowledge.		
#Exemplar/Case Studies	Use of AI to enhance the decision-making process in healthcare for improving efficiency, and contributes to better patient outcomes	
Mapping of Course Outcomes for Unit IV	CO2	
Unit V	**Probabilistic Reasoning**	**(06 Hours)**
Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.		
#Exemplar/Case Studies	To construct a model showing the relationships between the disease, symptoms, test results, and risk factors using Bayesian network.	
Mapping of Course Outcomes for Unit V	CO3, CO5	
Unit VI	**Expert Systems and Contemporary Issues**	**(06 Hours)**
Representing and using domain knowledge, expert system shells, and knowledge acquisition. Recent trends in Artificial Intelligence.		
#Exemplar/Case Studies	DENDRAL - An Expert System for Chemical Analysis, MYCIN	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. Russell, S. and Norvig, P. —Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall., 2015.
2. Poole, D. and Mackworth, A. —Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
3. Elaine Rich, Kevin Knight —Artificial Intelligence, Mc-Graw Hill.
4. Dan W. Patterson —Introduction to AI & Expert System, PHI.

Reference Books:

1. Ric, E., Knight, K and Shankar, B. —Artificial Intelligence, 3rd edition, Tata McGraw Hill. 2009.
2. Luger, G.F. —Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson, 2008

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	1	2	-	-	-	-	-	-	-	-
CO4	3	2	1	3	-	-	-	-	-	-	-	-
CO5	1	1	3	2	1	-	-	-	-	-	-	-
CO6	1	1	2	3	2	-	-	-	-	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

Lab Name: Artificial Intelligence Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: ESC-CS 501: Artificial Intelligence

Course Objectives:

- To impart artificial intelligence principles, techniques and its history.
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
- To develop intelligent systems by assembling solutions to concrete computational problems.

Course Outcomes:

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

CO1: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.

CO2: Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.

CO3: Analyze and illustrate how search algorithms and planning play vital role in problem solving.

CO4: Development of different AI based models.

Guidelines for Instructor's Manual

The instructor's manual should be created as a comprehensive guide and practical tool. It should encompass an introduction (detailing information about the University, program, institute, department, foreword, and preface), the course curriculum, guidelines for conducting classes and assessments, topics covered, concepts, objectives, outcomes, a selection of typical applications/assignments/guidelines, and reference materials..

Guidelines for Student's Laboratory Journal

Students are required to submit their laboratory assignments in the form of a journal. This journal should include a certificate, a table of contents, and a handwritten write-up for each assignment. The write-up should cover the assignment title, completion date, objectives, problem statement, software and hardware requirements, assessment grades/marks with the assessor's signature, a brief overview of the theory/concepts, algorithm, flowchart, test cases, test data set (if applicable), mathematical models (if applicable), and conclusion/analysis. Additionally, softcopies of program codes along with sample outputs for all assignments must be submitted. In an effort to promote environmental consciousness and contribute to Green IT, please refrain from attaching printed papers to the journal. Instead, it is encouraged to utilize a DVD containing students' programs, which will be maintained by the Laboratory In-charge. For reference purposes, one or two journals with program prints may be retained in the Laboratory.

Guidelines for Laboratory /Internal Assessment

The Continuous Assessment of laboratory work should consider a student's overall performance on laboratory assignments. Each assessment of laboratory assignments will allocate grades/marks based on various criteria, including adherence to deadlines, performance, creativity, effective coding, and punctuality.

Guidelines for Practical Examination

The formulation of problem statements should be a collaborative effort between the internal and external examiners. In practical assessments, utmost importance should be placed on successfully executing the problem statement. Evaluation may include relevant questions to gauge students' grasp of fundamental concepts and their ability to implement solutions effectively and efficiently. This approach promotes transparent evaluation and fairness, thereby alleviating any uncertainty or doubt among students. Adhering to these principles will solidify our collective efforts for a promising beginning to students' academic journey.

Guidelines for Laboratory Conduction

The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.

Operating System recommended: - Windows

Programming tools recommended: - Python

Virtual Laboratory:

Part I : Artificial Intelligence Lab

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	Study & list tuple, set, dictionary, classes, inheritance in Python.
2.	Study and understand simple reflex and Model Based Agent.
3.	Implement basic searching algorithm for given AI problem
4.	Write a program to solve 8 Queens' problem.
5.	Implement memory bounded A* & A* algorithm for given problem.
6.	Implement Alpha Beta Tree search.
7.	Implement classical planning algorithm.
8.	Solve Robot Obstacle/transversal problem means end analysis.

	Group B (Mini Project) Select any one problem statement
1.	Solving Missionaries and cannibals problems.
2.	Water Jug Problem.
3.	Monkeys and Bananas Problem using Logic.
4.	Bayesian Classification Problem.
5.	Developing a sentiment analysis system.
6.	Solving Wampus Problem using Logic
7.	Development of Medical Expert system with Recommendation system.
8.	Travelling Salesman Problem.

@The CO-PO Mapping Matrix

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

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	**4**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Programming Languages.
- Data Structures and Algorithms.

Companion Course, if any: System Software

Course Objectives:

- To explain main components of OS and their working.
- To familiarize the operations performed by OS as a resource Manager.
- To impart various scheduling policies of OS.
- To teach the different memory management techniques.

Course Outcomes:

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

CO1: Outline the basic concept of operating systems
CO2: Analyze the working of operating system
CO3: Examine the working of various scheduling/allocation approaches
CO4: Measure the performance of various scheduling/allocation approaches
CO5: Implement algorithm of CPU Scheduling, Memory Scheduling and disk scheduling.
CO6: Compare various operating systems with respect to characteristics and features.

Course Contents

Unit I	Basics of operating systems	(07 Hours)

Basics of operating systems: Generations, Types, Structure, Services, System Calls, System Boot, System Programs, Protection and Security. Process management: Process Concepts, Process States, Process Control Block, Scheduling-Criteria, Scheduling Algorithms and their Evaluation, Threads, Threading Issues.

#Exemplar/Case Studies	Case Study: Introduction to OS concepts using Windows 10. Example: Exploring file management, user interfaces, and basic system utilities.
Mapping of Course Outcomes for Unit I	Outline the basic concept of operating systems

Unit II	Process synchronization	(08 Hours)

Process synchronization: Background, Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors. Deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock.

#Exemplar/Case Studies	Case Study: Managing concurrent processes in Linux. Example: Implementing semaphores and mutexes in a multi-threaded application to prevent race conditions.
Mapping of Course Outcomes for Unit II	Analyze the working of operating system

Unit III	Memory management	(07 Hours)

Memory management: Main Memory, Swapping, Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.

#Exemplar/Case Studies	Case Study: Efficient memory allocation in macOS. Example: Using virtual memory and paging to optimize application performance.

Mapping of Course Outcomes for Unit III	Examine the working of various scheduling/allocation approaches	
Unit IV	**Concurrency And Synchronization**	**(08 Hours)**
CONCURRENCY AND SYNCHRONIZATION: Process synchronization, critical section problem, Peterson's solution, synchronization hardware, semaphores, classic problems of synchronization, readers and writers problem, dining philosophers problem, monitors, synchronization examples(Solaris), atomic transactions. Comparison of UNIX and windows.		
#Exemplar/Case Studies	Case Study: Avoiding deadlocks in database systems. Example: Implementing deadlock detection algorithms and resource allocation graphs in a transaction management system.	
Mapping of Course Outcomes for Unit IV	Measure the performance of various scheduling/allocation approaches	
Unit V	**Deadlocks**	**(06 Hours)**
DEADLOCKS: System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery from deadlock banker's algorithm. File System: Concept of a file, access methods, directory structure, file system mounting, file sharing, protection.		
#Exemplar/Case Studies	Case Study: Ensuring data consistency in multi-user environments. Example: Using locking mechanisms and isolation levels in SQL Server to manage concurrent access to data.	
Mapping of Course Outcomes for Unit V	Implement algorithm of CPU Scheduling, Memory Scheduling and disk scheduling.	
Unit VI	**I/O System**	**(06 Hours)**
I/O SYSTEM: Mass storage structure - overview of mass storage structure, disk structure, disk attachment, disk scheduling algorithms, swap space management, stable storage implementation, tertiary storage structure. I/O: Hardware, application I/O interface, kernel I/O subsystem, transforming I/O requests to hardware operations, streams, performance.		
#Exemplar/Case Studies	Case Study: Enhancing I/O operations in embedded systems. Example: Using interrupt handling and buffering techniques to improve data transfer efficiency in real-time applications.	
Mapping of Course Outcomes for Unit VI	Compare various operating systems with respect to characteristics and features	
Learning Resources		
Text Books: Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition, Wiley India Private Limited, New Delhi.		
Reference Books: 1. Operating System Concepts, Silberschatz, Ninth Edition, Willey Publication. 2. Operating Systems, Internals and Design Principles, Stallings, Seventh Edition, Pearson Publication. 3. Modern Operating Systems, Tanenbaum, Fourth Edition. Pearson Publication.		

@The CO-PO mapping table

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

CO4	3	2	3	1	1	-	-	-	1	-	-	-
CO5	3	2	3	1	1	-	-	-	1	-	-	1
CO6	3	2	3	1	1	-	-	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune **Dr. D. Y. Patil School of Science & Technology** **BTCSD Third Year of Engineering (2024-25 Course)** **ESC-CS 502: Operating System Lab**		
Teaching Scheme **Practical: 02 Hours/Week**	**Credit Scheme** **02**	**Examination Scheme and Marks** **Internal: 50 Marks** **External: 50 Marks**
Companion Course:		
Course Objectives: • To explain main components of OS and their working.		

- To familiarize the operations performed by OS as a resource Manager.
- To impart various scheduling policies of OS.
- To teach the different memory management techniques.

Course Outcomes:

CO1: Implementation of various scheduling/allocation approaches
CO2: Measure the performance of various scheduling/allocation approaches through program.
CO3: Implement algorithm of CPU Scheduling, Memory Scheduling and disk scheduling.
CO4: Compare various operating systems Algorithm for multitasking

Virtual Laboratory:

-

Part I : Operating System Lab

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A(Two Assignments are compulsory)
1.	Develop a basic command-line shell that supports execution of commands, piping, and redirection.
2.	Create a simulator for a simple file system with features like file creation, deletion, and navigation.
3.	Implement a simulator for memory allocation techniques such as paging, segmentation, and virtual memory.
4.	Develop a process scheduler that implements various scheduling algorithms (FCFS, SJF, Round Robin, etc.).
5.	Create a virtual memory manager that handles page replacement algorithms (LRU, FIFO, Optimal).
6.	Implement a system that demonstrates concurrency control using semaphores and monitors.
7.	Develop a simulator to implement and compare different disk scheduling algorithms (FCFS, SSTF, SCAN, etc.).
8.	Create a tool that detects and resolves deadlocks using algorithms like Banker's algorithm.
	Group B (Mini Project) **Select any one problem statement**
1.	Implement a system to intercept and log system calls made by user processes.
2.	Develop a secure user authentication system with support for multiple users and access control.
3.	Create a network packet sniffer to capture and analyze network traffic.
4.	Implement a RAM disk driver that creates a virtual disk in RAM.
5.	Develop a loadable kernel module to extend the functionality of an existing operating system.
6.	Create a tool to monitor and display CPU usage statistics for different processes.
7.	Develop a user-level thread library with support for basic threading operations.
8.	Implement a basic distributed file system that supports file sharing across multiple nodes.

@The CO-PO Mapping Matrix

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

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune
Dr. D. Y. Patil School of Science & Technology
Third Year of Engineering (2024-25 Course)
ESC-CS 503: Animation Design Principles

Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 3 Hours/Week	**4**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Students need to have basic knowledge of computers and specific software like Photoshop and basic programming.

Companion Course, if any:

Course Objectives:

- The main objective of this subject is to impart strong knowledge about the fundamental principles of animation in addition to an invaluable appreciation for observational techniques & the art of planning.
- To Recognize the design principles of animation
- To implement the use of animation tools in application design.
- To construct an architectural design using the development process.
- To Examine the prototype for an existing application.
- To Demonstrate audio and visual effects in an application
- To Get hands-on experience with animation tools and application

Course Outcomes:

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

CO1. Grasp complete information on early attempts of animation, equipments, development, animation studios, and projects.

CO2. Grasp complete animation film production

CO3. Grasp and implementation of Animation Principles

CO4. Understand different types of walks, runs, dialogues, expressions, acting for animation etc. through mini project work.

CO5. Understand the case studies of Classic Animated features and Short Films

CO6: know the various theories of film studies and to relate various technologies and their development

Course Contents

Unit I	**Introduction**	**(06 Hours)**
Introduction to Traditional animation, Early attempts and Development of Animation in various countries: Mainstream Animation in the United States, Independent Animation in the United States, Canadian Animation, European Animation, Japanese Animation, Animation in Other Asian Countries, Southeast Asian Animation, Animation in Australia and New Zealand, Animation in India, Animation in Iran, and African Animation.		
#Exemplar/Case Studies	designing the logo of a company	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Types of Animation**	**(08 Hours)**
Step By Step Procedure for Traditional Animation: Script, Storyboard, Soundtrack, Track Breakdown, Designs, Animatic (Leica Reel), Layouts, Dope Sheets and Production Folders, Pencil Tests, Pose Tests, Clean-Up, Ink and Paint, Backgrounds, Checking, Final Shoot/Composite, Final Edit and Dub, and The Tools of the Trade.		
#Exemplar/Case Studies	user experience for a mobile app	
Mapping of Course Outcomes for Unit II	CO2, CO3	
Unit III	**Principles of Animation:**	**(06 Hours)**
Principles of Animation: Squash and stretch, Anticipation, Staging, Straight ahead action and pose to pose, Follow through and overlapping action, Slow in and slow out, Arc, Secondary action, Timing, Exaggeration, Solid drawing, and Appeal.		
#Exemplar/Case Studies	Animated Marketing Video – Tyson Hunger Relief	
Mapping of Course Outcomes for Unit III	CO3, CO4	
Unit IV	**Movements**	**(08 Hours)**

Weight and Weighted Movement, Flexibility and Fluid Joint Movement, Generic Walks, Keys, Passing Position, Inbetweens, Walk Cycles, Personality Walks and Timing, Runs and Run Cycles, Personality Runs and Timing, Silhouetting, Storyboarding & Animatics.		
#Exemplar/Case Studies	Demandbase Sales Accelerator	
Mapping of Course Outcomes for Unit IV	CO2	
Unit V	Animating Expressions & Dialogue	**(06 Hours)**
Animating Expressions & Dialogue, Lip Sync, Acting & Emotion, Laughter, Takes, Eyes and Expressions, Sound Track Recording and Editing. Understanding traditional trends in animation making in terms of content, Styling, Techniques and applications		
#Exemplar/Case Studies	Animated Explainer Video – Buy Hold Sell	
Mapping of Course Outcomes for Unit V	CO3, CO5	
Unit VI	**Animation films**	**(06 Hours)**
Studying animation films through film viewing, Appreciation, criticism, Theoretical writings, Essays, Research studies, and Mini Project.		
#Exemplar/Case Studies	How to Create a Short Animation Film	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources: **https://archive.nptel.ac.in/courses/107/101/107101001/**		
Text Books: 1. Animation: From Pencil to Pixels by Tony White 2. Animator's Survival Kit – Richard Williams 3. The Illusion of Life – Frank Thomas & OlieJohnstan 4. Animation Script to Screen (Author: Shamus Culhane)		
Reference Books: 1. Animation Writing and Development: From Script Development to Pitch By Jean Ann Wright 2. The History of Moviemaking: Animation and Live-Action,		

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CO4	3	2	1	3	-	-	-	-	-	-	-	-
CO5	1	1	3	2	1	-	-	-	-	-	-	-
CO6	1	1	2	3	2	-	-	-	-	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

ESC-CS 503: Animation Design Principles Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: ESC-CS 503: Animation Design Principles Lab

Course Objectives:

- To impart animation design principles, techniques and its history.
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
- To develop animated softwares by using animation tools .

Course Outcomes:

After successfully completing this animation design principles practical course, the students will be able to:

CO1. Strong base on animation and graphics softwares and its functions.
CO2. Fundamentals of animation designing to pursue the course.
CO3. Creative animations for various types of case studies.
CO4. Creating branding digital material for multiple kind of business.

CO5. understanding client's requirement .
CO6. Understanding of rules and art of amination designing tools.

Guidelines for Instructor's Manual

The instructor's manual should be created as a comprehensive guide and practical tool. It should encompass an introduction (detailing information about the University, program, institute, department, foreword, and preface), the course curriculum, guidelines for conducting classes and assessments, topics covered, concepts, objectives, outcomes, a selection of typical applications/assignments/guidelines, and reference materials..

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The formulation of problem statements should be a collaborative effort between the internal and external examiners. In practical assessments, utmost importance should be placed on successfully executing the problem statement. Evaluation may include relevant questions to gauge students' grasp of fundamental concepts and their ability to implement solutions effectively and efficiently. This approach promotes transparent evaluation and fairness, thereby alleviating any uncertainty or doubt among students. Adhering to these principles will solidify our collective efforts for a promising beginning to students' academic journey.

Guidelines for Laboratory Conduction

The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.
Operating System recommended: - Windows
Programming tools recommended: - Python

Virtual Laboratory:

Part I : Animation Design Principles Lab

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	Introduction to the Softwares such as: Adobe Flash, Pencil, Tupi : Open 2D Magic, Plastic animation paper,Synfig studio, Powtoon, ToonBoom, Anime Studio or Photoshop, CorelDraw.

2.	Create Free hand sketching from real objects: Building, vehicles, chair, table,trees etc.
3.	Generate Free hand practices and Designs in 2 D (Hills, Trees, Hut, Riversetc.)
4.	Create Basic Head Drawings male, female, children, old person, Text, letters,logos
5.	Draw the Backgrounds and Layouts for Animation.
6.	Familiarize Realistic Human Drawings, Anatomy, Animal Drawings, Cartoonsand Comic Drawings
7.	Working with pages and layout tools in CorelDraw7
8.	Use CorelDraw tools to draw the objects and workspace
	Group B (Mini Project) **Select any one problem statement**
1.	Do the Logo Designing, Menu bar, Layers, Colours, Filters in CorelDraw, Perform Importing/Exporting Formats in Different Patterns Designs
2.	Draw the Buildings Layouts and human structures in Multiple PointPerspective.
3.	Create Object Animations, Water Ripple.
4.	Create Various Actions and Facial Expression of Human, Animal, Cartoon
5.	Pick any picture of a magazine cover page make changes using selection tool.

@The CO-PO Mapping Matrix

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

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

ESC-CS 504: Machine Learning

Teaching Scheme:	Credit	Examination Scheme:
TH: 2 Hours/Week	**4**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Students must have knowledge of calculus, programming skills, probability, and statistics.

Companion Course, if any:

Course Objectives:

- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- To apply the algorithms to a real-world problem, optimize the models learned, and report on the expected accuracy of the models.

Course Outcomes:

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

CO5: Appreciate the significance of modelling in data analytics solutions.
CO6: Apply structured thinking to unstructured problems.
CO7: Demonstrate how to evaluate models generated from data.
CO8: Develop an appreciation for what is involved in learning models from data.
CO9: Apply the algorithms to a real problem, optimize the models learned.
CO10: Apply dimensionality reduction techniques to effectively analyze and extract valuable insights from high-dimensional datasets.

Course Contents

Unit I	Introduction to Machine Learning	(06 Hours)
Overview Of Machine Learning, Related Areas, Applications, Software Tools. Different Paradigms of Machine Learning.		
#Exemplar/Case Studies	Fraud Detection (Credit card) in Machine learning	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Supervised Learning**	**(07 Hours)**
Artificial Neural Network, classifying with k-Nearest Neighbors, splitting datasets one feature at a time: decision trees, classifying with probability theory: naive Bayes, Logistic regression, Support vector machines, Improving classification with the AdaBoost meta-algorithm.		
#Exemplar/Case Studies	Support Vector Machines (SVM) for Handwritten Digit Recognition	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Unsupervised Learning**	**(07 Hours)**
Association analysis with the Apriori algorithm, K-means clustering, expectation maximization, Gaussian mixture density estimation, mixture of naive Bayes, model selection.		
#Exemplar/Case Studies	K-Means Clustering for Customer Segmentation in Retail	
Mapping of Course Outcomes for Unit III	CO2	
Unit IV	**Reinforcement Learning**	**(07 Hours)**
Markov decision process (MDP), Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), Linear Quadratic Gaussian (LQG), Q-learning, Value function approximation, Policy search, POMDPs.		
#Exemplar/Case Studies	Bellman Equations for Dynamic Pricing in E-Commerce	
Mapping of Course Outcomes for Unit IV	CO3, CO4	
Unit V	**Forecasting and Learning Theory**	**(07 Hours)**
Predicting numeric values: regression, Tree-based regression. Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, Vapnik–Chervonenkis (VC) dimension, Worst case (online) learning, Practical advice on how to use learning algorithms.		
#Exemplar/Case Studies	Tree-Based Regression for Predictive Maintenance in Manufacturing	

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Neural Networks and Dimensionality Reduction**	**(08 Hours)**
The perceptron algorithm, multilayer perceptrons, backpropagation, nonlinear regression, multiclass discrimination, training procedures, localized network structure, deep neural networks. Feature selection, principal component analysis, linear discriminant analysis, factor analysis, independent component analysis, multidimensional scaling, and manifold learning.		
#Exemplar/Case Studies	Nonlinear Regression for Drug Dosage Response Modeling	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. E. Alpaydin, —Machine Learning, MIT Press, 2010.

2. C. M. Bishop, —Pattern Recognition and Machine Learning. First Edition. Springer, 2006. (Second Indian Reprint, 2015).

3. K. Murphy, —Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Reference Books:

1. T. Mitchell, —Machine Learning, McGraw-Hill, 1997.

2. Hastie, Tibshirani, Friedman, —The Elements of Statistical Learning.

3. Tom Mitchell (TM),—Machine Learning.

4. R. Duda, E. Hart, and D. Stork, —Pattern Classification, Wiley-Interscience, 2000

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	1	2	-	-	-	-	-	-	-	-
CO4	3	2	1	3	-	-	-	-	-	-	-	-
CO5	1	1	3	2	1	-	-	-	-	-	-	-
CO6	1	1	2	3	2	-	-	-	-	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

Machine Learning Practical

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: ESC-CS 504: Machine Learning

Course Objectives:

- To implement and differentiate regression, clustering and classification techniques and their algorithms.
- To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning models.

Course Outcomes:

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

CO1: Gain knowledge to combine machine learning models to get better results.

CO2: Choose an appropriate clustering technique to solve real world problems.

CO3: Choose a suitable Machine learning algorithm, implement and examine the performance of the model for real world problems.

CO4: Implementation of different machine learning algorithms.

Guidelines for Instructor's Manual

The instructor's manual should be created as a comprehensive guide and practical tool. It should encompass an introduction (detailing information about the University, program, institute, department, foreword, and preface), the course curriculum, guidelines for conducting classes and assessments, topics covered, concepts, objectives, outcomes, a selection of typical applications/assignments/guidelines, and reference materials..

Guidelines for Student's Laboratory Journal

Students are required to submit their laboratory assignments in the form of a journal. This journal should include a certificate, a table of contents, and a handwritten write-up for each assignment. The write-up should cover the assignment title, completion date, objectives, problem statement, software and hardware requirements, assessment grades/marks with the assessor's signature, a brief overview of the theory/concepts, algorithm, flowchart, test cases, test data set (if applicable), mathematical models (if applicable), and conclusion/analysis. Additionally, softcopies of program codes along with sample outputs for all assignments must be submitted. In an effort to promote environmental consciousness and contribute to Green IT, please refrain from attaching printed papers to the journal. Instead, it is encouraged to utilize a DVD containing students' programs, which will be maintained by the Laboratory In-charge. For reference purposes, one or two journals with program prints may be retained in the Laboratory.

Guidelines for Laboratory /Internal Assessment

The Continuous Assessment of laboratory work should consider a student's overall performance on laboratory assignments. Each assessment of laboratory assignments will allocate grades/marks based on various criteria, including adherence to deadlines, performance, creativity, effective coding, and punctuality.

Guidelines for Practical Examination

The formulation of problem statements should be a collaborative effort between the internal and external examiners. In practical assessments, utmost importance should be placed on successfully executing the problem statement. Evaluation may include relevant questions to gauge students' grasp of fundamental concepts and their ability to implement solutions effectively and efficiently. This approach promotes transparent evaluation and fairness, thereby alleviating any uncertainty or doubt among students. Adhering to these principles will solidify our collective efforts for a promising beginning to students' academic journey.

Guidelines for Laboratory Conduction

The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.

Operating System recommended: - Windows

Programming tools recommended: - Python

Virtual Laboratory:

- Coursera: Coursera offers a wide range of machine learning courses, including the famous "Machine Learning" course by Andrew Ng. It covers the fundamentals of machine learning and is highly recommended for beginners.
- edX: edX provides courses on machine learning from prestigious institutions like Harvard, MIT,
  and Microsoft. One popular course is "Introduction to Artificial Intelligence" by IBM.

Part I : Machine Learning Lab	
Suggested List of Laboratory Experiments/Assignments (6 assignments are compulsory)	
Sr. No.	**Group A (Two Assignments are compulsory)**
1.	Write a program to learn a decision tree. Decision tree learning should use information gain as the criterion for choosing the attribute for splitting. Tree pruning should not be performed. The tree should be tested on few test samples. The tree structure should be printed as output.
2.	Write a program to learn a naïve Bayes classifier and use it to predict class labels of test data. The learned classifier should be tested on test instances with unknown class labels and the predicted class labels for the test instances should be printed as output.
3.	Write a program to implement the Adaboost algorithm with decision tree as the base classifier. The decision tree implemented in Assignment 1 may be called as a function. Run Adaboost for 3 rounds. The combined classifier should be tested on test instances and the accuracy of prediction for the test instances should be printed as output. A single program should train the classifier on the training set as well as test it on the test set.
4.	Write a program to cluster a set of points using K-means. Consider, K=2, clusters. Also, consider Euclidean distance as the distance measure. Randomly initialize a cluster mean as one of the data points. Iterate for 10 iterations. After iterations are over, print the final cluster numbers for each of the data points.
5.	Write a program to use a K-nearest neighbor it to predict class labels of test data. Euclidean distance should be used as the distance metric. Consider K=5. The learned classifier should be tested on test instances with unknown class labels, and the predicted class labels for the test instances should be printed as output.
6.	Spam email classification using Support Vector Machine: In this assignment you will use a SVM to classify emails into spam or non-spam categories. And report the classification accuracy for various SVM parameters and kernel functions. You have to submit the report file in pdf format.
7.	Write a program to train a single perceptron using the delta learning rule. Consider learning rate to be 0.1. (You may also try to find out a better learning rate by trial.) Randomly initialize the weights of the perceptron. Train the perceptron for 10 epochs. Then, the learned classifier should be tested on test instances with unknown class labels, and the predicted class labels for the test instances should be printed as output.
8.	Write a program for linear and nonlinear regression models.
	Group B (Mini Project) **Select any one problem statement**
1.	Food Delivery Time Prediction
2.	Password Strength checker
3.	Instagram Reach Analysis and Prediction
4.	Article Recommendation system
5.	Stress Detection

6.	Google Search Analysis
7.	Credit card clustering
8.	Clustering movies genres

@The CO-PO Mapping Matrix

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

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune
Dr. D. Y. Patil School of Science & Technology
Third Year of Computer Science & Design (2024-25 Course)
PCC-CS-501 : Engineering Design & Innovation-III

Teaching Scheme:	Credit	Examination Scheme:
Practical: 4 Hours/week	**2**	**Internal (PR): 20 Marks** **External (PR): 30 Marks**

Prerequisite Courses, if any:

- Engineering Design & Innovation

Companion Course, if any: Embedded Systems and IoT

Course Objectives:

- The primary objective of this project-based learning course is to develop critical thinking.
- To develop problem solving skills by exploring and proposing solutions to current computer engineering problems in the real world.
- This course will help students begin to identify themselves as computer engineers and prepare them for opportunities for their undergraduate studies.

Course Outcomes:

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

CO1: Students will develop and apply intermediate engineering design techniques, utilizing various tools and methodologies to solve design problems

CO2: Innovation Processes: Students will understand and implement processes for fostering innovation, including brainstorming, ideation, and conceptualization techniques.

CO3: Presentation Skills: Students will enhance their ability to communicate design concepts and project results through oral presentations, using appropriate visual aids and technical language.

CO4: Students will apply theoretical knowledge from previous courses to practical design challenges, bridging the gap between theory and real-world application.

Students Role in Project Based Learning

1. Prepare students for Prepare students for PBL before starting the sessions.
2. Students must have ability to enhance the task/idea .they should not be mere imitators.
3. They must learn to think.
4. Students working in EDI must be responsible for their own learning.
5. Throughout the PBL process, students have to define and analyze the problem, generate learning issues and apply what they have learned to solve the problem and act for them-selves and be free.
6. Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
7. Students in EDI are actively constructing their knowledge and understanding of the situation in groups.
8. Students in EDI are expected to work in groups.
9. They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Guidelines for Assessment

EDI require regular mentoring by faculty throughout the semester for successful completion of the idea/project tasks selected by the students per batch. EDI is monitored and continuous assessment is done by supervisor /mentor and authorities. It is recommended that all activities should to be recorded regularly, regular assessment of work need to be done and proper documents need to be maintained at college end by both students as well as mentor (EDI work book). EDI is an integral part of the EDI. **Continuous Assessment Sheet (CAS) is to be maintained by all mentors**

Recommended parameters for assessment, evaluation and weightage:

● Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (60%) (Individual assessment and team assessment)

● Documentation (Gathering requirements/ design & modeling/ implementation/execution, use of technology and final report, other documents) (20%)

● Demonstration (Presentation, User Interface, Usability etc) (20%)

As a part of the progress report of EDI, the candidate shall deliver a presentation on the advancement in technology pertaining to the selected project topic. PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator.

During university examination Internal examiner (preferably the guide) and External examiners jointly, evaluate the project work. The student shall submit the duly certified progress report of project in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute. Project Exam will be conducted at end of semester.

Parameters for Assessment

1. Determine, dissect, and estimate the parameters, required in the solution.
2. Implement the system with existing algorithms
3. Perform system testing.
4. Evaluate the solution by considering the standard data / Objective function and by using appropriate performance metrics
5. Submit a Progress Report on work done.

Text Books:

T1.A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

T2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.

T3. Stem Project based learning and integrated science, Technology, Engineering and Mathematics approach. By Robert Capraro, Mary Margaret Capraro

T4. Hassan Gomaa, ”Software Modeling and Design- UML, Use cases, Patterns and Software Architectures” Cambridge University Press, 2011, ISBN 978-0-521-76414-8.

Reference Books:

R1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.

R2. Gopalan," Project management core text book", 2 Indian Edition

R3. James Shore and Shane Warden, " The Art of Agile Development"

R4. Gardy Booch, James Rambaugh, Ivar Jacobson,"The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562-8.

R5. Mason, Peter & Wright, Pamela & Luu, Hoat. (2008). Writing and Publishing a Scientific Paper. 10.13140/2.1.4010.0480

@The CO-PO mapping table

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

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Third Year of Engineering (2024-25 Course)
PCC-CS-502 : Design & Thinking

Teaching Scheme:	Credit	Examination Scheme:
Tut: 02 Hours/Week	**02**	**Internal (TH): 20 Marks** **External (TH): 30 Marks**

Prerequisite Courses, if any: None

Companion Course, if any: Not Applicable

Course Objectives:

- To inculcate core design principles and applied creativity to develop innovative strategies that better connect engineers with their end users
- To build mindset leading to flow of creative ideas, validating those ideas and prioritizing the best ones
- To incorporate tools that designers need to take a design project from inspiration and insights to ideation and implementation
- To instill full scope of organizational innovation and strategy through knowledge, insight and analytical skills

Course Outcomes:

After completion of the course, the student should be able to:
CO1: Use design thinking and hypothesis-driven innovation processes to develop viable solutions to user challenges.
CO2: Use multiple brainstorming techniques to find innovative solutions.
CO3: Develop and test a business model or business case to support the viability of the solution.
CO4: Prototype a solution to a user challenge.
CO5: Knowledge for enhancing our abilities to create a new product
CO6: Investigate the cultural, emotional, technological and business factors relevant to developing new product or service design concept

Course Contents

Unit I	Fundamentals of Design Thinking	(04 Hours)
Introduction to Design Thinking, Five stages of DT, Three lenses of Design Thinking, The Double Diamond by the Design Council :Framework for Innovation, Common Elements of Design Thinking Frameworks, DT: a non linear process		
#Exemplar/Case Studies	IDEO’s design thinking process	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	Revisiting Design Thinking	(04 Hours)
Creative thinking as basis of innovation; Empathy process for deep understanding of challenge with practical ingenuity; Making sense of observations and insights; Defining a point of view and context Design thinking skills for Problem Discovery, Definition, and Ideation – Identifying problems in daily lives and in the world at large, Understanding user and customer perspectives		
#Exemplar/Case Studies	IBM's Design Thinking journey	
Mapping of Course Outcomes for Unit II	CO2	

Unit III	Ideation Process	(04 Hours)
Clear Articulation of problem statement with focus on latent needs; Brainstorming potential solutions; Ideation methods with case-study based approach to using Systematic Inventive Thinking (SIT) Methods such as Addition, Subtraction, Multiplication, Division and Task Unification, Strategic Innovation for competition in future: Linear Innovation vs. non-linear innovation, Understanding and identifying weak signals, 3-box thinking		
#Exemplar/Case Studies	3-Box framework and Box-3 ideation	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	Designing Customer Experience	(04 Hours)
Understanding Innovation through Design Thinking; Enhancing Customer Experience; Service Design and Development Process and Case Studies; Service Experience Cycle and Case Studies.		
#Exemplar/Case Studies	Design Sprint: A Condensed Version of Design Thinking	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Sustainable Design Approaches	(04 Hours)
Concern for Environment and Sustainability in Design, Case Studies to understand good Design for Environment (DFE) Decisions; Design Considerations in the five stages of the Product Life Cycle.		
#Exemplar/Case Studies	Airbnb Design Thinking case study	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Integrative Engineering Design Solutions	(06 Hours)
Identifying and resolving issues with working in diverse teams, Modularising, prototype building by different engineering disciplines within the team, validated learning with accessible metrics Applying Design Thinking Principles and Methods for Ideation and Prototyping, Testing Solution, Refining Solution, and Taking the Solution to the Users		
#Exemplar/Case Studies	Netflix Design Thinking Prototype	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		
TextBooks: 1. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, John Wiley & Sons, ISBN: 978-1118083468 2. Living with Complexity, Donald A Norman, MIT Press, ISBN: 978-0262528948, 2016. 3. Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work, Beverly Rudkin Ingle, A Press, ISBN: 978-1430261810		
Reference Books: 1.Emotionally Durable Design: Objects, Experiences and Empathy, Jonathan Chapman, 2nd Edition, Routledge, ISBN: 978-0415732161 2. Innovation Design: How Any Organization Can Leverage Design Thinking to Produce Change, Drive New Ideas, and Deliver Meaningful Solutions, Thomas Lockwood, Edgar Papke, New Page Books, ISBN: 978-1632651167. 3. Design Thinking Business Analysis: Business Concept Mapping Applied, Thomas Frisendal, Springer, ISBN: 978-3642434822.		

@The CO-PO mapping table												
PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	1	3	-	-	-	-	-	1	-	-	-
CO3	3	1	3	1	-	-	-	-	1	-	-	-
CO4	3	2	-	-	1	-	-	-	1	-	-	-
CO5	3	1	3	1	1	-	-	-	1	-	-	1
CO6	3	2	3	2	3	-	-	-	1	-	-	1

SEMESTER VI						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
ESC-CS 601	Cloud Computing	3	0	2	5	4
ESC-CS 602	Multimedia Techniques & Tools	3	0	2	5	4
ESC-CS 603	Complexity and Algorithms	3	0	2	5	4
ESC-CS 604	Software Design and Methodologies	2	0	2	5	4
PCC-CS-601	Engineering Design & Innovation-IV	0	0	4	4	2
PCC-CS-602	Design Thinking	0	2	0	2	2
PEC-CS 601	Skill Enhancement Course-IV	2	0	0	2	2
	Total	**13**	**2**	**12**	**28**	**22**
Skill Enhancement Course-III-Language-I: (Foreign Language (French / German / Japanese) / Hindi / Marathi) Skill Enhancement Course-IV-Language-II: (Foreign Language (French / German / Japanese) / Hindi / Marathi)						

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune **Dr. D. Y. Patil School of Science & Technology** **Third Year of Engineering (2024-25 Course)** **ESC-CS 601: Cloud Computing**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 3 Hours/Week	**3**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Fundamentals of Embedded Systems, IoT
- Basic of Computer Networking, data communication ,

Companion Course, if any: Embedded Systems and IoT

Course Objectives:

- To introduce the fundamentals of cloud computing, its technologies, Challenges and Applications
- To give Insights into the virtualization technologies and Architecture
- To know the relationship between Cloud and SOA
- To classify and evaluate Cloud Security Issues
- To apply theory to practical knowledge through case Studies

Course Outcomes:

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

CO1: Describe the concepts of Cloud Computing and its Service Models&Deployment Models. (Understand)

CO2: Classify the types of Virtualization. (Understand)

CO3: Describe the Cloud Management and relate Cloud to SOA. (Understand)

CO4: Interpret Architecture and Pharrell Programing of Cloud Computing. (Apply)CO5: Demonstrate practical implementation of Cloud computing. (Apply)

CO11:

Course Contents

Unit I	**Cloud Services and Cloud Models**	**(07 Hours)**

Cloud Services and Cloud Models- Introduction to Cloud,Cloud Computing vs. Cluster Computing vs. GridComputing,Introduction to Cloud Service Models,Characteristics, Advantages, Security,XAAS- Anything as a Service – Storage as a service,Network as a Service, Database as a Service etc.,IAAS, PAAS, SAAS characteristics, benefits andApplications,Comparison of SAAS, PASS and IAAS,Cloud Deployment Models-Public, Private, Hybrid,Cloud Platforms :Google Cloud Platform,Microsoft Azure,SalesForce,AWS.

#Exemplar/Case Studies	Cloud Computing for Government
Mapping of Course Outcomes for Unit I	CO1

Unit II	**Virtualization**	**(08 Hours)**

Virtualization--Introduction to Virtualization concept &Hypervisors,Types of Virtualization: Server, Storage and Network,Pros and Cons of Virtualization,Machine Image, Virtual Machine (VM),Technology Examples,Xen: Para virtualization,VMware: Full Virtualization,Open Source Virtualization Manager.

#Exemplar/Case Studies	Xen
Mapping of Course Outcomes for Unit II	CO2, CO3

Unit III	**SOA & Cloud Management**	**(08 Hours)**

SOA & Cloud Management- Definition of Service Oriented Architecture,Basic concepts of SOA,Web Services: SOAP and REST,Cloud APIs (RESTful),Relating SOA and Cloud Computing.,Cloud Availability,Cloud Governance,Service Level Agreement		
#Exemplar/Case Studies	Pricing Model: Usage Reporting, billing andmetering (AWS), Cloud Statistics	
Mapping of Course Outcomes for Unit III	CO2,CO3	
Unit IV	**Multi Core Architecture**	**(08 Hours)**
Multi Core Architecture- Cloud Computing Architecture,Multi Core Architecture,Multi Cloud Environment,Parallel Programming,Parallel Processing,Edge Computing Concepts		
#Exemplar/Case Studies		
Mapping of Course Outcomes for Unit IV	CO3, CO4	
Unit V	**Moving Applications to the Cloud**	**(06 Hours)**
Moving Applications to the-Cloud Migration Strategies and Process,Issues in Inter Cloud,Applications in the Clouds,Cloud Service Attributes,Cloud Bursting,Data Migration in Cloud,Quality of Services in cloud Computing		
#Exemplar/Case Studies	Six R for Cloud Migration	
Mapping of Course Outcomes for Unit V	CO3, CO5	
Unit VI	**Cloud Security & Implementation of Cloud**	**(06 Hours)**
Cloud Security & Implementation of Cloud- Cloud Security Fundamentals,Cloud Security Architecture ,Cloud Computing Security Challenges,Privacy and Security in Cloud,Identity Management and Access control,Demonstrate the commercial cloud computingInfrastructures,Introduction to Dockers Container		
#Exemplar/Case Studies		
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

Text Books:

1. Cloud Computing Black Book, Kailash Jayaswal (Author), Jagannath Kallakurchi (Author), Donald J. Houde (Author), Dr. Deven Shah (Author), ISBN: 978-9351193944.
2. Cloud Computing For Dummies by Judith Hurwitz, Robin Bloor, Marcia Kaufman, and Fern Halper ISBN: 978-1119546658

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,
2. Cloud Computing : Automating the Virtualized Data Center
3. Cloud Computing by Dr. Kumar Saurabh ,Wiley–India
4. Cloud computing: A practical approach by Anthony T. Velte, TataMcGraw-Hill
5. Cloud Computing Concepts, Technology & Architecture by Thomas Erl,Zaigham Mahmood, and Ricardo Puttin
6. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola,S.Thamarai Selvi - McGraw Hill Education (India) Private Limited,
7. Cloud Computing Web –Based Applications that change the way youwork and Collaborate Online by Michael Miller, Pearson
8. Cloud Computing for Dummies by Judith Hurwitz, Robin Bloor, MarciaKaufman, FernHalper

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	2	3	-	-	1	-	-	1
CO2	3	2	3	1	3	-	-	-	1	-	-	-
CO3	3	2	3	1	3	-	-	-	1	-	-	-
CO4	3	2	3	1	1	-	-	-	1	-	-	-
CO5	3	2	3	1	1	-	-	-	1	-	-	1
CO6	3	2	3	1	1	-	-	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

Cloud Computing Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 02 Hours/Week	**02**	**Internal: 20 Marks** **External: 30 Marks**

Companion Course: ESC-CS 601: Cloud Computing

Course Objectives:

- To learn basic concepts ,types and characteristics of cloud computing
- To learn Cloud Computing Architecture and service models.
- To learn Virtualization and its type's in cloud computing.
- To learn fundamental concepts and architecture of cloud computing security.
- To learn basics of SOA and cloud based storage

Course Outcomes:

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

CO1 : Able to understand basic concepts, principles and paradigm of Cloud Computing

CO2 : Understand the various Cloud computing models and services.

CO3 : Able to identify the significance of implementing virtualization techniques.

CO4 : Able to understand the need of security in Cloud computing.
CO5 : Understand the concept SOA and cloud based storage in Cloud computing.

Guidelines for Instructor's Manual

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The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.
Operating System recommended :- Ghost OS,CloudMe
Programming tools recommended: - CloudZero,Amazon Web Services,Google App Engine

Virtual Laboratory:

- https://vlab.noaa.gov/web/osti-modeling/cloud-computing1
- https://www.codio.com/solutions/virtual-labs

Part I : Cloud Computing

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	Create an Account to Cloud Service Provider (AWS, AZURE, Google Cloud, etc.)

2.	Create an Instance on Cloud
3.	Provide Access Control and Permission to Users
4.	Execute the Web Page on Cloud
5.	Provide Security Mechanism to your instance.
6.	Create an Account to Cloud Service Provider (AWS, AZURE, Google Cloud, etc.)
7.	Create an Instance on Cloud
	Group B (Mini Project) **Select any one problem statement**
9.	E-learning Platform
10.	Information Chatbot
11.	Secure File Storage System
12.	Smart Traffic Management Solution
13.	Movie Recommendations Application
14.	Bus Ticketing System with Payment Capabilities
15.	Virtual Event Management Platform

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CO2	1	2	1	3	1	-	1	-	1	-	-	-
CO3	-	2	3	1	2	1	-	1	1	-	-	-
CO4	2	1	2	1	-	2	1	-	1	-	-	-
CO5	1	1	1	2	1	2	-	1	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

ESC-CS 602: Multimedia Techniques & Tools

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week **PR: 2 Hours/Week**	**4**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

1.Data Structures and Files

2. Computer Graphics

Companion Course, if any: **Not Applicable**

Course Objectives:

- To describe basic components of multimedia (text, image, audio, video, and animation).
- To state text and image file formats and apply different compression techniques.
- To classify different audio and video file formats.
- To define animation techniques and use open-source authoring tools.
- To express virtual reality and VR devices used in various applications.
- To identify emerging trends and practice various tools.

Course Outcomes:

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

CO1. Identify basics of multimedia and multimedia system architecture.

CO2. Solve and analyze different algorithms for text and image compression.

CO3. Classify different audio and video file formats of Multimedia.

CO4. Apply open-source authoring tools of animation and list various devices used in virtual reality and its use in daily life.

CO5. Recognize emerging trends in Multimedia

CO6. Identify application areas and tools used.

Course Contents

Unit I	**Introduction to Multimedia**	(06 Hours)

Goals, objectives, and characteristics of multimedia, what is Multimedia, Objects and Elements of Multimedia ,Multimedia and Hypermedia.

Multimedia building blocks: text, image, audio, video, animation, Multimedia architecture, Evolving Technologies for Multimedia Systems, Some useful editing and Authoring tools.

#Exemplar/Case Studies	Articulate Storyline 360
Mapping of Course Outcomes for Unit I	CO1

Unit II	**Text and Image Processing**	(06 Hours)

Text: Text file formats: TXT, DOC; RTF, PDF, PS, EPS, OXPS **Text compression:** Huffman coding, LZ & LZW **Image:** Image Data Representation, Image File formats - BMP, TIFF, JPEG, GIF, PNG **Image processing:** Acquisition, Storage, Communication, Display, Enhancement **Types of Compression:** Lossless: RLE, Shannon - Fano algorithm, Arithmetic coding. **Lossy:** Vector quantization, Fractal Compression Technique		
#Exemplar/Case Studies	Transform coding and Hybrid: JPEG-DCT	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Audio and Video Processing**	(06 Hours)
Audio: Nature of sound waves, characteristics of sound waves, Use of audio in computer applications, psycho-acoustic, MIDI, Digital audio file formats: AIFF, VOC, AVI, WMA, OGG, PCM,MP3,AAC Audio compression techniques: DM, ADPCM and MPEG. **Video:** video signals formats, Video transmission standards: EDTV, CCIR, CIF, SIF, HDTV, Video file formats: AVI, MOV,RM,WAV,FLV,3GP,Video editing, Video Compression: H-261,H-263, MPEG		
#Exemplar/Case Studies	**Real-Time Video Streaming**	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Animation and Virtual Reality**	(06 Hours)
Animation: Historical Background, Uses of Animation, Traditional Animation, Principal of Animation, Techniques of animation, Computer based Animation, Animation on the Web,3D Animation, Rendering Algorithms, Animation File formats Virtual Reality: Architecture of VR, Concept and History of VR, Human Physiology and Perception, Forms of VR, VR applications, VR devices		
#Exemplar/Case Studies	Animation tools: Autodesk Maya Virtual Reality in education and health care	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Trends in Multimedia**	(06 Hours)
Multimedia networking, Quality of data transmission, Multimedia over IP, Media on Demand, Multimedia in Android: Android Multimedia Framework Architecture, Multimedia Databases: storage, retrieval, organization, Multimedia application development: software life cycle overview, Mobile Gaming, Cloud Gaming On-Demand Gaming.		
#Exemplar/Case Studies	Blender VFX software	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Applications and tools**	(06 Hours)
Multimedia Applications, Overview of Multimedia Software Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools,I mage Editing Tools, Sound Editing Tools, Animation ,Video and Digital movies tools.		
#Exemplar/Case Studies	Java3D,DirectX	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

TextBooks:
1. Multimedia System Design, Prabhat K. Andleigh & Kiran Thakrar, PHI.
2. Multimedia Communication Systems: Techniques, Standards & Networks,
K. R. Rao, Zoran S. Bojkovic&Dragorad A. Milovanovic, TMH.
3. Multimedia Systems, K. Buford, PHI.
4. Fundamentals of Multimedia, Ze-Nian Li & Mark S. Drew, PHI.

Reference Books:
1. Multimedia Computing Communications & Applications, Ralf Steinmetz &Klara Nahrstedt, Pearson.
2. Digital Image processing, Rafael C. Gonzalez, Richard E. Woods, Pearson.
3. Multimedia Applications, Ralf Steinmetz & Klara Nahrstedt, Springer International Edition

Useful Links:
1. https://nptel.ac.in/courses/117/105/117105081/
2. https://nptel.ac.in/courses/117/105/117105081/
3. http://www.cse.unsw.edu.au/~cs9519/lecture_notes_06/L1_COMP9519_4in1.pdf

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Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

ESC-CS 602 : Multimedia Techniques & Tools Lab

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Course Objectives:

- To grasp the fundamental knowledge of Multimedia elements and systems
- To get familiar with Multimedia file formats and standards
- To develop proficiency in using industry-standard multimedia software and tools for graphic design, video editing, audio production, web development, and animation.
- To gain hands-on experience in creating various forms of multimedia content, including graphics, videos, animations, interactive websites, and digital presentations.

Course Outcomes:

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

CO1: To explore creativity through multimedia by exploring different mediums, techniques, and styles of expression

CO2: To analyze multimedia content, including evaluating design choices, storytelling techniques, and the impact of multimedia on audiences.

CO3: To provide an opportunity to gain hands-on experience in building multimedia applications

CO4: To encourage innovative approaches to multimedia design

CO5: To raise awareness of ethical issues related to multimedia production

CO6: To promote collaboration and effective communication skills through group projects

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Operating System recommended :- Windows
Programming tools recommended: - Image Editing tools, Audio Editing tools, Video Editing and conversion tools, Animation tools

Virtual Laboratory:

Part I : Multimedia Techniques & Tools Lab

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	**Working with Image Editing tools:** Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations: 1.Use different selection and transform tools to modify or improve an image 2. Create logos and banners for home pages of websites
2.	**Working with Audio Editing tools:** 1. Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade-in or fade-out etc., 2. Perform audio compression by choosing a proper codec.
3.	**Working with Video Editing and conversion tools:** Install tools like OpenShot / Cinelerra / HandBrake for editing video content. 1. Edit and mix video content, remove noise, create special effects, add captions. 2.Compress and convert video file format to other popular formats.

4.	**Working with web/mobile authoring tools:** Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web: 1. Design simple Home page with banners, logos, tables quick links etc 2. Provide a search interface and simple navigation from the home page to the inside pages of the website. 3. Design Responsive web pages for use on both web and mobile interfaces.
5.	**Working with Animation tools:** Install tools like, Krita, Wick Editor, Blender: 1. Perform a simple 2D animation with sprites 2. Perform simple 3D animation with keyframes, kinematics
6.	**Working with E-Learning authoring tools:** Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN: 1.Demonstrate screen recording and further editing for e-learning content. 2.Create a simple E-Learning module for a topic of your choice.
7.	**Creating VR and AR applications:** Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc.
8.	Working with various tools: Origami studio / Lottie / Framer etc.
	Group B (Mini Project) **Select any one problem statement**
1.	Digital Portfolio Showcase: Create an interactive digital portfolio showcasing your multimedia work, including graphics, videos, animations, and web designs.
2.	Social Media Campaign: Develop a multimedia-based social media campaign to raise awareness about a social issue, promote a cause, or market a product or service
3.	Multimedia Storytelling Project: Produce a multimedia narrative using various media elements, such as text, images, audio, and video, to tell a compelling story or explore a specific theme.
4.	Mobile App Design: Design and prototype a mobile application that utilizes multimedia elements, such as images, videos, and audio, to provide entertainment, education, or utility to users.

5.	Virtual Reality Experience: Create a virtual reality experience using VR technology, immersing users in a virtual environment with interactive multimedia elements and storytelling elements. Eg. Factory machines simulation using virtual reality
6.	Mobile App Design: Design and prototype a mobile application that utilizes multimedia elements, such as images, videos, and audio, to provide entertainment, education, or utility to users.
7.	Interactive multiplayer or single player games
8.	Interactive Web Application: Design and develop an interactive web application incorporating multimedia elements, such as animations, videos, and dynamic content, to provide an engaging user experience.

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CO1	3	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	3	-	-	-	-	-	-	1
CO4	1	-	-	-	2	-	-	-	-	-	-	-
CO5	1	2	-	-	-	-	-	3	-	-	-	1
CO6	1	-	-	-	-	-	-	-	3	3	3	2

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

ESC-CS-603 : Complexity and Algorithms

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	**5**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Advanced Data Structures
- Discrete Structure and Automata Theory

Course Objectives:

- To develop problem solving abilities using mathematical theories.
- To apply algorithmic strategies while solving problems.
- To analyze performance of different algorithmic strategies in terms of time and space.
- To develop time and space efficient algorithms.

Course Outcomes:

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

CO1: Calculate computational complexity using asymptotic notations for various algorithms.
CO2: Apply Divide & Conquer as well as Greedy approach to design algorithms.
CO3: Understand and analyze optimization problems using dynamic programming.
CO4: Illustrate different problems using Backtracking.
CO5: Compare different methods of Branch and Bound strategy.
CO6: Classify P, NP, NP-complete, NP-Hard problems.

Course Contents

Unit I	**Introduction**	**(06 Hours)**
Algorithm: The Role of Algorithms in Computing - What are algorithms, Design of Algorithm, Analysis of Algorithm: Efficiency- Analysis framework, asymptotic notations – big O, theta and omega. Analysis of Non-recursive and recursive algorithms: Solving Recurrence Equations using Masters theorem and Substitution method. Brute Force method: Introduction to Brute Force method & Exhaustive search, Brute Force solution to 8 queens' problem.		
#Exemplar/Case Studies	Implement Tower of Hanoi	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Computational Complexity**	**(06 Hours)**
Non Deterministic algorithms, The classes: P, NP, NP Complete, NP Hard, Satisfiability problem, Proofs for NP Complete Problems: Clique, Vertex Cover		
#Exemplar/Case Studies	Analysis of iterative and recursive algorithm	
Mapping of Course Outcomes for Unit II	CO1, CO6	
Unit III	**Divide & Conquer and Greedy Method**	**(07 Hours)**
Divide & Conquer: Overview, Quick Sort, Binary search, Finding Max-Min, Large integer Multiplication. Greedy Method: General method and characteristics, Kruskal's method for MST, Dijkstra's Algorithm, Fractional Knapsack problem, Job Sequencing, Max flow problem.		
#Exemplar/Case Studies	Study and analyze Merge sort implementation by using Divide and Conquer	
Mapping of Course Outcomes for Unit III	CO1, CO2	

Unit IV	Dynamic Programming	(07 Hours)
Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomial coefficients, Travelling Salesman Problem, OBST, 0/1 knapsack, Chain Matrix multiplication.		
#Exemplar/Case Studies	Study and analyze Fibonacci sequence by using Dynamic Programming.	
Mapping of Course Outcomes for Unit IV	CO1,CO3	
Unit V	**Backtracking and Branch-n-Bound**	**(07 Hours)**
Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem. Branch-n-Bound: Principle, control abstraction, time analysis of control abstraction, strategies- FIFO, LIFO and LC approaches, TSP, knapsack problem.		
#Exemplar/Case Studies	Study of Airline Crew Scheduling	
Mapping of Course Outcomes for Unit V	CO1, CO4, CO5	
Unit VI	**Amortized Analysis**	**(07 Hours)**
Amortized Analysis: Aggregate Analysis, Accounting Method, Potential Function method, Amortized analysis-binary counter, stack Time-Space tradeoff, Introduction to Tractable and Non tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.		
#Exemplar/Case Studies	Study and analyze cutting stock problem	
Mapping of Course Outcomes for Unit VI	CO3, CO5	

Learning Resources

Text Books:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, “Design And Analysis of Algorithms”, Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, “Fundamentals of Algorithmics”, PHI, ISBN 978-81-203-1131-2

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia, “Algorithm Design: Foundations,” Analysis and Internet Examples‖, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 81 7371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms” Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, “Algorithms on Strings, Trees and Sequences”, Cambridge University Press,ISBN:0- 521-67035-7

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CO6	2	2	1	2	1-	-	-	-	1	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year Computer Science and Design(2024-25 Course)

ESC-CS-603: Complexity and Algorithms Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 02 Hours/Week	**05**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: Complexity and Algorithms

Course Objectives:

- To develop problem solving abilities using mathematical theories.
- To apply algorithmic strategies while solving problems.
- To analyze performance of different algorithmic strategies in terms of time and space.
- To develop time and space efficient algorithms.

Course Outcomes:

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

CO7: Apply and demonstrate Divide & Conquer as well as Greedy approach to design algorithms.
CO8: Apply and analyze optimization problems using dynamic programming.
CO9: Illustrate different problems using Backtracking.
CO10: Demonstrate problems using Branch and Bound strategy.

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Operating System recommended :- Windows / Linux

Programming tools recommended: - Turbo C++, Open Source C++ Programming tool like G++/GCC

Virtual Laboratory:

- https://ds1-iiith.vlabs.ac.in/Introduction.html
- https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

Part I : Name of the Lab

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	Using Divide and Conquer Strategies design a function for Binary Search.
2.	Implement Travelling Salesman problem by using Greedy Strategy.
3.	Write a program to implement Min-Max algorithm.
4.	Implement Dijkstras shortest path algorithm by using Greedy Strategy.
5.	Write a program to implement OBST by using Dynamic Programming.
6.	Write a program to implement graph coloring problem by using Backtracking.
7.	Implement 8 Queens problem by using Backtracking.
8.	Implement 0-1 knapsack problem using branch and bound approach
	Group B (Mini Project) **Select any one problem statement**
1.	Implement Tower of Hanoi.
2.	Implement Chessboard Game..
3.	Stochastic Control by using Dynamic Programming.
4.	Crossword Puzzle.
5.	Implement job scheduling.
6.	Implement Sudoku.
7.	Build Maze for shortest path.
8.	

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	2	3	2	2	-	-	-	-	-	-	-	-
CO2	2	3	2	2	-	-	-	-	-	-	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Second Year of Engineering (2024-25 Course)
ESC-CS 604: Software Design and Methodologies

Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 02 Hours/Week	**04**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:
- Fundamentals of programming and object oriented programming concepts

Companion Course, if any: - ESC-CS 503: Animation Design Principles

Course Objectives:
- To understand the fundamentals of object modeling
- To understand and differentiate Unified Process from other approaches.
- To design with static UML diagrams.
- To design with the UML dynamic and implementation diagrams.
- To improve the software design with design patterns.
- To develop the agile model.

Course Outcomes:
On completion of the course, learner will be able to–
CO1: Apply software design principles to develop software.
CO2: Design Use case diagrams for specific application.
CO3: Design different UML diagrams for specific application
CO4: Create a dynamic and architectural model for given problem statement.
CO5: Create the design patterns for given problem statement.
CO6: Develop the agile model for real world applications

Course Contents

Unit I	**Introduction to Software Design**	**(05 Hours)**
Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring,		
#Exemplar/Case Studies	College Management system	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**UNIFIED PROCESS AND USE CASE DIAGRAMS**	**(05 Hours)**

Introduction to Object Oriented Analysis and Design with Object Oriented Basics - Unified Process – UML diagrams – Use Case –Case study – the Next Gen POS system, Inception -Use case Modelling – Relating Use cases – include, extend and generalization – When to use Use-cases.		
#Exemplar/Case Studies	Library Management system	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**STATIC UML DIAGRAMS**	**(05 Hours)**
Class Diagram— Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition - Relationship between sequence diagrams and use cases – When to use Class Diagrams.		
#Exemplar/Case Studies	Hospital management system	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**DYNAMIC AND ARCHITECTURAL MODELING UML DIAGRAMS**	**(06 Hours)**
Dynamic Diagrams – UML interaction diagrams - System sequence diagram – Collaboration diagram – When to use Communication Diagrams - State machine diagram and Modelling –When to use State Diagrams - Activity diagram – When to use activity diagrams Implementation Diagrams - UML package diagram - When to use package diagrams - Component and Deployment Diagrams – When to use Component and Deployment diagrams.		
#Exemplar/Case Studies	Online shopping	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**DESIGN PATTERNS AND ELEMENTS**	**(06 Hours)**
DESIGN PATTERNS : GRASP-Designing objects with responsibilities –Applying GoF design patterns – Creational Patterns , Structural Patterns , Behavioral Patterns, Design Elements: 54 Architectural design elements - Interface design elements - Component level diagram elements - Deployment level design elements, Mapping design to code.		
#Exemplar/Case Studies	Web application Login Controller	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**AGILE METHODOLOGY**	**(05 Hours)**
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values		
#Exemplar/Case Studies	Web application Login Controller	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

TEXT BOOKS:

1. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Third Edition, Pearson Education, 2005.

2. Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition – 1999.

Reference Books:

6. Erich Gamma, a n d Richard Helm, Ralph Johnson, John Vlissides, "Design patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley, 1995.
7. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Third edition, Addison Wesley, 2003.

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	2	-	-	-	-	-	-	1
CO3	2	-	1	-	1	-	-	-	1	-	1	-
CO4	1	-	2	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	1	-	-	-	-	-	-	1
CO6	2	1	-	-	-	-	-	-	-	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Second Year of Engineering (2024-25 Course)
ESC-CS 604: Software Design and Methodologies Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: ESC-CS 503: Animation Design Principles, PCC-CS-502: Design & Thinking

Course Objectives:

- To Apply software design principles to develop software.
- To Design Use case diagrams for specific application.
- To Create different UML diagrams for specific application

Course Outcomes:

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

CO1: Design Use case diagrams for specific application.
CO2: Design different UML diagrams for specific application
CO3: Create a dynamic and architectural model for given problem statement.
CO4: Create the design patterns for given problem statement.

Guidelines for Instructor's Manual

The instructor's manual should be created as a comprehensive guide and practical tool. It should encompass an introduction (detailing information about the University, program, institute, department, foreword, and preface), the course curriculum, guidelines for conducting classes and assessments, topics covered, concepts, objectives, outcomes, a selection of typical applications/assignments/guidelines, and reference materials..

Guidelines for Student's Laboratory Journal

Students are required to submit their laboratory assignments in the form of a journal. This journal should include a certificate, a table of contents, and a handwritten write-up for each assignment. The write-up should cover the assignment title, completion date, objectives, problem statement, software and hardware requirements, assessment grades/marks with the assessor's signature, a brief overview of the theory/concepts, algorithm, flowchart, test cases, test data set (if applicable), mathematical models (if applicable), and conclusion/analysis. Additionally, softcopies of program codes along with sample outputs for all assignments must be submitted. In an effort to promote environmental consciousness and contribute to Green IT, please refrain from attaching printed papers to the journal. Instead, it is encouraged to utilize a DVD containing students' programs, which will be maintained by the Laboratory In-charge. For reference purposes, one or two journals with program prints may be retained in the Laboratory.

Guidelines for Laboratory /Internal Assessment

The Continuous Assessment of laboratory work should consider a student's overall performance on laboratory assignments. Each assessment of laboratory assignments will allocate grades/marks based on various criteria, including adherence to deadlines, performance, creativity, effective coding, and punctuality.

Guidelines for Practical Examination

The formulation of problem statements should be a collaborative effort between the internal and external examiners. In practical assessments, utmost importance should be placed on successfully executing the problem statement. Evaluation may include relevant questions to gauge students' grasp of fundamental concepts and their ability to implement solutions effectively and efficiently. This approach promotes transparent evaluation and fairness, thereby alleviating any uncertainty or doubt among students. Adhering to these principles will solidify our collective efforts for a promising beginning to students' academic journey.

Guidelines for Laboratory Conduction

The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.

Operating System recommended: - Windows / Linux

Programming tools recommended: - StarUML/Rational Rose

Part I : Unified Modeling Language diagrams

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	Document the Software Requirements Specification (SRS) for the identified system
2.	Identify use cases and develop the Use Case model.
3.	Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.

4.	Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
5.	Draw relevant State Chart and Activity Diagrams for the same system.
6.	Implement the system as per the detailed design
7.	Test the software system for all the scenarios identified as per the use case diagram
8.	Improve the reusability and maintainability of the software system by applying appropriate design patterns.
	Group B (Mini Project) **Select any one problem statement**
1.	e-Library online public access catalog (OPAC)
2.	Restaurant business model
3.	Online shopping system
4.	Hospital Management
5.	Software protection and licensing
6.	Online ticket booking System
7.	Netflix
8.	Any real world application other (choice of student)

@The CO-PO Mapping Matrix

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

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Computer Science & Design (2024-25 Course)

PCC-CS-601 : Engineering Design & Innovation-IV

Teaching Scheme:	Credit	Examination Scheme:
Practical : 4 Hours/week	**2**	**Internal (PR): 20 Marks** **External (PR): 30 Marks**

Prerequisite Courses, if any:

- Any Programming Language

Companion Course, if any:

Course Objectives:

- The primary objective of this course is to develop critical thinking and problem- solving skills by exploring and proposing solutions to current computer engineering problems in real world. This course to provide every student opportunity to get involved either individually or group so as to develop team skills and learn professionalism.

Course Outcomes:

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

CO 1: To Identify real life problems from societal need point of view through extensive literature survey.

CO 2: Prepare and submit the paper/papers in peered reviewed journal/conference or prepare and submit the draft for patent/ copyright on implementation work

CO 3: Prepare Business model for implemented system

CO 4: Participate in different technical competitions/ contests.

Guidelines for Assessment

EDI requires regular mentoring by faculty throughout the semester for successful completion of the idea/project tasks selected by the students per batch. EDI is monitored and continuous assessment is done by supervisor /mentor and authorities. It is recommended that all activities should be recorded regularly, regular assessment of work needs to be done and proper documents need to be maintained at college end by both students as well as mentors.

In EDI- IV, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is duly certified by the concerned guide and head of the Department/Institute. Project Exam will be conducted at the end of the semester.

The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is duly certified by the concerned guide and head of the Department/Institute. Project Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
3. Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities should to be recorded regularly, regular assessment of work need to be done and proper documents need to be maintained at the college end by both students as well as mentors.

Continuous Assessment Sheet (CAS) is to be maintained by mentors/departments.

Parameters for Assessment -Weightage

1. Final & Complete Implementation of the Project – 40%
2. Performance evaluation of the Project – 10%
3. Submission of the Project report in LATEX as per given guidelines. – 10%
4. Demonstration of the Project within given timeline – 20%
5. Participation in International/ National Conference/ Hackathon/ Participation in Project Competitions – 10%
6. Paper Publication in 2 referred Journals / Filing Patent/ Copyright Registration – 10%

Text Books:

T1.A new model of problem-based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

T1.Problem Based Learning. By Mahnazmoallem, Woei Hung and Nada Dabbagh, Wiley Publishers. 2019.

T2.Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Capraro, Mary Margaret Capraro

T3.Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures" Cambridge University Press, 2011, ISBN 978-0-521-76414-8.

Reference Books:

R1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.

R2. Gopalan," Project management core text book", 2 Indian Edition

R3. James Shore and Shane Warden, "The Art of Agile Development"

R4. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562-8.

@The CO-PO mapping table

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

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Third Year of Engineering (2024-25 Course)

PCC-CS-602 : Design Thinking

Teaching Scheme:	Credit	Examination Scheme:
Tut: 02 Hours/Week	02	Internal (TH): 20 Marks External (TH): 30 Marks

Prerequisite Courses, if any: None

Companion Course, if any: Not applicable

Course Objectives:

- Introduce tools & techniques of design thinking for innovative product development
- Illustrate customer-centric product innovation using on simple use cases
- Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

Course Outcomes:

CO1: Generate and develop design ideas through different techniques.
CO2: Define & test various hypotheses to mitigate the inherent risks in product innovations.
CO3: Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit by various tools.
CO4: Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching
CO5: Apply design thinking concepts to give solution for the problems identified
CO6: Apply system thinking in a real-world scenario

Course Contents

Unit I	Design Thinking Principles	(04 Hours)

Exploring Human-centered Design , Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] , Case studies

Activity: Apply the Forge Innovation Rubric (FIR) to a hypothetical example of validating a new mobile app designed to help users reduce food waste

#Exemplar/Case Studies	Case study on Duolingo using the Forge Innovation Rubric (FIR)
Mapping of Course Outcomes for Unit I	CO1

Unit II	End User - centric Innovation	(04 Hours)

Importance of customer-centric innovation , Problem Validation and Customer Discovery , Understanding problem significance and problem incidence , Customer Validation, Target user, User persona & user stories, Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design .

Activity: Customer development process - Customer interviews and field visit

#Exemplar/Case Studies	UberEats: Key innovations in user-centric approach
Mapping of Course Outcomes for Unit II	CO2

Unit III	Tools for Design Thinking	(06 Hours)
Real-Time design interaction capture and analysis, Enabling efficient collaboration in digital space ,tools, Empathy for design , Collaboration in distributed Design ,Concept of Minimum Usable Prototype [MUP] , MUP challenge brief , Designing & Crafting the value proposition , Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design Activity : Simulation exercises for collaborated enabled design thinking		
#Exemplar/Case Studies	Case studies on design thinking for real-time interaction and analysis	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	Design Thinking for Strategic Innovation	(04 Hours)
Innovation Management, Changing Management Paradigms, Design Thinking in Business, Linking Design Thinking Solution to Business Challenges, Rapid prototyping, Strategy and Organization – Business Model Design Activity: Business model examples of successful designs		
#Exemplar/Case Studies	The Impact of Design Thinking on Innovation: A Case Study at Scania IT	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Concept Generation	(04 Hours)
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility; Systematic concept generation; evaluation of technology alternatives and the solution concepts Activity: Create an example of a Minimum Usable Product (MUP) for a fitness tracking app		
#Exemplar/Case Studies	Case Study: Mobile Task Management App (MUP Design)	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	System Thinking	(06 Hours)
System Thinking, Design Thinking to Business Process modelling , Agile in Virtual collaboration environment , Scenario based Prototyping, Design Thinking vs Agile Methodology, **DevOps vs Agile** methodology, Understanding Systems, Examples and Understandings, Complex Systems Activity: Simulation on the role of virtual eco-system for collaborated prototyping		
#Exemplar/Case Studies	Case study of Apple :Development of the iPhone's User Interface (UI)	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

TextBooks:

1. Steve Blank, “The four steps to epiphany: Successful strategies for products that win”, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, “Value Proposition Design: How to Create Products and Services Customers Want”, Wiley
3. Donella H. Meadows “Thinking in Systems -A Primer”, Sustainability Institute.
4. Tim Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

Reference Books:

1. John.R.Karsnitz, Stephen O’Brien and John P. Hutchinson, “Engineering Design”, Cengage learning (International edition) Second Edition.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	1	-	-	-
CO2	3	1	2	-	-	-	-	-	1	-	-	-
CO3	3	1	2	1	-	-	-	-	1	-	-	-
CO4	3	2	-	-	1	-	-	-	1	-	-	-
CO5	3	2	1	1	1	-	-	-	2	-	-	1
CO6	3	2	2	2	3	-	-	-	2	-	-	1

SEMESTER VII						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
PEC-CS 701	Skill Enhancement Course-V	2	0	0	2	2
PCC-AI 702	Project- I/ Internship	0	0	28	28	14
	Total	**2**	**0**	**28**	**30**	**16**
Skill Enhancement Course-V: Graphics Design UI/UX/Computer Vision/Computer Game Design/Application Development Augmented using Reality & Virtual Reality/ Computer Game Design						

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Fourth Year of Engineering (2024-25 Course)

PEC-CS 701 : Skill Enhancement Course-V
Application Development using Augmented Reality & Virtual Reality

Teaching Scheme:	Credit	Examination Scheme:
TH: 02 Hours/Week	02	Internal (TH): 20 Marks External (TH): 30 Marks

Prerequisite Courses, if any: Computer Graphics

Companion Course, if any: Not Applicable

Course Objectives:

1. To understand the need and significance of Virtual Reality.
2. To explore the concepts of Virtual reality and develop 3D virtual environments.
3. To understand the technical and engineering aspects of virtual reality systems.
4. To analyze various techniques for applying virtual reality.
5. To provide a foundation to the fast growing field of AR and make the students aware of the various AR devices.

Course Outcomes:

On completion of the course, learner will be able to–
CO1. Describe how VR systems work and list the applications of VR
CO2. Elaborate geometric presentation of the virtual world and its operations
CO3. Explain the concepts of motion and tracking in VR systems
CO4. Design and implementation of the hardware that enables VR systems to be built.
CO5. Describe how AR systems work and analyze the hardware requirement of AR
CO6. Use different tools to design and develop AR/VR applications

Course Contents

Unit I	**Introduction to Virtual Reality**	(02 Hours)

What is virtual reality? ,The beginnings of VR ,VR paradigms , Collaboration, Virtual reality systems, Representation ,User interaction

#Exemplar/Case Studies	Walmart's virtual-reality employee training
Mapping of Course Outcomes for Unit I	CO1

Unit II	**The Geometry of Virtual Worlds**	(02 Hours)

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations

#Exemplar/Case Studies	Balenciaga's VR-powered promotions

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Motion in Real and Virtual Worlds**	(04 Hours)
Velocities and Accelerations , The Vestibular System , Physics in the Virtual World , Mismatched Motion and Vection		
#Exemplar/Case Studies	Virtual Reality Game	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Applying Virtual Reality**	(05 Hours)
Virtual reality: the medium, Form and genre, What makes an application a good candidate for VR, Promising application fields, Demonstrated benefits of virtual reality , A framework for VR application development		
#Exemplar/Case Studies	Kellogg's virtual-reality merchandising	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Augmented Reality**	(05 Hours)
Terminology, Simple augmented reality, Augmented reality as an emerging technology, Augmented reality applications, Marker detection, Marker pose, Marker types and identification: Template markers, 2D bar-code markers, Imperceptible markers: Image markers, Infrared markers, Miniature markers,		
#Exemplar/Case Studies	General marker detection application	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Applications and Development Tools**	(06 Hours)
Designing and developing 3D user interfaces, Application of VR and AR, Digital Entertainment: VR Technology in Film & TV Production, Demonstration of Digital Entertainment by VR tools, Development Tools in VR. X3D Standard: Blender, Unity		
#Exemplar/Case Studies	Unreal engine 4, Three.js	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

TextBooks:
1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)‖. Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig,William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker-based augmented reality SanniSiltanen
5. Virtual Reality Filmmaking, Celine Tricart,2018

Reference Books:
1. AR Game Development‖, 1st Edition,Allan Fowler, A press Publications, 2018, ISBN 978-1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
3. Learning Virtual Reality, Tony Parisi,O'Reilly Media, Inc., 2015, ISBN- 9781491922835

Useful Links:

1. https://nptel.ac.in/courses/106/106/106106138/
2. https://www.mooc-list.com/course/introduction-xr-vr-ar-and-mr-foundations-coursera
3. http://msl.cs.uiuc.edu/vr/
4. https://nptel.ac.in/courses/121/106/121106013/

@The CO-PO mapping table

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CO2	3	1	3	-	-	-	-	-	-	-	-	-
CO3	3	1	3	1	-	-	-	-	-	-	-	1
CO4	3	2	-	-	1	-	-	-	-	-	-	1
CO5	3	2	3	1	1	-	-	-	-	-	-	1
CO6	3	2	3	2	3	-	-	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Engineering (2024-25 Course)

PEC-CS 701 : Skill Enhancement Course-V

Computer Game Design

Teaching Scheme:	Credit	Examination Scheme:
TH: 02 Hours/Week	02	Internal (TH): 20 Marks External (TH): 30 Marks

Prerequisite Courses, if any: Computer Graphics, Discrete Structures

Companion Course, if any: Game Engineering

Course Objectives:

1. To develop strong conceptual underpinnings of games.
2. To understand the complete structure of a computer game and the major components of a game engine.
3. To develop creativity and individuality in problem solving and performing tasks.
4. To learn how to design challenges, rules and feedback when implementing and aligning the game activities with goals.
5. To develop competencies necessary for graduate students to be employed in the game design industry.

Course Outcomes:

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

CO1. Describe fundamentals of game designing and the social- ethical issues in game development.
CO2. Develop creative and critical thinking skills for designing compelling games.
CO3. Apply game mechanics to make the game more enjoyable.
CO4. Analyze Games over Networks and Peer Effects.
CO5. Demonstrate an understanding of various tools that are used in game development.
CO6. Apply mathematical and game programming knowledge and skills to solve development tasks

Course Contents

Unit I	An Introduction to Games and Gaming	(03 Hours)

Definition of Gamification, Why Gamify, Examples and Categories, Gamification in Context, Resetting Behaviour, Replaying History, Gaming foundations, The role of Game Designer, A Model of Games, Game-Player and Experience, Play Mechanics, Interface, Game Systems, Design Work, Prototyping and Playtesting Cycles, Playtesting.
Re-framing Context: Concepts Applied to Video games and Gamification

#Exemplar/Case Studies	Clash of Clans
Mapping of Course Outcomes for Unit I	CO1, CO2, CO6

Unit II	Game Mechanism and Design Fundamentals	(05 Hours)

Reclaiming Opposition: Counter gamification, Gamed Agencies: Affectively Modulating Our Screen- and App-Based Digital Futures, Remodelling design, Game Mechanics: Elements, Designing for Engagement, Game Mechanics and dynamics. Rules of Play: Defining Rules, Rules on Three Levels, The Rules of Digital Games,Network effects and games over networks: Positive and negative externalities, Utility-based resource allocation, Selfish routing, Wardrop and Nash equilibrium, partially optimal routing, Network pricing,Competition and implications on network performance, Strategic network formation,Design Issues for Online Gaming		
#Exemplar/Case Studies	Case Study: Cricket League	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	Graphics and Animation	(06 Hours)
Introduction to 3D Modeling, Box Modeling with Polygons,Subdivision Surfaces, 3D Sculpting, Reverse Engineering, BSP Modeling, Modeling Methodology,Texture Mapping, Mapping UV Coordinates, Animation, Motion Capture, Motion Extraction, Mesh Deformation, Inverse Kinematics, Collision Detection, Real-Time Animation Playback, Character Development and Animation, Facial Animation		
#Exemplar/Case Studies	NURBS	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	Programming Languages and Fundamentals	(05 Hours)
C++ and Game Development, Java, Scripting Languages, Data Structures, Object-Oriented Design in Games, Component Systems, Design Patterns Game Architecture, Memory and Debugging: Bird's-Eye View of a Game, Initialization/Shutdown Steps, Main Game Loop, Game, Entities, Memory Management, File I/O, Game Resources, Serialization, The Five-Step Debugging Process		
#Exemplar/Case Studies	Angry Birds game	
Mapping of Course Outcomes for Unit IV	CO3, CO4	
Unit V	**Tools and Techniques**	(04 Hours)
Godot 3.2, Construct 2, Unity: Game Engine, LOVE 2D: Framework, GameMaker: Studio, Clickteam Fusion 2.5,GameFroot ,Sploder, Stencyl, Flowlab, GameSalad, Scratch,Instant Gamification Platforms:Mambo.io, Installation and use of BigDoor		
#Exemplar/Case Studies	The Sandbox Game Maker	
Mapping of Course Outcomes for Unit V	CO3, CO5	
Unit VI	**Trends and Case Studies**	(04 Hours)
Artificial Intelligence for Games: AI for Games, Game Agents, Finite-State Machines, Common AI Techniques, Search Space, Pathfinding, Audio and Network, Programming Basic Audio, Programming Music Systems, Programming Advanced Audio Case studies:Counter-Strike, Minecraft, Nike Plus: Making Fitness Fun,Yahoo! Gamifies Questions,Axie Infinity: blockchain-based game		
#Exemplar/Case Studies	Hidden Door: AI powered	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

TextBooks:

1. Gabe Zechermann, Christopher Cunningham, Gamification by Design, Oreilly media, First, ISBN: 978-1-449-39767-8.
2. Martin Osborne, An Introduction to Game Theory, Oxford University Press
3. Steve Rabin, Introduction to Game Development, 2nd ed. Course Technology 2010, 978-1-58450-679-9.

Reference Books:

1. Kenneth C. Finney, 3D Game Programming: All in One, 3rd Ed Course Technology 2013, 978-1-4354- 5744-7.
2. Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, Delmar Cengage Learning

Useful Links:

1. https://godotengine.org/
2. https://mambo.io/
3. https://gamemaker.io/

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	3	-	-	-	-
CO2	3	2	-	1	-	-	-	-	-	-	-	-
CO3	3	2	3	1	-	-	-	-	-	-	-	-
CO4	3	-	3	1	1	-	-	-	-	-	-	-
CO5	1	2	1	-	3	-	-	-	-	-	-	1
CO6	3	-	-	2	3	-	-	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Engineering (2024-25 Course)

PEC-CS 701 : Skill Enhancement Course-V

Computer Vision

Teaching Scheme:	Credit	Examination Scheme:
TH: 02 Hours/Week	02	Internal (TH): 20 Marks External (TH): 30 Marks

Prerequisite Courses, if any: 1.Image processing
2.Mathematics (Linear algebra, calculus, geometry, Fourier transform)

Companion Course, if any: Image Processing

Course Objectives:

1. To review image processing techniques
2. To understand shape and region analysis.
3. To understand Hough Transform and its applications to detect lines, circles,ellipses.
4. To understand three-dimensional image analysis techniques and motion analysis.
5. To implement computer vision algorithms for real-world problems

Course Outcomes:

On completion of the course, learner will be able to–
CO1. Apply fundamental image processing techniques
CO2. Evaluate shapes and regions
CO3. Illustrate Hough Transform for line, circle, and ellipse detections.
CO4. Analyze different 3D vision techniques
CO5. Acquire knowledge of motion analysis
CO6. Design applications using computer vision techniques

Course Contents

Unit I	Introduction to computer vision	(03 Hours)

Introduction to computer vision, CV challenges, Comparison between image processing and Computer Vision, Classical filtering operations; thresholding techniques; edge detection technique, Applications

#Exemplar/Case Studies	Automotive Industry - Object Recognition and Classification on Traffic
Mapping of Course Outcomes for Unit I	CO1

Unit II	Shapes And Regions	(05 Hours)

Binary shape analysis; connectedness; object labeling and counting; distance functions; skeletons and thinning; Deformable shape analysis, Boundary tracking procedures; active contours; shape models and shape recognition; centroidal profiles; handling occlusion; boundary length measures; boundary descriptors

#Exemplar/Case Studies	Pedestrian detection
Mapping of Course Outcomes for Unit II	CO2

Unit III	Hough Transform	(05 Hours)
Line detection; Hough Transform (HT) for line detection; foot-of-normal method; line localization; line fitting; RANSAC for straight line detection; HT based circular object detection; accurate centre location; speed problem; ellipse detection, applications		
#Exemplar/Case Studies	Circle Detection Using Circular Hough Transform	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	3D Vision	(05 Hours)
Methods for 3D vision; projection schemes; shape from shading; photometric stereo; shape from texture; surface representations; point-based representation; 3D object recognition; 3D reconstruction		
#Exemplar/Case Studies	Cobots: dreamvu	
Mapping of Course Outcomes for Unit IV	CO3, CO4	
Unit V	Introduction to Motion	(03 Hours)
Triangulation; bundle adjustment; translational alignment; parametric motion; Spline-based motion; optical flow; layered motion		
#Exemplar/Case Studies	Human Motion Analysis:vay	
Mapping of Course Outcomes for Unit V	CO3, CO5	
Unit VI	Applications	(03 Hours)
Applications: Face detection, face recognition foreground-background separation, Chamfer matching, tracking, and occlusion; Case Studies and recent researches in Computer Vision.		
#Exemplar/Case Studies	Car inspection: Tractable Skin cancer detection: skinvision	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		
TextBooks: 1. R. Szeliski, Computer Vision: Algorithms and Applications, Springer. 2. D. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education. 3. J. Solem, Programming Computer Vision with Python: Tools and Algorithms for Analyzing Images, O'Reilly.		

Reference Books:

1. M. Nixon and A. Aquado, Feature Extraction & Image Processing for Computer Vision, 3rd Edition, Academic Press.
2.R. Jain, R. Kasturi, B. Schunck, Machine Vision, Indo American Books.
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3.S. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press
4. Rafael C. Gonzalez : Digital image processing,Pearson

Useful Links:

1. https://towardsdatascience.com/computer-vision-for-beginners-part-1-7cca775f58ef
2. https://www.kaggle.com/learn/computer-vision
3. https://graphics.stanford.edu/courses/cs205a-13-fall/assets/notes/cs205a_notes.pdf

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CO1	3	1	1	-	-	-	-	-	-	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	-	-
CO3	3	2	3	1	-	-	-	-	-	-	-	-
CO4	3	2	3	1	1	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	1
CO6	3	3	3	2	3	-	-	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Engineering (2024-25 Course)

Graphics Design UI/UX

PEC-CS 701 : Skill Enhancement Course-V

Teaching Scheme:	Credit	Examination Scheme:
TH: 02 Hours/Week	**02**	**Internal (TH): 20 Marks** **External (TH): 30 Marks**

Prerequisite Courses, if any: Design Thinking I

Companion Course, if any: Human Computer Interface

Course Objectives:

- To learn basic design principles of UI and UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various tools used in UI & UX
- Creating a wireframe and prototype
- To study emerging trends in UI/UX design

Course Outcomes:

CO1: Learn fundamental aspects of designing and implementing user interfaces.

CO1:Build UI for various Applications

CO2:Evaluate UX design of any product or application

CO3:Demonstrate UX Skills in product development

CO4: Implement the interactive designs for feasible data search and retrieval.

CO5:To create Wireframe and Prototype

CO6: Apply recent trends in UI/UX design

Course Contents

Unit I	**Introduction to UI/UX Design**	(02 Hours)
What is UI and UX? Difference between UI and UX, Ubiquitous interaction, Understanding User Experience , Defining the UX Design Process and its Methodology		
#Exemplar/Case Studies	Mobile Banking App (Illustration for UI/UX features)	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Foundations of UI /UX Design**	(04 Hours)
Visual and UI Principles , UI Elements and Patterns , Interaction Behaviors and Principles ,Branding , Style Guides, User-centered Design Process, Persona mapping, Storyboarding, Scenario Map, Empathy Mapping, Methods of UX research - Qualitative/Quantitative, Data Gathering Methods and Sources		
#Exemplar/Case Studies	**Sample Pattern Library for any product (Mood board, Fonts, Colors based on UI principles)**	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	User Interface and Design Principles: Visual Design	(05 Hours)

Cognitive Studies for Better User Experience, Gestalt Principles, Visual Design - Color Theory, Typography, Using Graphics and Illustrations to Finalize Designs - Informational Components – Containers, User Interface Elements, UI Controls/Patterns - Input Controls - Navigational Components,Graphics, icons, and images		
#Exemplar/Case Studies	**Visual Design of Fitness Tracking App**	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	UI Prototyping and Styling	(05 Hours)
Prototyping, Wireframing, Fidelity of a Prototype - High / Medium / Low, Digital Prototype, Grid and Layout Systems, Interaction Design, Sketching Screens, Invision, Navigation, Creating Error Messages, Guerilla Usability Testing, Iconography,Interaction Design,Develop system menus		
#Exemplar/Case Studies	Balsamiq Wireframes, Breadcrumb Navigation	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	UX Research and Testing	(04 Hours)
Assessing Prototypes, Writing Good Heuristic Evaluations, Visibility of System Status, User Control and Freedom, Error Tolerance, Aesthetic and Minimalist Design, Planning and Conducting Usability Tests, A/B Testing, UX Laws, Design Validation & Tradeoffs		
#Exemplar/Case Studies	Heatmaps with Tools like Hotjar User Testing	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Emerging trends**	(04 Hours)
UX methods for Agile Development, AI-integrated Design, Cross-Platform UX, Emotionally Intelligent Design, Integrating AR and VR in UX Design		
#Exemplar/Case Studies	Gravity Sketch , Minsar studio	
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

TextBooks:

1. The Design of Everyday Things by Don Norman
2. Designing Interfaces: Patterns for Effective Interaction Design by Jenifer Tidwell
3. UX for Beginners, Joel Marsh, O'Reilly , 2022
4. Designing the User Interface: Strategies for Effective Human- Computer Interaction, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, ,6th Edition,Pearson Education Limited. ISBN 987-1-292-03701-1

Reference Books:

1. The Elements of User Experience: User-Centered Design for the Web and Beyond by Jesse James Garrett
2. The Essential Guide to user Interface Design, Wibert O. Galitz,WILEY India, ISBN: 978-1-265-0280-6

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	3	1	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	1
CO6	3	3	3	2	3	-	-	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune
Dr. D. Y. Patil School of Science & Technology
Fourth Year of Computer Science & Design (2024-25 Course)
PCC-AI 702 : Project-I/Internship

Teaching Scheme:	Credit	Examination Scheme:
TH: 28 Hours	**14**	**Internal (TH): __ Marks** **External (TH): __ Marks**

Prerequisite Courses, if any:

- In depth knowledge about societal/research/innovation/ entrepreneurial problems and appropriate applicable solutions

Companion Course, if any: Embedded Systems and IoT

Course Objectives:

- To gain the experience in preparing and writing Technical
- Documentation/ reports for product/projects.
- To Identify and analyze the societal/research/entrepreneurial
- Problem in detail to define its scope with problem specific data.
- To develop clarity of presentation based on communication,
- Teamwork and leadership skills.

Course Outcomes:

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

CO1: Apply the engineering and technical knowledge for problem Identification, analysis, design and developing solutions.

CO2: Present and demonstrate the real time problem solution across national/international project competitions and conference.

CO3: To write conference paper

CO4: To write code using tools and technologies or propitiatory Tools as per requirements;

CO5: To practice presentation, communication and team-work skills.

Project-I/Internship	**Supporting Activities to be completed under Project-I/Internship**	28 hours/ Week

- Here, 1 credit is equivalent to minimum 45 hours of work. Therefore, a full-time intern is expected to spend 45 hours per week on Internship, Training, Project work, Seminar activities etc. This will result in about minimum of 630 hours (i.e. 14 Credits) of total internship duration for B. Tech.
- Internship can be with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ Online Internship or Rural Internship.
- Student need to submit report that is to be evaluated by Faculty Mentor / TPO / Industry supervisor. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The students are encouraged to use the facility available to maintain their daily log on AICTE's Internship Portal. The daily diary may be asked to produce by the Industry Supervisor of Faculty Mentor of the student at any point of time. Failing to produce the same, Intern may be debarred for the remaining period of his/her internship. Thus, all interns must strictly maintain his/her diary. Daily Diary needs to be submitted to Faculty Mentor at the end of the Internship. Student's diary and Internship report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Faculty Mentor immediately after the completion of the training. It may be evaluated on the basis of the following

Criteria:

- Regularity in maintenance of the diary/log.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

@The CO-PO mapping table

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

CO5	3	2	3	3	1	-	-	1	1	-	-	1

SEMESTER VIII						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
PEC-CS 801	Skill Enhancement Course-VI	2	0	28	2	2
PCC-AI 802	Project- II/ Internship	0	0	28	28	14
	Total	**2**	**0**	**28**	**30**	**16**
Skill Enhancement Course-VI: R programming / tableau / PowerBI / SAS / Google Analytics						
TOTAL CREDITS - 168						

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune **Dr. D. Y. Patil School of Science & Technology** **Fourth Year of Engineering (2024 - 25 B. Tech Computer Science and Design)** **PEC-CS 801: Skill Enhancement Course-VI** **R-Programming**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 2 Hours/Week	**2**	**Internal (TH): 20 Marks** **External (TH): 30 Marks**

R Programming:

- Fundamentals of R programming, R scripts
- Basic statistics of R programming, data analysis

Companion Course, if any: R Programming

Course Objectives:

- To analysis data for the purpose of exploration using Descriptive and Inferential Statistics.
- To understand Probability and Sampling Distributions and learn the creative application of Linear Regression in multivariate context for predictive purpose.
- To define suitable data analysis workflows by interpreting simple R scripts
- To summarize basic statistics used in data analysis and interpreting simple R programs.

Course Outcomes:

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

CO1: To install, Code and Use R Programming Language in R Studio IDE to perform basic tasks on Vectors, Matrices and Data frames.

CO2: To describe key terminologies, concepts and techniques employed in Statistical Analysis.

CO3: To define, Calculate, Implement Probability and Probability Distributions to solve a wide variety of problems.

CO4: To conduct and interpret a variety of Hypothesis Tests to aid Decision Making.

CO5: To understand, Analyse, Interpret Correlation and Regression to analyse the underlying relationships between different variables.

CO6: Understand the concept of structured query language, xml and function.

Course Contents

Unit I	**Introduction**	**(06 Hours)**
What exactly is R? R and R-Studio, Installation, R-Studio, Overview Functioning in the Console Arithmetic, Operators, Logical Procedures Making Use of Functions, Obtaining Assistance in R and Leaving R-Studio		
#Exemplar/Case Studies	Book Call Number, Dictionary,	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Operators, variables in R**	**(07 Hours)**
Variables, Numeric, Characteristic, and Logical Data, Vectors, Data Frames, Factors, Numeric, Character, and Factor Vector Sorting, Special Values		
#Exemplar/Case Studies	Use different operators	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Control Statements**	**(08 Hours)**
If, if…else statement, if else () function, switch function, repeat loop, while loop, for loop, break statement, next statement, while loops, for loops, R Plot, R Line, R Pie Chart, R Bars		
#Exemplar/Case Studies	Use of different Loop	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Data Types in R**	**(08 Hours)**
Creating Vectors, accessing elements of a Vector, Operations on Vectors, Vector Arithmetic, creating matrices, accessing matrices' elements Matrices operations, transpose a matrix Creating strings, copying, and pasting Using format to format integers and strings manipulation of strings Creating and modifying lists, as well as manipulating list elements combining lists, converting lists to vectors, Arrays are created, and array elements are accessed. Calculations between array components, data frame creation Data frame operations, data frame access, and data frame manipulation Putting together data frames from a variety of sources		
#Exemplar/Case Studies	Use of different elements	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Statistics & Data Visualization**	**(08 Hours)**
Data visualization need. Bar Graph, Categorical data plotting Graph with stacked bars Line plot and histogram plot functions as pie chart / a three-dimensional pie chart. Scatter graph, Graph in a box, creating a working directory, Downloading, and importing data, working with missing data Extracting a subset of a data frame, Writing R scripts, Adding comments and documentation		

#Exemplar/Case Studies	Use of data to plot different graph	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Data and File Handling and SQL**	**(08 Hours)**
Reading and writing data: R CSV file, R Excel file, R XML file, R Database, Writing SQL statements in R Using the Select, From, Where Is, Like, Order By, Limit, Max, Min SQL functions, scripting, Introducing R-Studio and R-Studio-Cloud		
#Exemplar/Case Studies	Use of cloud for different data	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. Peng, R.D. (2020). R Programming for Data Science.
2. R in Action, By - Robert L. Kabacoff, Latest Edition – Second

Reference Books:

1. R for Data Science , Hadley Wickham and Garrett Gorlemund, Latest Edition – First Publisher - O'Reilly
2. Phillips, N.D. (2018). YaRrr, The Pirate's Guide to R.
3. Grolemund, G. and Wickham, H. (2019). R for Data Science

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CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	2	1	2	-	-	-	-	-	-	-	-

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Engineering (2024-25 Course)

PEC-CS 801 Skill Enhancement Course-VI

Google Analytics

Teaching Scheme:	Credit	Examination Scheme:
TH: 2 Hours/Week	**2**	**Internal (TH): 20 Marks** **External (TH): 30 Marks**

Prerequisite Courses, if any:

- Basic knowledge of charts, designs

Course Objectives:

- Describe how Analytics addresses your business's measurement needs
- Set up your Analytics account in a way that supports your business objectives
- Navigate the key features of the Analytics interface to surface the insights you care about

Course Outcomes:

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

CO1: To understand the basics of analytics

CO2: Learns how data gets collected and processed into readable reports and dashboards.

CO3: Learn how to collect data that's specific to your business

CO4: To understand basic campaign tracking and google ads campaign

CO5: To demonstrate more advanced analysis techniques

CO6: To demonstrate marketing strategies

Course Contents

Unit I	Introducing Google Analytics	(06 Hours)
Why digital analytics? How Google Analytics works, Measuring a website, Processing and reporting, Google Analytics setup, How to set up views with filters		
#Exemplar/Case Studies	To set up google analytics for a website	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**The Google Analytics Interface**	**(06 Hours)**
Navigating Google Analytics, Understanding overview reports, Understanding full reports, How to share reports, How to set up dashboards and shortcuts		
#Exemplar/Case Studies	Set up dashboards	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Data Collection and Processing**	**(06 Hours)**
Google Analytics data collection, Categorizing into users and sessions, Applying configuration settings, Storing data, generating reports, Audience reports Acquisition reports, Behavior reports, Creating a measurement plan		
#Exemplar/Case Studies	Prepare reports	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Basic Campaign and Conversion Tracking**	**(06 Hours)**
How to measure Custom Campaigns, Tracking campaigns with the URL Builder, Use Goals to measure business objectives, How to measure Google Ads campaigns		

#Exemplar/Case Studies	To measure Google Ads for any URL	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Advanced Analysis Tools and Techniques**	**(06 Hours)**
Analysis tools, Segment data for insight, Analyze data by channel, Analyze data by audience, Analyze data with Custom Reports		
#Exemplar/Case Studies	To analyze data captured by channels	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Advanced Marketing Tools**	**(06 Hours)**
Remarketing, Use, benefits, Set up of remarketing, Setting up Remarketing Audiences, linking of Google Analytics to Google Ads		
#Exemplar/Case Studies	Case study to link Google Analytics to Google Ads	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. Justin Cutroni, “Google Analytics”, O'Reilly Media, Inc.
2. Brain Clifton, “Successful Analytics, Gain Business Insights by Managing Google Analytics”
3. Feras Alhlou, “Google Analytics Breakthrough, Wiley Publication

e- learnings

1. https://analytics.google.com/analytics/academy/course/7
2. https://support.google.com/analytics/answer/12159447?hl=en
3. https://www.edureka.com
4. https://www.coursera.org/in/articles/google-analytics-certification

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CO2	1	2	2	-	-	-	-	-	-	-	-	1
CO3	1	2	2	-	-	-	-	-	-	-	-	1
CO4	1	2	2	-	1	-	-	-	-	-	-	1
CO5	1	2	2	-	-	-	-	-	-	-	-	1
CO6	1	2	2	-	-	-	-	-	-	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Engineering (2024-25 Course)

PEC-CS 801 Skill Enhancement Course-VI

Power BI

Teaching Scheme:	Credit	Examination Scheme:
TH: 2 Hours/Week	2	**Internal (TH): 20 Marks** **External (TH): 30 Marks**

Prerequisite Courses, if any:

Basic knowledge of charts, designs, python

Course Objectives:

- To Understand how to extract and transform data from various sources
- To clean and shape their datasets for optimal analysis
- To enhance their skills in calculation using DAX
- To prepare reports and dashboard

Course Outcomes:

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

CO1: Understand how to import data into Power BI.

CO2: Understanding of data modeling, DAX formulas, and interactive dashboard creation in Power BI

CO3: Understand when to use specific charts.

CO4: Integrate custom visuals into your reports and dashboards

CO5: Demonstrate connecting Python in Power BI

CO6: To perform advance analytics

Course Contents

Unit I	Introduction	(06 Hours)
Introduction to Power BI, Terminologies, Interface, Working with Power BI, Basic Components of Power BI, Power BI installation, Loading Data in Power BI Desktop, Transform, Clean, Shape and Model Data, Saving Work file		
#Exemplar/Case Studies	To complete the installation of PowerBI. Perform operation on dataset	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Data Analysis Expression (DAX)**	**(06 Hours)**
Introduction to DAX, Importance of DAX, Data Types in DAX, DAX Calculation Types, Steps to Create Calculated Columns, Measures in DAX, DAX Syntax, DAX Function, DAX Operators, DAX Tables and Filtering, Performing Data Analysis using DAX		
#Exemplar/Case Studies	To perform data analysis expression on datasets	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Data Visualization**	**(06 Hours)**
Introduction to Visuals In Power BI, Visualization Charts in Power BI, Matrixes and Tables, Modifying Colors in Charts And Visuals, Shapes, Text Boxes, and Images, Custom Visuals, KPI Visuals, maps		
#Exemplar/Case Studies	To prepare the visualization of any dataset	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Power BI Service**	**(06 Hours)**

Introduction to Power BI Service, Creating reports and dashboard, Publishing reports on Power BI Service, Using Power BI Service for operations on reports, Connecting to datasets in the Power BI service from Desktop		
#Exemplar/Case Studies	Connect the dataset to service desktop	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Python in Power BI**	**(06 Hours)**
Python Programming, Python Scripts in BI, Python integration with Power BI, Data cleaning and transformation, Power BI integration, importing data from python and creating dashboards		
#Exemplar/Case Studies	Use of python for visualization	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Perform Advanced Analytics**	**(06 Hours)**
Advanced Analytics in Power BI, segmentation and cohort analysis, Data streaming, Visualizations, Data connection and shaping		
#Exemplar/Case Studies	Perform data streaming and cohort analysis for dataset	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. Mastering Power BI by Brett Powell
2. Power BI Cookbook by Brett Powell
3. Microsoft Power BI Dashboards Step by Step by Errin O'Connor
4. Data Analysis with Power BI and Power Pivot for Excel by Marco Russo and Alberto Ferrari

e-learnings:

1. https://www.edureka.co/power-bi-certification-training.
2. https://www.simplilearn.com/power-bi-certification-training
3. https://www.nptel.com

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	1
CO2	1	2	2	-	-	-	-	-	-	-	-	1
CO3	1	2	2	-	-	-	-	-	-	-	-	1
CO4	1	2	2	-	1	-	-	-	-	-	-	1
CO5	1	2	2	-	-	-	-	-	-	-	-	1
CO6	1	2	2	-	-	-	-	-	-	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Engineering (2024-25 Course)

PEC-CS 801 Skill Enhancement Course-VI

SAS

Teaching Scheme:	Credit	Examination Scheme:
TH: 2 Hours/Week	2	Internal (TH): 20 Marks External (TH): 30 Marks

Prerequisite Courses, if any:

- Basic of programming

Course Objectives:

- Learn how to write SAS programs to access, explore, prepare, and analyze data.
- Understand the fundamentals of the SAS programming language.
- Access different types of data (SAS, Excel, or text) and explore and prepare the data.
- Analyze and report on data, exporting results to common formats

Course Outcomes:
On completion of the course, learner will be able to–
CO1: To understand basics of SAS
CO2: To understand data and work on data
CO3: To apply programming skills
CO4: To understand SAS functions
CO5: The statistical methods of studying data samples
CO6: Communicate the results of statistical analyses effectively

Course Contents

Unit I	Introduction	(06 Hours)
Introduction to SAS Programs, SAS Data types and Libraries, Data and Proc Steps, Format and In Format, Creating Output Proc Print, Proc Contents, Output Delivery System (ODS)		
#Exemplar/Case Studies	Perform programming to study SAS data types and libraries	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Data Management in SAS**	**(06 Hours)**
Reading Raw Data - Column Input, Understanding data step processing, Formatted Input and List Input, Reading date and time format, Reading instream data, Creation of raw data file from a dataset		
#Exemplar/Case Studies	Follow data processing steps on raw data	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**SAS Programming**	**(06 Hours)**
Managing variables in dataset, Assigning and Cumulative Statement, subsetting data, drop and keep option, if else, If else with do statement, Select When, Do loop statement, Managing SAS dataset using set statement		
#Exemplar/Case Studies	Implementation of conditional statements on SAS dataset	
Mapping of Course Outcomes for Unit III	CO3	

Unit IV	SAS Functions	(06 Hours)
SAS functions Overview, String Functions, Conversion Functions ,Date Functions Mathematical Functions		
#Exemplar/Case Studies	Programming using functions	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**SAS Statistics**	**(06 Hours)**
Descriptive Statistics - Proc mean and Proc freq, Proq report - column, define, headline, head skip, compute, order and group, Proc tabulate, Proc transpose		
#Exemplar/Case Studies	To perform descriptive statistics using proc statements	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**SAS Report**	**(06 Hours)**
Combining data set - one to one reading, concatenation and merge, Array - single and multidimensional array, Proc print to, proc import, proc export, SQL procedure		
#Exemplar/Case Studies	Prepare and export report	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. Susan Slaughter and Lora Delwich, "The Little SAS Enterprise SAS Book"
2. SAS Institute, "SAS Certification Prep Guide: Base Programming for SAS9, Fourth Edition"
3. Ron Cody, "Learning SAS by Example: A Programmer's Guide"
4. Tricia Aanderud and Angela Hall," Building Business Intelligence Using SAS: Content Development Examples"

e-learnings:

1. Getting Started with SAS Programming Course by SAS | Coursera
2. SAS Training, Courses & Classes | SAS India
3. Course: SAS® Programming 1: Essentials

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	1
CO2	1	2	2	-	-	-	-	-	-	-	-	1
CO3	1	2	2	-	-	-	-	-	-	-	-	1
CO4	1	2	2	-	1	-	-	-	-	-	-	1
CO5	1	2	2	-	-	-	-	-	-	-	-	1
CO6	1	2	2	-	-	-	-	-	-	-	-	1

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Fourth Year of Engineering (2024-25 Course)

PEC-CS 801 Skill Enhancement Course-VI

Tableau

Teaching Scheme:	Credit	Examination Scheme:
TH: 2 Hours/Week	2	Internal (TH): 20 Marks External (TH): 30 Marks

Prerequisite Courses, if any:

- Basic knowledge of charts, designs
- Basic knowledge of computers

Course Objectives:

- Use Tableau techniques to address common business use cases.
- Format your visualizations and dashboards for maximum impact.
- Explore real world business scenario examples.

Course Outcomes:

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

CO1: To understand and get started with Tableau
CO2: To connect to data to edit its source.
CO3: To sort, filter, and group data
CO4: To build a range of essential chart types for analysis
CO5: To build interactive dashboards to reveal data insights.
CO6: To learn and create stories

Course Contents

Unit I	Introduction and Overview	(06 Hours)
Why Tableau? Understand the Tableau Workflow, Recognize Elements of a Visualization, Get Started in Tableau, Understanding the Tableau workspace, Building Basic Views		
#Exemplar/Case Studies	To get started with Tableau and understanding of basic workflow	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Connection and Data Source Setup**	**(06 Hours)**
File types, Identify Tableau File Types and Extensions, Create a Live Data Connection, Save and Edit a Data Source, Modify Data Attributes, Understand Changes to Data		
#Exemplar/Case Studies	To create and connect a live data source	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Data Simplification, Sorting & Organization**	**(06 Hours)**
Filter Data , Create Date Filters , Sort Data, Use Groups, Create and Use Hierarchies, Work with Dates in Tableau , Create Crosstabs, Map in Tableau		
#Exemplar/Case Studies	To work with data (create, filter, maps)	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Build Charts and Analyze Data**	**(06 Hours)**
Build Views with Ask Data, Navigating to Ask Data lenses, Build queries, Change fields, filters, and displayed data, Adjust date filters, analyze data		

#Exemplar/Case Studies	Build charts using templates	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Create a Dashboard**	**(06 Hours)**
Create a dashboard, and add or replace sheets, Add dashboard objects, options, Navigation and Download objects, Accelerators, Dynamic Axis		
#Exemplar/Case Studies	Create interactive dashboard	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Create Stories**	**(06 Hours)**
The Story Workspace, Best Practices, create story, explore layout options, Fit a dashboard to story, formatting, present the story		
#Exemplar/Case Studies	Create and publish stories by using layouts	
Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. Tristan Guillevin , "Getting Started with Tableau 2019.2 (Second Edition)"
2. Marleen Meier, David Baldwin, "Mastering Tableau 2019.1 (Second edition)"
3. Joshua N. Milligan," Learning Tableau 2019 (Third edition)"
4. Jen Stirrup, "Tableau: Creating Interactive Data Visualizations"
5. Jen Stirrup, Ruben Oliva Ramos, " Advanced Analytics with R and Tableau"

e- learnings

1. Automatically Build Views with Ask Data - Tableau
2. Free Training Videos - 2023.2 (tableau.com)
3. https://www.udemy.com/course/tableau
4. https://www.edureka.com

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	1
CO2	1	2	2	-	-	-	-	-	-	-	-	1
CO3	1	2	2	-	-	-	-	-	-	-	-	1
CO4	1	2	2	-	1	-	-	-	-	-	-	1
CO5	1	2	2	-	-	-	-	-	-	-	-	1
CO6	1	2	2	-	-	-	-	-	-	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Fourth Year of Computer Science & Design (2024-25 Course)

PCC-CS 702 : Project-II/Internship

Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 28 Hours	**14**	**Internal (TH): __ Marks** **External (TH): __ Marks**

Prerequisite Courses, if any:

- In depth knowledge about societal/research/innovation/ entrepreneurial problems and appropriate applicable solutions

Companion Course, if any: Embedded Systems and IoT

Course Objectives:

- To gain the experience in preparing and writing Technical
- Documentation/ reports for product/projects.
- To Identify and analyze the societal/research/entrepreneurial
- Problem in detail to define its scope with problem specific data.
- To develop clarity of presentation based on communication,
- Teamwork and leadership skills.

Course Outcomes:

After completion of the course students will be able to use different experimental techniques.
CO1: Students will be able to use different software/ computational/analytical tools.
CO2: Students will be able to design and develop an experimental set up/ equipment/test rig.
CO3: Students will be able to conduct tests on existing set ups/equipment and draw logical conclusions from the results after analyzing them.
CO4: Students will be able to either work in a research environment or in an industrial environment.
CO5: Students will be conversant with technical report writing.
CO6: Students will be able to present and convince their topic of study to the engineering community.

Project-II/Internship	**Supporting Activities to be completed under Project-II/Internship**	28 hours/ Week

Selection of Technology, Installations, UML implementations, testing, Results, and performance discussions using data tables per parameter considered for the improvement with existing known algorithms and comparative graphs to support the conclusions drawn. Student should publish one International Journal Paper (having ISSN Number and preferably with Citation Index II); or paper can be published in reputed International Journal recommended by the guide of the project and in addition to above the term work shall include the paper published, reviewers comments and certificate of presenting the paper in the conference. To maintain the quality of the project work it is mandatory on the project guides to maintain a progressive record of the project which shall include the project discussion agenda, weekly outcomes achieved during practical sessions, corrective actions and comments on the progress report as per the plan submitted by the students including dates and timing, along with the signature of the student as per the class and teacher time table; such record of progressive work shall be referred by the project examiners during evaluation.

Criteria:

- Regularity in maintenance of the diary/log.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

@The CO-PO mapping table

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