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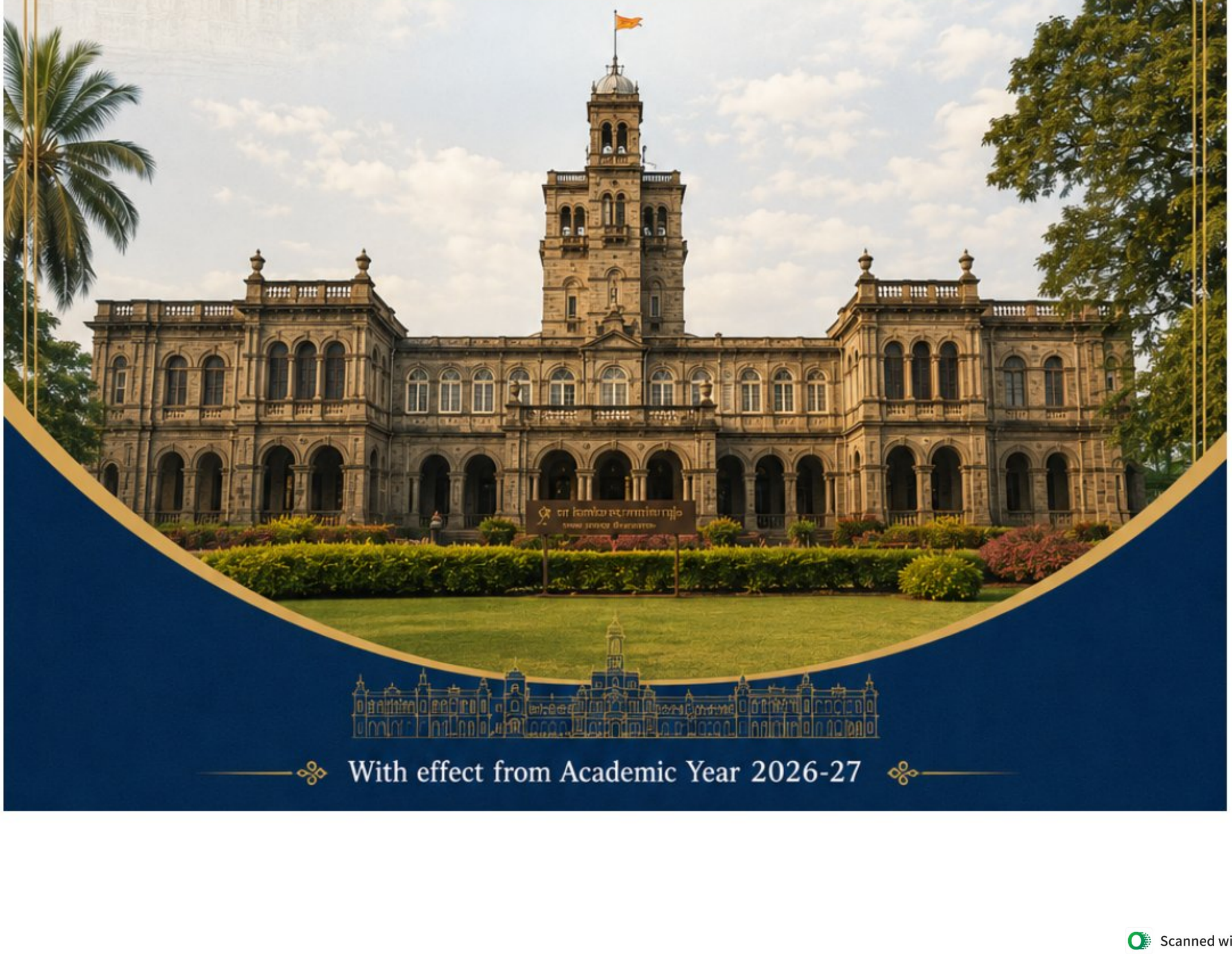
Savitribai Phule Pune University, Pune

Faculty of Science and Technology

National Education Policy (NEP) - 2020
Compliant Curriculum

S. E. (Computer Engineering)

2024 Pattern - Revised



With effect from Academic Year 2026-27

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Nomenclature

AEC Ability Enhancement Course

AICTE All India Council for Technical Education

CEP Community Engagement Project

EEM Entrepreneurship/Economics/Management Courses

MDM Multidisciplinary Minor

MOOC Massive Open Online Course

NEP National Education Policy

NPTEL National Programme on Technology Enhanced Learning

OE Open Elective

PCC Program Core Course

PEO Programme Educational Objectives

PSO Program Specific Outcomes

SWAYAM Study Webs of Active-learning for Young Aspiring Minds

UGC University Grants Commission

VEC Value Education Course

VSE Vocational and Skill Enhancement Course

WK Knowledge and Attitude Profile

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Preface by Board of Studies

Dear Students and Teachers,

The Indian higher education landscape is undergoing a monumental shift, driven by the visionary National Education Policy (NEP) 2020. As the Chairman of the Board of Studies in Computer Engineering at Savitribai Phule Pune University, it gives me immense pride to present the revised curriculum structure and syllabi for the Second Year of Engineering (S.E.) Computer Engineering (2024 Pattern), implemented with effect from the Academic Year 2026–27.

Computer Engineering is a dynamic, rapidly evolving discipline that forms the backbone of global digital transformation. To prepare our students for this fast-paced ecosystem, this curriculum seamlessly integrates the core pillars of NEP-2020: holistic development, multi-disciplinary flexibility, skill-centric learning, and industry relevance. While maintaining the core technical rigor and fundamental continuity of the 2024 Pattern, this revision introduces a crucial recalibration in our assessment methodology to foster deeper engagement and sustained academic excellence.

The revised syllabus falls in line with the objectives of NEP - 2020, Savitribai Phule Pune University, AICTE New Delhi, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements. Wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided at the end of each course. In alignment with modern pedagogical best practices, a structured examination scheme has been instituted featuring 40 marks for Continuous Comprehensive Evaluation (CCE) and 60 marks for the End-Semester Examination. This shift reduces the pressure of high-stakes summative exams and encourages consistent, classroom-level active learning, critical thinking, and regular formative feedback.

This curriculum is the outcome of extensive deliberations, collaborative workshops, and invaluable inputs from distinguished academicians, industry stalwarts, prominent alumni, and dedicated faculty members. I extend my heartfelt gratitude to the members of the Board of Studies, the subject experts, and the university administration for their unwavering support and rigorous effort in bringing this revision to fruition.

I am confident that this student-centric, outcome-based curriculum will empower our faculty members to deliver high-quality instruction and inspire our students to innovate, research, and become competent professionals driving the future of technology.



Dr. Nilesh Uke
Chairman - Board of Studies (Computer Engineering)
Savitribai Phule Pune University

Members of Board of Studies - Computer Engineering	
Dr. Pramod Patil	Dr. Dipti Patil
Dr. Dhananjay Kshirsagar	Dr. Amol Potgantwar
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Dr. Pradip Jawandhiya	Dr. Sandeep Deshmukh

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Program Specific Outcomes (PSO)

- **PSO1:** Professional Skills-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
- **PSO2:** Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
- **PSO3:** Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Programme Educational Objectives (PEO)

Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PEO	PEO Focus	PEO Statements
PEO1	Core competence	Attainment of key principles and practices of computation, mathematics and basic principles of engineering to ensure that graduates are able to apply their software development skills in design and implementation of practical systems consisting of software and/or hardware components.
PEO2	Problem solving skills and Ethics	Analyze real-life problems and impart science-based engineering education to develop professional skills that will prepare the students for immediate employment in the industry.
PEO3	Professionalism and Lifelong Learning	Imbibe lifelong learning, professional and ethical attitude for embracing global challenges and make positive impact on environment and society.

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Knowledge and Attitude Profile (WK)

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) in some contexts, is a framework or assessment tool used to evaluate an individual’s knowledge and attitudes related to a specific area, topic, or domain.

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Reference: Self-Assessment Report (SAR) Format Undergraduate Engineering Programs Graduate Attributes and Professional Competencies Version 4.0 (GAPC V4.0) - (August 2024) Page 55.

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Programme Outcomes (PO)

Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. On successful completion of B.E. in Computer Engineering, graduating students/graduates will be able to:

PO1	Engineering knowledge	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem analysis	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design / Development of Solutions	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigations of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

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PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Reference: Self-Assessment Report (SAR) Format Undergraduate Engineering Programs Graduate Attributes and Professional Competencies Version 4.0 (GAPC V4.0) - (August 2024) Page 56.

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General Rules and Guidelines

- **Course Outcomes (CO):** Course Outcomes are narrower statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.
- **Assessment:** Assessment is one or more processes, carried out by the institution, that identify, collect, and prepare data to evaluate the achievement of Program Educational Objectives and Program Outcomes.
- **Evaluation:** Evaluation is one or more processes, done by the Evaluation Team, for interpreting the data and evidence accumulated through assessment practices. Evaluation determines the extent to which Program Educational Objectives or Program Outcomes are being achieved, and results in decisions and actions to improve the program

Guidelines for Examination Scheme

Theory Examination: The theory examination shall be conducted in two different parts Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

Comprehensive Continuous Evaluation (CCE) :

1. CCE of 40 marks based on all the Units of course syllabus to be scheduled and conducted at institute level.
2. Case studies included under each unit are intended to support applied learning and are part of Comprehensive Continuous Evaluation
3. These case studies will be assessed through internal assessment components such as presentations, assignments, or group discussions. They shall not be included in the End-Semester Theory Examination.
4. To design a Comprehensive Continuous Evaluation scheme for a theory subject of 30 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1	Unit Test	15 Marks	Units 1 & Unit 2 (7/8 Marks/Unit)
2	Assignments / Case Study	15 Marks	Units 3 & Unit 4 (7/8 Marks/Unit)
3	Seminar Presentation / Open Book Test/ Quiz	10 Marks	Unit 5

5. CCE of 20 marks based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a CCE scheme for a theory subject of 20 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1	Unit Test	10 Marks	Units 1 & Unit 2 (5 Marks/Unit)
2	Seminar Presentation / Open Book Test/ Assignments/Case Studies	10 Marks	Units 3 & Unit 4

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Format and Implementation of Comprehensive Continuous Evaluation (CCE)

- **Unit Test**
  - **Format :** Questions designed as per Bloom's Taxonomy guidelines to assess various cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).
  - **Implementation**: Schedule the test after completing Units 1 and 2. Ensure the question paper is balanced and covers key concepts and applications.
- **Sample Question Distribution**
  - Remembering (2 Marks): Define key terms related to [Topic from Units 1 and 2].
  - Understanding (2 Marks): Explain the principle of [Concept] in [Context].
  - Applying (2 Marks): Demonstrate how [Concept] can be used in [Scenario].
  - Analyzing (3 Marks): Compare & contrast [Two related concepts] from Units 1 and 2.
  - Evaluating (3 Marks): Evaluate the effectiveness of [Theory/Model] in [Situation].
- **Assignments / Case Study** : Students should submit one assignment or one Case Study Report based on Unit 3 and one assignment or one Case Study Report based on Unit 4.
  - **Format:** Problem-solving tasks, theoretical questions, practical exercises, or case studies that require in-depth analysis and application of concepts.
  - **Implementation:** Distribute the assignments or case study after covering Units 3 and 4. Provide clear guidelines and a rubric for evaluation.
- **Seminar Presentation:**
  - **Format:** Oral presentation on a topic from Unit 5, followed by a Q&A session.
  - **Deliverables:** Presentation slides, a summary report in 2 to 3 pages, and performance during the presentation.
  - **Implementation:** Schedule the seminar presentations towards the end of the course. Provide students with ample time to prepare and offer guidance on presentation skills.
- **Open Book Test:**
  - **Format:** Analytical and application-based questions to assess depth of understanding.
  - **Implementation:** Schedule the open book test towards the end of the course, ensuring it covers critical aspects of Unit 5.
- **Quiz :**
  - **Format:** Quizzes can help your students practice existing knowledge while stimulating interest in learning about new topic in that course. You can set your quizzes to be completed individually or in small groups.
  - **Implementation:** Online tools and software can be used create quiz. Each quiz is made up of a variety of question types including multiple choice, missing words, true or false etc
- **Example Timeline for conducting CCE:**
  - Weeks 1-4 : Cover Units 1 and 2
  - Week 5 : Conduct Unit Test (15 marks)
  - Weeks 6-8 : Cover Units 3 and 4

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- Week 9 : Distribute and collect Assignments / Case Study (15 marks)
- Weeks 10-12 : Cover Unit 5
- Week 13 : Conduct Seminar Presentations or Open Book Test or Quiz (10 marks)

- **Evaluation and Feedback:**
  - **Unit Test:** Evaluate promptly and provide constructive feedback on strengths and areas for improvement.
  - **Assignments / Case Study:** Assess the quality of submissions based on the provided rubric. Offer feedback to help students understand their performance.
  - **Seminar Presentation:** Evaluate based on content, delivery, and engagement during the Q&A session. Provide feedback on presentation skills and comprehension of the topic.
  - **Open Book Test**: Evaluate based on the depth of analysis and application of concepts. Provide feedback on critical thinking and problem-solving skills.

End-Semester Examination (ESE)

End-Semester Examination (ESE) of 60 marks written theory examination based on all the unit of course syllabus scheduled by university. Question papers will be sent by the University through QPD (Question Paper Delivery). University will schedule and conduct ESE at the end of the semester.

- **Format and Implementation :**
  - **Question Paper Design** : Below structure is to be followed to design an End-Semester Examination (ESE) for a theory subject of 60 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines and 12 marks allocated per unit.
  - **Balanced Coverage**: Ensure balanced coverage of all units with questions that assess different cognitive levels of Bloom's Taxonomy: Remember, Understand, Apply, Analyze, Evaluate, and Create. The questions should be structured to cover:
    - Remembering: Basic recall of facts and concepts.
    - Understanding: Explanation of ideas or concepts.
    - Applying: Use of information in new situations.
    - Analyzing: Drawing connections among ideas.
    - Evaluating: Justifying a decision or course of action.
    - Creating: Producing new or original work (if applicable).
  - **Detailed Scheme for 60 Marks :** Unit-Wise Allocation (12 Marks per Unit): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.
  - **Detailed Scheme for 30 Marks :** Unit-Wise Allocation (06 Marks per Unit) : Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

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Curriculum Structure - Semester III

Second Year Engineering (2024 Pattern) – "Computer Engineering"

Level 5.0

Course Code	Course Type	Course Name	Teaching Scheme			Examination Scheme						Credits			
			Theory	Tutorial	Practical	CCE	EndSem	TermWork	Practical	Oral	Total	Theory	Tutorial	Practical	Total
PCC-201-COM	Program Core Course	Data Structures	3	-	-	40	60	-	-	-	100	3	-	-	3
PCC-202-COM	Program Core Course	Object Oriented programming and Computer Graphics	3	-	-	40	60	-	-	-	100	3	-	-	3
PCC-203-COM	Program Core Course	Operating Systems	3	-	-	40	60	-	-	-	100	3	-	-	3
PCC-204-COM	Program Core Course	Data Structures Laboratory	-	-	4	-	-	50	25	-	75	-	-	2	2
PCC-205-COM	Program Core Courses	Object Oriented Programming and Computer Graphics Laboratory	-	-	2	-	-	25	-	25	50	-	-	1	1
	Open Elective	*Open Elective - I	2	-	-	20	30	-	-	-	50	2	-	-	2
MDM-221-COM	Multi disciplinary Minor	Digital Electronics and Logic Design	2	-	-	40	60	-	-	-	100	2	-	-	2
EEM-231-COM	Entrepreneurship/ Management	Entrepreneurship Development	-	1	2	-	-	25	-	-	25	-	1	1	2
VEC-232-COM	Value Education Course	Universal Human Values and Professional Ethics	2	-	-	20	30	-	-	-	50	2	-	-	2
CEP-241-COM	Community Engagement Project	Community Engagement Project	-	-	4	-	-	50	-	-	50	-	-	2	2
Total			**15**	**1**	**12**	**200**	**300**	**150**	**25**	**25**	**700**	**15**	**1**	**6**	**22**

***Note:** Students can opt for Open Electives offered by different faculty like Arts, Science, Commerce ,Management, Humanities or Inter-Disciplinary studies.

- Example – Open Elective I - Financial Accounting, Digital Finance, Digital Marketing can be opted from Commerce and Management faculty.
- Elective II - Project Management, Business Analytic, Financial Management can be opted from Inter-Disciplinary studies, Commerce and Management faculty respectively.

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Curriculum Structure - Semester - IV

Second Year Engineering (2024 Pattern) – "Computer Engineering"

Level 5.0

Course Code	Course Type	Course Name	Teaching Scheme			Examination Scheme						Credits			
			Theory	Tutorial	Practical	CCE	EndSem	Term Work	Practical	Oral	Total	Theory	Tutorial	Practical	Total
PCC-251-COM	Program Core Course	Database Management systems	3	-	-	40	60	-	-	-	100	3	-	-	3
PCC-252-COM	Program Core Course	Discrete Mathematics	3	-	-	40	60	-	-	-	100	3	-	-	3
PCC-253-COM	Program Core Course	Computer Organization & Microprocessor	2	-	-	40	60	-	-	-	100	2	-	-	2
PCC-254-COM	Program Core Course	Database Management Laboratory	-	-	2	-	-	25	25	-	50	-	-	1	1
PCC-255-COM	Program Core Course	Microprocessor Laboratory	-	-	2	-	-	-	-	25	25	-	-	1	1
	Open Elective	*Open Elective - II	2	-	-	20	30	-	-	-	50	2	-	-	2
MDM-271-COM	Multi Disciplinary Minor	Internet of Things	2	-	-	40	60	-	-	-	100	2	-	-	2
VSE-281-COM	Vocational and Skill Enhancement	Web Development	-	-	4	-	-	25	25	-	50	-	-	2	2
AEC-282-COM	Ability Enhancement	Modern Indian Language (Marathi)	-	1	2	-	-	50	-	-	50	-	1	1	2
EEM-283-COM	Entrepreneurship / Management	Engineering Product Design	-	1	2	-	-	25	-		25		1	1	2
VEC-284-COM	Value Education Course	Environmental Studies	2	-	-	20	30	-	-	-	50	2	-	-	2
Total			**14**	**2**	**12**	**200**	**300**	**125**	**50**	**25**	**700**	**14**	**2**	**6**	**22**

***Note:** Students can opt for Open Electives offered by different faculty like Arts, Science, Commerce ,Management, Humanities or Inter-Disciplinary studies.

- Example – Open Elective I - Financial Accounting, Digital Finance, Digital Marketing can be opted from Commerce and Management faculty.
- Elective II - Project Management, Business Analytic, Financial Management can be opted from Inter-Disciplinary studies, Commerce and Management faculty respectively.

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Savitribai Phule Pune University, Pune

Maharashtra, India

SE - Computer Engineering

Semester - III



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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-201-COM : Data Structures		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hours/Week	03	CCE : 40 Marks End-Semester: 60 Marks

Prerequisite Courses:

1. Programming and Problem Solving
2. Fundamentals of Programming Languages

Companion Course : Data Structures Lab

Course Objectives: The course aims to:

1. To understand importance of data structures in context of writing efficient programs
2. To be able to implement linear and non-linear data structures

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

- CO1: **Understand** and **Analyze** various types of data structures and algorithms
- CO2: **Apply** various sorting and searching algorithms for given problem
- CO3: Make **Use** of Stacks and Queues to **solve** the given problem
- CO4: **Analyze** different hashing techniques and collision resolution strategies.
- CO5: **Demonstrate** basic operations on trees and graphs

Course Contents

Unit I - Introduction to Data Structures and Algorithms (09 Hours)

Introduction: Introduction to Data Structures: Abstract Data Types (ADT), Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures

Algorithms: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic.

Algorithmic Strategies: Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy

Case Study:E-commerce Product Sorting using Divide and Conquer strategy Google Calendar application using Greedy strategy

Unit II - Linear Data Structures, searching and sorting (09 Hours)

Overview of Array, Array as an Abstract Data Type, Operations on Array, Storage Representation, Multidimensional Arrays[2D, nD], Sparse matrix representation using 2D Searching: Sequential Search/Linear Search, Binary Search, Fibonacci Search, and Indexed Sequential Search.

Sorting: Concepts- Stability, Efficiency, and Number of Passes, Internal and External Sorting, Bubble sort, Insertion Sort, Selection Sort , Quick Sort, Merge sort

Case Study : Social Network Adjacency Matrix Representing friendship connections among millions of users.

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Unit III - Stacks, Queues and Linked Lists (09 Hours)

Stacks: Stack operations, Multiple Stacks, Applications of Stack for Expression Conversion [infix, prefix and postfix], Postfix expression evaluation

Queues: Queue Operations, Circular Queue, Priority Queue and its advantages and applications

Linked list: Introduction of Linked Lists, Primitive Operations on Linked List- Create, Traverse, Search, Insert, Delete, Sort, and Concatenate. Types of Linked List: Singly linked, linear and Circular Linked Lists, Doubly Linked List,

Case study: Implementation of Stack and Queue operations using Linked lists

Unit IV - Hashing (09 Hours)

Hash Table : Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, properties of good hash function, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining

Case study : Dictionary Application using Hash Tables, Description: Implement a dictionary where words and meanings are stored and retrieved using hashing with collision resolution

Unit V - Graphs and Trees (09 Hours)

Graphs: Basic Concepts, Storage representation, Adjacency matrix, adjacency list, Traversals-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms

Trees: General tree and its representation: sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals (recursive and non-recursive) - inorder, preorder, post order, Operations on binary tree. Binary Search Tree (BST) and its operation

Case study: GPS/Navigation system that models a city map as a weighted graph and applies core graph algorithms ZIP/GZIP file compression using frequency-based encoding. using Huffman tree

Learning Resources

Text Books:

1. Data structures and algorithms in python by Michael T. Goodrich, ISBN-13: 978- 1118290279, ISBN-10: 1118290275, Publisher: Wiley; 1st edition (March 18, 2013).

2. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum. ISBN-13: 978-1590282571, ISBN-10: 1590282574, Publisher: Franklin, Beedle & Associates; 2nd edition (August 22, 2011).

Reference Books:

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka. ISBN: 9781788991933, 2018.

2. Core Python Programming -R. Nageswara Rao, ISBN-10: 9789351199427, ISBN-13: 978-9351199427, Willy; 1st edition (January 1, 2016).

MOOC / NPTEL/YouTube Links: -

1. Programming, Data Structures and Algorithms using Python By Prof. Madhavan Mukund, Chennai Mathematical Institute, https://archive.nptel.ac.in/courses/106/106/106106145/

YouTube/Video Links:

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1. https://nptel.ac.in/courses/106102064
2. https://onlinecourses.swayam2.ac.in/cec19_cs04/preview

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-202-COM : Object Oriented programming and Computer Graphics		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hours/Week	03	**CCE** : 40 Marks **End-Semester :** 60 Marks

Prerequisite Courses :

1. Programming and Problem Solving concepts

Course Objectives: The course aims to:

1. To explore & understand the principles of Object Oriented Programming (OOP)
2. To apply the object-oriented paradigm in program design
3. To provide object-oriented programming insight using Java
4. To lay a foundation for computer graphics concepts and implementation

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

- CO1: **Apply** fundamental programming constructs, object oriented constructs in Java for Implementing an application.
- CO2: **Apply** fundamental object oriented constructs like class, objects, array of objects in Java for Implementing an application..
- CO3: **Apply** object-oriented features like Inheritance, Polymorphism, Dynamic binding, Exception handling, multi-threading in Java for implementing an application
- CO4: **Understand** basic concepts in computer graphics and **implement** them by applying object oriented features
- CO5: **Understand** mathematical foundation in 2D, 3D Transformation, Projections and **implement** them by applying object oriented features

Course Contents

Unit I - Introduction to OOP Concepts and Control Structure (09 Hours)

Programming paradigms - Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic & rule based. Need of object-oriented programming,

Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Benefits of OOP, Java as object oriented programming language.

Overview of Java Language: simple Java program structure: documentation section, package statement, import statements, class definition, main method class. Implementing Java Program, JVM, Data types, Primitive Types vs. Reference type, floating point numbers, operators and expressions, Java Class Libraries, Typical Java Development Environment, and Memory Concepts.

Control Statements: Selection Statements: if, if-else, nested if-else, Iteration Statements: do, while, for, for-each statement, break, and continue statements

Case Study: Analyze the object -oriented features in Java with other object oriented programming languages.

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Unit II - Introduction to Classes and Objects and Arrays (09 Hours)

Introduction to Classes and Objects: Defining a Class, Field declaration, method declaration and definition, instantiating an object of a Class, Accessing class members, declaring methods with multiple parameters, argument passing, object as a parameter, returning objects, assigning object reference variables, set methods and get methods, constructors, this keyword, Constructors, static methods, scope of declaration, method overloading and Java API packages.

Arrays: declaring and creating arrays in Java, examples using arrays, passing arrays to methods, multidimensional arrays, variable-length argument lists, using command-line arguments.

Managing I/O: Streams Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class.

Case Studies: Demonstrate an interactive Banking/Library management system using class, objects, array of objects

Unit III - Inheritance and Polymorphism Exception Handling and Multithreading (09 Hours)

Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, types of Inheritance, constructors in subclasses, object class.

Polymorphism: Abstract classes and methods, final methods and classes, dynamic binding, polymorphism examples and Interfaces.

Exception handling: fundamentals, Exception Types, Using try-catch, Multiple try-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions

MultiThreading: Java Thread Model, Main Thread, Creating a Thread , Creating Multiple Threads.

Case Study ; Demonstrate online Banking/Library system using Inheritance, Exception handling and Multi-Threading concepts

Unit IV- Graphics Primitives, Scan Conversion, Windowing and Clipping (09 Hours)

Introduction: graphics primitives - pixel, resolution, aspect ratio, frame buffer. Display devices, applications of computer graphics.

Scan conversion: Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint.

Polygons: Introduction to polygon, types: convex, concave and complex. Inside test. Polygon Filling: flood fill, seed fill, scan line fill.

Windowing and clipping: viewing transformations, 2-D clipping: Cohen – Sutherland algorithm line Clipping algorithm, Sutherland Hodgeman polygon clipping algorithm.

Case Studies - 1) Real-Time Map Rendering in GPS Navigation Systems using Line and Circle Drawing Algorithms 2) 3D pipeline / polygonal modelling and applications

Unit V- 2D, 3D Transformations and Projections (09 Hours)

2-D Transformations: 2-D transformations - Translation, Scaling, Rotation and Shear, Rotation about an arbitrary point. 3-D Transformations: 3-D transformations - Translation, Scaling, Rotation and Shear, Rotation about an arbitrary axis.

Projections: Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)

Case Studies - 1) Affine Transformations Vlab (Vlab link: https://cse19- iiith.vlabs.ac.in/exp/affine-transformation/theory.html) 2) Image augmentation in Deep learning

Learning Resources

Text Books:

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1. E Balaguruswamy, (2023). Programming with Java: A Primer. 7th edition. India: McGraw Hill Education

2. Herbert Schildt, (2021). Java: The complete reference, 13th edition. McGraw-Hill Education.

3. S. Harrington, "Computer Graphics", 2ndEdition, McGraw-Hill Publications, 1987, ISBN 0 – 07–100472 – 6.

4. Donald D. Hearn and Baker, "Computer Graphics with OpenGL", 4thEdition, ISBN-13: 9780136053583

Reference Books:

1. Paul Deitel and Harvey Detail, Java: How to Program, Pearson's Publication, 9thEdition

2. Horstmann, C. S. (2023). Core Java - Vol. I – Fundamentals (Vol. 12). Pearson Education

3. Dr. Samit Bhattacharya, Computer Graphics, Oxford University Press, ISBN-13: 978-0-19-809619-1; ISBN-10: 0-19-809619-4.

4. D. Rogers, "Procedural Elements for Computer Graphics", 2ndEdition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

MOOC / NPTEL/YouTube Links: -

1. https://archive.nptel.ac.in/courses/106/103/106103224/

2. https://archive.nptel.ac.in/courses/106/102/106102065/

3. https://nptel.ac.in/courses/106106090

E-Books :

1. https://www.iitg.ac.in/samit/Computer%20Graphics.pdf

2. https://open.umn.edu/opentextbooks/textbooks/introduction-to-computer-graphics

3. http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-203-COM : Operating Systems		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hours/Week	03	**CCE** : 40 Marks **End-Semester:** 60 Marks

Prerequisite Courses : Data Structure, Digital Electronics

Companion Course : Computer Organization and Microprocessors

Course Objectives: The course aims to:

1. To understand the fundamental concepts, types, and structures of Operating Systems.
2. To understand and analyze process management concepts.
3. To identify and solve concurrency and deadlock in the operating system.
4. Explore the various techniques of memory management.
5. Understand I/O management, disk scheduling, and file systems.

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

- CO1: **Analyze** the fundamentals of Operating Systems, including types, structures, system calls, and basic Linux commands.
- CO2: **Apply** process scheduling and synchronization to optimize CPU utilization in modern operating systems.
- CO3: **Identify** the mechanism for dealing with deadlocks and concurrency concerns.
- CO4: **Apply** techniques of memory management to solve memory management problems
- CO5: **Illustrate** I/O and file management policies.

Course Contents

Unit I - Introduction to Operating System (09 Hours)

Basics of Operating Systems: Objectives & Functions, Evolution of OS, Types of Operating Systems, OS Service, System Calls: Introduction, Types of System Calls

OS structure: Layered Approach, Monolithic, Microkernel Operating Systems

Introduction to Linux OS: Components of Linux system, Basic Shell commands

Case studies: 1) Automating User and File Management in Linux using Shell Script 2) Demonstrating Different OS Structures (Monolithic, Layered, Microkernel OS)

Unit II - Process and Thread Management (09 Hours)

Process management: Definition, types of process. Process States and Transitions diagram, Process Control Block (PCB), context switching and its impact on performance, Process Scheduling.

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Types of Schedulers: long term, short term, middle term, Threads: Concept of thread, Multithreading, User-level vs Kernel-level Threads.

Scheduling Algorithms: Preemptive Scheduling vs Non-preemptive Scheduling, FCFS, SJF, RR, Priority Process Scheduling in UNIX and Windows

Cast Studies - 1) Prepare case study on challenges for Real-time Scheduling 2)Performance Comparison of Scheduling Algorithms (FCFS vs SJF, RR vs Priority Scheduling) under different workload conditions

Unit III - Interprocess Communication and Deadlock (09 Hours)

Concurrency: Critical section problem, Synchronization primitives (Semaphores, Mutexes, Monitors) Synchronization Problems: Producer-Consumer, Reader Writer, Dining Philosophers

Inter-Process Communication (IPC): Message passing, Shared memory Deadlocks: Conditions, Prevention, Avoidance (Banker's Algorithm), Detection, Recovery

Case Studies - 1) Interprocess Communication (IPC) in a Banking System 2) Deadlock in Railway Scheduling Systems

Unit IV - Memory Management (09 Hours)

Introduction, Contiguous and non-contiguous, Fragmentation:Internal and External fragmentation

Memory allocation strategies: First Fit, Best Fit, Worst Fit, Memory Partitioning:Fixed and Dynamic partitions

Paging: Structure of page table, Segmentation.Virtual Memory: Background, Demand Paging

Page Replacement: FIFO, LRU, Optimal Thrashing.

Case study : Intel Premium

Unit V - File and Disk Management (09 Hours)

File Management: File operation, Directory structure, File System structure, File Organization and Access, File Directories, File Allocation Methods,Secondary Storage Management, File Systems in Operating System (FAT, NTFS, EXT, and HFS).

Disk Management: Secondary-Storage Structure - Disk structure, Disk scheduling algorithm (FIFO, SSTF, SCAN, C-SCAN, LOOK, C-LOOK), Disk reliability, Disk formatting, Boot-block, Bad blocks.

Case Studies - 1) Study of Linux File System. 2) Study of Android File System.

Learning Resources

Text Books:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, ISBN-10: 0-13-380591-3, ISBN-13: 978-0-13-380591-8, 8th Edition

2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, WILEY, ISBN 978-1-118-06333-0, 9th Edition

3. Arnold Robbins, Nelson H. F. Beebe, Classic Shell Scripting, O'Reilly Media, Inc., 2005, ISBN 9780596005955.

Reference Books:

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1. Tom Adelstein and Bill Lubanovic, Linux System Administration, O'Reilly Media, ISBN-10: 0596009526, ISBN-13: 978-0596009526.

2. Harvey M. Deitel, Operating Systems, Prentice Hall, ISBN-10: 0131828274, ISBN-13: 978-0131828278.

3. Thomas W. Doeppner, Operating System in depth: Design and Programming, WILEY, ISBN: 978- 0-471-68723-8.

4. Mendel Cooper, Advanced Shell Scripting, Linux Documentation Project. 5. Andrew S. Tanenbaum & Herbert Bos, Modern Operating System, Pearson, ISBN-13: 9780133592221, 4th Edition.

E-Book

1. https://repository.dinus.ac.id/docs/ajar/Operating_System.pdf

MOOC/NPTEL/SWAYAM Course Links:

1. https://onlinecourses.nptel.ac.in/noc24_cs108/preview

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-204-COM : Data Structures Laboratory		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 04 Hours/Week	02	**Term Work** : 50 Marks **Practical :** 25 Marks

Prerequisite Courses : Basics of python programming and Principles of Problem Solving
Companion Course : Data Structures
Course Objectives: The course aims to:

1. Provide hands-on experience with basic and advanced data structures.
2. Understand various data searching and sorting methods with pros and cons.
3. Apply Data Structures for real-world problem solving.

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

- CO1: **Analyze** basic searching and sorting algorithms to solve problems and evaluate their efficiency in different scenarios.
- CO2: Make **use** of stacks and queue concepts to solve the given problem
- CO3: **Demonstrate** various types of linked lists.
- CO4: **Demonstrate** basic operations on trees and graphs and **determine** minimum spanning.
- CO5: **Apply** a suitable data structure for solving application-based problems.

Course Contents

Guidelines for Instructor's Manual

The instructor's manual/Lab Manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/guidelines, references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Students programs maintained on cloud or college server by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory for accreditation purpose.

Guidelines for Laboratory/Term Work Assessment

Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned

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grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include timely completion performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to conduct **TWO assignments from each group (A,B,C,D,E).** The instructor may set multiple sets of assignments and distribute them among batches of students.

Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructors may assign one real life application in the form of a mini-project based on the concepts learned.

Suggested Language: Python/C++/C or any open source

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Oral Examination

Oral examination gauge students' knowledge and skills based on the spoken word, typically guided by questions or small tasks. A pair of examiners must design appropriate questions for each learning outcome. They should focus on depth rather than breadth. They should include potential follow-up questions and prompts based on different types of answers. Examiners should standardize the number of questions, difficulty of questions, and the time allotted. Questions should be based on the practical assignments performed in the term work and not on the entire syllabus.

Suggested List of Laboratory Experiments/Assignments

Sr.	Group A: Arrays and Searching Sorting Algorithms
1	Write a Python program to manage the borrowing records of books in a library. Implement the following functionalities: • Compute the average number of books borrowed by all library members. • Find the book with the highest and lowest number of borrowings in the library. • Count the number of members who have not borrowed any books (denoted by a borrow count of 0). • Display the most frequently borrowed book (i.e., the mode of borrow counts). After performing, determine the time and Space complexity of each operation
2	In an e-commerce system, customer account IDs are stored in a list, and you are tasked with writing a program that implements the following: • Linear Search: Check if a particular customer account ID exists in the list. • Binary Search: Implement Binary search to find if a customer account ID exists, improving the search efficiency over the basic linear

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3	In a company, employee salaries are stored in a list as floating-point numbers. Write a Python program that sorts the employee salaries in ascending order using the following two algorithms: • Selection Sort: Sort the salaries using the selection sort algorithm. • Bubble Sort: Sort the salaries using the bubble sort algorithm. After sorting the salaries, the program should display top five highest salaries in the company
Group B Stacks Queues and Linked List	
1	Implementing a real-time undo/redo system for a text editing application using a Stack data structure. The system should support the following operations: • Make a Change: A new change to the document is made. • Undo Action: Revert the most recent change and store it for potential redo. • Redo Action: Reapply the most recently undone action. • Display Document State: Show the current state of the document after undoing or redoing an action
2	Implement a real-time event processing system using a Queue data structure. The system should support the following features: • Add an Event: When a new event occurs, it should be added to the event queue. • Process the Next Event: The system should process and remove the event that has been in the queue the longest. • Display Pending Events: Show all the events currently waiting to be processed. • Cancel an Event: An event can be canceled if it has not been processed.
3	A call center receives incoming calls, and each call is assigned a unique customer ID. The calls are answered in the order they are received. Your task is to simulate the call queue of a call center using a queue data structure. • addCall(customerID, callTime): Add a call to the queue with the customer ID and the call time (in minutes). • answerCall(): Answer and remove the first call from the queue. • viewQueue(): View all calls currently in the queue without removing them. • isQueueEmpty(): Check if the queue is empty.
4	Create a Student Record Management System using linked list • Use a singly/doubly linked list to store student data (Roll No, Name, Marks). • Perform operations: Add, Delete, Update, Search, and Sort. • Display records in ascending/descending order based on marks or roll number.
Group C - Hashing	

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1	Implement a hash table of size 10 and use the division method as a hash function. In case of a collision, use chaining. Implement the following operations: • Insert(key): Insert key-value pairs into the hash table. • Search(key): Search for the value associated with a given key. • Delete(key): Delete a key-value pair from the hash table
2	Design and implement a hash table of fixed size. Use the division method for the hash function and resolve collisions using linear probing. Allow the user to perform the following operations: • Insert a key • Search for a key • Delete a key • Display the table
3	Implement a hash table with extendible hashing. The hash table should dynamically expand when the number of keys in a bucket exceeds a certain threshold. Perform the following operations: • Insert(key): Insert key-value pairs into the hash table • Search(key): Search for the value associated with a given key • Delete(key): Delete a key-value pair from the hash table
Group D: Graphs and Trees	
1	Consider a particular area in your city. Note the popular locations A, B, C . . . in that area. Assume these locations represent nodes of a graph. If there is a route between two locations, it is represented as connections between nodes. Find out the sequence in which you will visit these locations, starting from (say A) using (i) BFS and (ii) DFS. Represent a given graph using an adjacency matrix to perform DFS and an adjacency list to perform BFS.
2	A pizza shop receives multiple orders from several locations. Assume that one pizza boy is tasked with delivering pizzas in nearby locations, which is represented using a graph. The time required to reach from one location to another represents node connections. Solve the problem of delivering a pizza to all customers in the minimum time. Use appropriate data structures.
3	Implement various operations on a Binary Search Tree, such as insertion, deletion, display, and search.
4	Construct an expression tree from the given prefix expression, e.g., +--a*bc/def, traverse it using post-order traversal (non-recursive), and then delete the entire tree.
5	A list stores city names and their populations. Use a Binary Search Tree for implementation. Provide a facility for adding new cities, deleting a city, and updating population values. Provide a facility to display all the city names in ascending/descending order. Also, find how many maximum comparisons are required to search for a particular city.
6	Read the formulas in propositional calculus. Write a function that reads such a formula and creates its binary tree representation. What is the complexity of your function?
Group E : Mini project	

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Implement any application based mini project. Sample mini projects can be selected from the list given here [not limited to]

- Implementation of Snake and Ladder [BFS]
- Implementation of Maze generation [DFS]
- Implementation of Flight Reservation System [Searching and Sorting]
- Implementation of Student Database Management system [Hashing]
- Implementation of Job Scheduling [Graphs]
- Implementation of Palindrome checker [Stacks and Queues]
- Implementation of Queue using Two Stacks
- Implementation of Keyword Frequency Counter [Hash Table]
- Implementation of a basic version of a web browser's back button functionality [Stack]

Learning Resources

Text Books

1. Data structures and algorithms in python by Michael T. Goodrich, ISBN-13: 978- 1118290279, ISBN-10: 1118290275, Publisher: Wiley; 1st edition (March 18, 2013).
2. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum. ISBN-13: 978-1590282571, ISBN-10: 1590282574, Publisher: Franklin, Beedle & Associates; 2nd edition (August 22, 2011).

Reference Books

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka. ISBN: 9781788991933, 2018.
2. Core Python Programming -R. Nageswara Rao, ISBN-10: 9789351199427, ISBN-13: 978-9351199427, Willy; 1st edition (January 1, 2016).

MOOC/NPTEL/SWAYAM Course Links:

1. NPTEL :- Programming, Data Structures and Algorithms using Python By Prof. Madhavan Mukund, Chennai Mathematical Institute, https://archive.nptel.ac.in/courses/106/106/106106145/

YouTube/Video Links:

1. https://www.youtube.com/playlist?list=PLeo1K3hjS3uu_n_a__MI_KktGTLYopZ12

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-205-COM : Object Oriented programming and Computer Graphics Laboratory		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 02 Hours/Week	01	**Term Work** : 25 Marks **Oral :** 25 Marks

Prerequisite Courses :

1. Understanding of Programming and Problem Solving concepts

Course Objectives: The course aims to:

1. To explore & understand the principles of Object-Oriented Programming (OOP).
2. To apply the object-oriented paradigm in program design.
3. To provide object-oriented programming insight using Java
4. To lay a foundation for computer graphics concepts and algorithms

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

- CO1: To **apply** fundamental programming constructs in Java for implementing an application.
- CO2: To **apply** fundamental object oriented constructs in Java for implementing an application.
- CO3: To **apply** object-oriented features like Inheritance, Polymorphism, Dynamic binding, exception handling, multi-threading in Java for implementing an application.
- CO4: To **implement** basic concepts in computer graphics by applying object oriented features
- CO5: To **implement** 2D, 3D Transformation, Projections by applying object oriented features

Course Contents

Guidelines for Instructor's Manual

The instructor's manual/Lab Manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/guidelines, references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Students programs maintained on cloud or college server by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory for accreditation purpose.

Guidelines for Laboratory/Term Work Assessment

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Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include timely completion performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute them among batches of students.

It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructors may assign one real life application in the form of a mini-project based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to respective branch beyond the scope of the syllabus.

Operating System recommended:- 64-bit Open source Linux or its derivative
Programming tools recommended: - Open Source Java Open JDK,
Programming IDE like: BlueJ, Eclipose, NetBeans, JDeveloper.

Part-A: 5 Assignments , Part- B: 5 Assignments, Part-C (Mini Project): Mandatory Assignment

Guidelines for Practical Examination

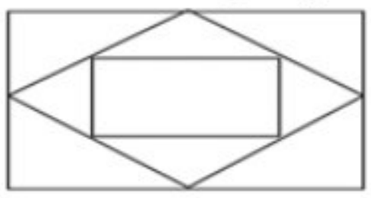
Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Oral Examination

Oral examination gauge students' knowledge and skills based on the spoken word, typically guided by questions or small tasks. A pair of examiners must design appropriate questions for each learning outcome. They should focus on depth rather than breadth. They should include potential follow-up questions and prompts based on different types of answers. Examiners should standardize the number of questions, difficulty of questions, and the time allotted. Questions should be based on the practical assignments performed in the term work and not on the entire syllabus.

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Suggested List of Assignment	
Sr	**Group A - Any THREE (from 1 to 5)**
1	Implement a robust Java calculator program that captures user input dynamically, processes mathematical operations using conditional logic and looping constructs, and ensures efficient error handling.
2	Develop a Java program for an E-commerce order processing where some products are initialized through multiple constructors, overloaded constructors, where users can input some product details manually, the system computes total order cost dynamically, applies discount policies based on conditions, and presents a detailed invoice summarizing the purchase.
3	Develop a Java program that implements a simple hotel room booking system using two-dimensional arrays. The system allows users to: View available and booked rooms, Book a room by selecting a floor and room number and exit the system when finished
4	Create a Java program demonstrating single inheritance where a subclass extends a superclass and calls its methods.
5	Implement Multiple Inheritance using interface in Java to demonstrate polymorphism.
6	Develop a Java program for simulation of any real time application with required functionalities. For eg. ATM machine with functionalities like checking account balance, withdrawing, and depositing money. Use try, catch, and finally blocks to handle potential exceptions such as insufficient funds (throwing ArithmeticException) and invalid input (throwing IllegalArgumentException). Ensure that the application continues to run smoothly after handling exceptions.
7	Create a multi-threaded Java application that simulates any real time application with required functionalities. For eg. Basic chat system in which each user (thread) sends and receives messages. Use isAlive() to check the status of threads and join() to ensure proper synchronization. Implement thread priorities to handle high-priority messages and demonstrate thread suspension, resumption, and stopping.

Sr.	**Group B - (Any SIX)**
1	Write a C/C++/Java program to draw the following pattern using (a) the DDA line drawing algorithm for both rectangles with Dotted, Thick line style and (b) Bresenham‘s line drawing algorithm for a diamond shape with Dashed, Solid line style. 
2	Write a menu driven program in C/C++/Java to draw circle using DDA, Bresenham’s , Midpoint circle drawing algorithm with different styles as solid, dotted and dashed circles.
3	Write a menu driven program in C/C++/Java to draw a concave polygon a d fill it with the desired color using the scan fill algorithm; flood fill and seed fill algorithms.
4	Write a program to implement the Sutherland-Hodgeman algorithm for clipping any polygon. Provide the vertices of the polygon to be clipped and the pattern of clipping interactively.
5	Write a C/C++/Java program to implement the Cohen-Sutherland line clip ing algorithm.
6	Write a C/C++/Java program to implement translation, rotation, shear and scaling transformations on a 2D object about X axis, Y axis.
7	Write C/C++/Java program to implement translation, sheer, rotation and scaling transformations on equilateral triangle and rhombus.
8	Write a C/C++/Java program to implement rotation of a 2D object about X axis and an arbitrary point.

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Sr.	**Group C - Mini Project**
Mini-Project using maximum features of Object-Oriented programming to develop solutions for any one a	
1	Banking system having the following operations: a. Create an account b. Deposit money c. Withdraw money d. Honor daily withdrawal limit e. Check the balance f. Display Account i formation. g. Passbook Print (from to)
2	Inventory management system having the following operations: a. List of all products b. Display individual product information c. Purchase d. Shipping e. Balance stock f. Loss and Profit calculation. g. Purchase Report (from to)
Note– Subject Incharge can consider any other application having similar features and complexity.	

Learning Resources

Text Books:

1. E Balaguruswamy, (2023). Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education

2. Herbert Schildt, (2021). Java: The complete reference, 13th edition. McGraw-Hill Education.

Reference Books:

1. Paul Deitel and Harvey Detail, Java: How to Program, Pearson's Publication, 9thEdition

2. Horstmann, C. S. (2023). Core Java - Vol. I – Fundamentals (Vol. 12). Pearson Education

3. Dr. Samit Bhattacharya, Computer Graphics, Oxford University Press, ISBN-13: 978-0-19-809619-1; ISBN-10: 0-19-809619-4.

4. D. Rogers, "Procedural Elements for Computer Graphics", 2ndEdition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

MOOC / NPTEL/YouTube Links: -

1. Programming In Java: https://onlinecourses.nptel.ac.in/noc25_cs57/preview
2. https://archive.nptel.ac.in/courses/106/102/106102065/
3. https://nptel.ac.in/courses/106106090

E-Books :

1. https://www.iitg.ac.in/samit/Computer%20Graphics.pdf
2. https://open.umn.edu/opentextbooks/textbooks/introduction-to-computer-graphics
3. http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
MDM-221- COM - Digital Electronics and Logic Design		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 02 Hours/Week	02	**CCE** : 30 Marks **End-Semester**: 70 Marks

Prerequisite Courses, if any :

1. Basic Electronics Engineering (ESE-101-ETC)

Course Objectives: The course aims to introduce engineering students to the fundamentals of Digital electronics technology, enhance problem-solving abilities, and provide a strong foundation for careers in computing, automation, and embedded systems.

1. Learn the basics of Boolean algebra and how to simplify digital circuits using Boolean functions.
2. Understand how signed binary numbers (like 1's complement and 2's complement) are used in digital systems.
3. Study how adders, subtractors, and code converters work in digital circuits.
4. Learn how flip-flops, registers, and counters function in memory and control systems.
5. Explore how to design digital systems using Algorithmic State Machines (ASMs) and understand the role of different logic families and programmable devices.

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

- CO1: **Understand** and **apply** key concepts of Boolean algebra, binary number systems and simplification techniques for Boolean functions.
- CO2: **Study** the **design** and operation of combinational circuits in digital systems.
- CO3: **Understand** and **apply** the design and operation of various sequential circuits in digital systems.
- CO4: **Understand** the **design** and implementation of FSMs and ASMs for sequential circuits, and study logic families.
- CO5: **Explore** the fundamentals and applications of programmable logic devices (PLDs) in digital circuit design

Course Contents

Unit I - Boolean Algebra and Simplification Techniques (06 Hours)

Boolean Algebra: Basic theorems and properties of Boolean algebra, DeMorgan's rules.
Signed Binary number representation: Signed Magnitude, 1's complement and 2's complement representation.
Simplification Techniques: Sum of product and Product of sum form, Minimization of SOP and POS using K-map. Minimization of Boolean function using K-map (up to 4 variables).
Case Study: Design and Optimization of a Digital Temperature Control System

Unit II - Combinational Logic Design (06 Hours)

Adders/Subtractors: Half Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator.

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Code Converters: BCD, Excess-3, Gray code, Binary Code. Multiplexers and Demultiplexers, Comparators (2 bit).

Case Study :Design of a Binary Calculator for BCD Input and 2's Complement Operations

Unit III - Sequential Circuits (06 Hours)

Flip-Flops: SR, JK, D, T; Preset &Clear, Master Slave JK Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flop Flop.
Registers: Registers: SISO, SIPO, PISO, PIPO, Shift Registers
Counters: Ring Counter, BCD Counter, Johnson Counter.

Case study: Design of a Digital Stopwatch Using Flip-Flops, Registers, and Counters

Unit IV - Algorithmic State Machines and Logic Families (06 Hours)

Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits.
Logic Families: Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Fan-in, Fan-out, Current and voltage parameters, Noise immunity, Propagation Delay, Power Dissipation, Figure of Merits, Operating Temperature Range, power supply requirements. Introduction to TTL & CMOS, Comparison between TTL and CMOS

Case study : Vending Machine Controller using Algorithmic State Machines

Unit V - Programmable Logic Devices (06 Hours)

PLDS: PLD, ROM as PLD, Programmable Logic Array (PLA): Implementation procedure, Construction and working, Advantages over read only memory and applications, Programmable Array Logic (PAL): Architecture, Programming PAL's, construction and working, Designing combinational circuits using PLDs.

Case study: Traffic Light Control System Using PLD

Learning Resources

Text Books:

1. Modern Digital Electronics by R.P.Jain, 4th Edition, ISBN 978-0-07-06691-16 Tata McGraw Hill
2. Digital Logic and Computer Design by Moris Mano, Pearson , ISBN 978-93-325-4252-5

Reference Books:

1. John F. Wakerly, "Digital Design: Principles and Practices," Pearson.
2. Mark Bach, "Complete Digital Design", Tata MCGraw Hill, 2005.
3. Charles H. Roth Jr., "Fundamentals of Logic Design," Cengage Learning.

e-Books:

1. https://link.springer.com/book/10.1007/978-3-030-36196-9
2. https://www.mheducation.co.uk/ebook-fundamentals-of-digital-logic-9780077144227-emea

MOOC / NPTEL/YouTube Links: -

1. Digital Circuits by Prof.SantanuChattopadhyay , IIT Kharagpur https://swayam.gov.in/nd1_noc19_ee5
2. Digital Circuits and Systems by Prof. S. Srinivasan , IIT Madras https://nptel.ac.in/courses/117/106/1

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3. Microprocessors and Interfacing by Prof Shaikh Rafi Ahamed, IIT Guwahati.https://onlinecourses.nptel
4. VLSI Technology by Dr. Nandita Dasgupta, IIT Madras https://nptel.ac.in/courses/117106093

YouTube/Video Links:

1. https://www.youtube.com/watch?v=CL3ups78jrs
2. https://www.youtube.com/watch?v=ibQBb5yEDlQ

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
EEM-231-COM : Entrepreneurship Development		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 2 Hours/Week **Tutorials** : 1 Hour/Week	01 01	**Term Work** : 25 Marks

Course Objectives: The course aims to:

1. Introduce the fundamental principles of entrepreneurship, forms of business organizations, and the startup ecosystem.
2. Enable students to identify, evaluate, and select viable business opportunities using structured techniques.
3. Familiarize students with business models, financial planning, and market validation strategies.
4. Expose students to key marketing strategies, customer acquisition techniques, and branding essentials for startups
5. Develop students' entrepreneurial mindset and their ability to communicate and pitch business ideas effectively using structured storytelling techniques

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

- CO1: **Describe** the role of entrepreneurship in economic growth and the startup ecosystem.
- CO2: **Apply** creative techniques to viable business ideas based on customer needs.
- CO3: **Develop** a basic business model using tools like the Business Model Canvas through market research.
- CO4: **Implement** basic marketing strategies for startups.
- CO5: **Deliver** a concise business pitch using storytelling and effective communication techniques.

Course Contents

Unit I - Introduction to Entrepreneurship (03 Hours)

Entrepreneurship: Definition and evolution, Role of entrepreneurship in economic development , Role in job creation, GDP, and innovation.
Characteristics of an Entrepreneur: Key traits: Risk-taking, innovation, pro-activeness, Leadership, perseverance, and resilience
Types of Entrepreneurships: Startup entrepreneurship, Social entrepreneurship, Intrapreneurship (corporate entrepreneurship), Lifestyle and small business entrepreneurship, Forms of Business Organization – Sole proprietorship, partnership, private limited, public limited.
Entrepreneurial Mindset: Growth mindset and adaptability, Creativity and problem-solving, Opportunity recognition and initiative-taking
Overview of the Startup Ecosystem: Key stakeholders: Incubators, accelerators, angel investors, VCs, Government support schemes (Startup India, Atal Innovation Mission, etc.), Global vs. Indian startup ecosystems
Case Study:

1. Ritesh Agarwal – Founder of OYO Rooms (India)
2. Falguni Nayar – Founder of Nykaa (India)

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3. Nandan Nilekani – Co-founder of Infosys & Architect of Aadhaar (India) etc.

Unit II -Idea Generation & Opportunity Recognition (03 Hours)

Creativity Techniques for Idea Generation: Definition and importance of creativity in entrepreneurship. Brainstorming: Rules of effective brainstorming. Individual vs. group brainstorming. Mind Mapping: Visual idea structuring using central themes and branches. Tools (manual and digital) for mind mapping.

Understanding Customer Needs and Pain Points: Customer pain points and their identification, Problem-solution fit: Linking pain points to possible solutions. Observational techniques, user interviews, and empathy mapping.

Evaluating Opportunities: Difference between an "idea" and an "opportunity." Basic filters: Desirability, feasibility, and viability. Tools: SWOT Analysis, Opportunity Matrix, Industry trends, market gaps.

Case Study : Analyzing how "Dunzo" or "BigBasket" identified urban pain points and How "Zerodha" scaled in India with a digital-first approach

Unit III - Business Model Development (03 Hours)

Introduction to Business Model Canvas: Definition and purpose of a business model, Overview of the Business Model Canvas by Osterwalder, Benefits of using BMC for startups.

Key Components of BMC: Value Proposition: Defining what unique value the product/service offers. Addressing customer pain points. Customer Segments: Identifying target customers. Creating customer personas Revenue Models: Direct sales, subscriptions, freemium, licensing, etc.

Basic Market Research for Validation: Importance of market research in early-stage business development. Designing effective surveys and customer feedback forms. Conducting basic interviews and analyzing responses. Introduction to MVP (Minimum Viable Product) and feedback loops.

Case study: Map the BMC for a well-known startup (e.g., Uber or Zomato).

Unit IV - Marketing Strategies & Customer Acquisition (03 Hours)

Basics of Branding and Positioning: Introduction to Brand – Elements of brand identity: name, logo, voice, tone, and values. Positioning – How to create a unique space in the customer's mind. Positioning maps, Value-based positioning vs. competitor-based positioning Startup Branding Challenges – Limited budget, building trust, clarity in messaging.

Costing & Pricing Strategies – Fixed vs. variable costs, break-even analysis.

Introduction to Digital Marketing: Distribution Channels: Traditional vs. digital distribution. Social Media Marketing: Platforms overview (Instagram, LinkedIn, Facebook, X/Twitter) Creating a content strategy and calendar Organic vs. paid reach

Search Engine Optimization (SEO): Basics of how search engines work, Keyword research and content optimization, On-page vs. off-page SEO Importance of Digital Presence – Website essentials, blogs, and analytics tools.

Customer Acquisition Strategies: Understanding the Customer Journey – Awareness, interest, decision, action. Early-Stage Customer Acquisition Tactics: Word-of-mouth & referrals, Influencer marketing (micro-influencers), Email marketing basics, building a landing page and collecting leads

Case Studies :

1. Zomato – Branding & Positioning in a Competitive Market
2. Mamaearth – Digital-First Customer Acquisition
3. Nykaa – Customer Segmentation and Channel Strategy

Unit V - Pitching & Business Communication (03 Hours)

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Crafting an Elevator Pitch: Definition and purpose, Key elements: Problem, solution, value proposition, target audience, Delivery tips: Clarity, brevity, confidence
Storytelling & Communication: Importance of Storytelling in Business, Structure of a Business Story: Setup, Conflict, Resolution. Communication Skills: Verbal and Non-verbal
Overview of Funding Sources: Public & private capital sources, venture capital, debt financing. Bootstrapping: Meaning, benefits, and risks, Angel investors: Role, expectations, approach, Brief on incubators, government schemes, crowdfunding.

Case study:

1. Shark Tank India – Pitch Analysis (Any Season)
2. Airbnb – The Original Pitch Deck
3. Dropbox – Storytelling Through Demonstration
4. Dunzo – Investor Pitch Evolution

Learning Resources

Text Books:

1. Bygrave, W.D., Zacharakis, A., & Corbett, A.C. Entrepreneurship, 6th Edition, Wiley, 2025. ISBN: 9781394262809.
2. Drucker, Peter F. Innovation and Entrepreneurship: Practice and Principles, Reprint Edition, Harper Business, 2006. ISBN: 9780060851132.
3. Osterwalder, Alexander & Pigneur, Yves. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, 1st Edition, Wiley, 2010. ISBN: 9780470876411.

Reference Books:

1. Ries, Eric. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, Crown Business, 2011. ISBN: 9780307887894.
2. Kawasaki, Guy. The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything, Portfolio (Penguin Random House), 2015. ISBN: 9781591847847.

MOOC / NPTEL/YouTube Links: -

1. Entrepreneurship Essentials By Prof. Manoj Kumar Mondal IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc20_ge08/preview
2. Entrepreneurship By Prof. C Bhaktavatsala Rao
   IIT Madras https://onlinecourses.nptel.ac.in/noc21_mg70/preview
3. https://onlinecourses.nptel.ac.in/noc20_mg35
4. https://www.coursera.org/learn/entrepreneur-guide-beginners
5. https://wadhwanifoundation.org/

YouTube/Video Links

1. https://www.youtube.com/@wadhwani-foundation/videos

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List of Assignments

No	Title	Objective	Description
1	Entrepreneurial Mindset Reflection	To encourage students to explore their personal views on entrepreneurship and recognize the key characteristics of an entrepreneurial mindset by studying the journey of a real-world entrepreneur.	**Write a reflective essay** (500–600 words) based on the following: • Explain what entrepreneurship means to you personally. • Identify an entrepreneur (Indian or global) whom you admire and explain the reasons for your admiration. • Highlight specific mindset traits (e.g., risk-taking, resilience, innovation, adaptability) that contributed to this entrepreneur's success. • Reflect on how these traits align with your own strengths or indicate areas you wish to develop.
2	Idea Generation Challenge	To foster creativity, structured brainstorming, and the ability to identify potential business opportunities based on real-world problems.	**Generate 10 Business Ideas** Use any structured brainstorming technique Ideas can be tech-based, social impact, service-based, or product-based 2. Select One Idea- Choose the most promising idea from your list 3. Write a 1-page Concept Summary, include the following: • Problem Identified: Describe the specific problem or pain point your idea addresses. • Solution Overview: Briefly describe your business idea. • Target Audience: Identify the group of people or organizations that would benefit. • Market Potential: Discuss the viability and scalability of the idea.
3	Business Model & Customer Validation	To help students develop a clear, structured business model and test its assumptions through customer conversations. The goal is to learn how to validate ideas through real-world feedback and refine the business concept accordingly.	**Part A: Business Model Canvas** 1. Choose a business idea (from Assignment 2 or a new one). 2. Create a Business Model Canvas with all 9 key blocks: o Customer Segments o Value Propositions o Channels o Customer Relationships o Revenue Streams o Key Resources o Key Activities o Key Partnerships o Cost Structure 3. Present the BMC in visual or tabular format.

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			Part B: Customer Interviews & Insights 1. Identify 2–3 potential customers from your target segment. 2. Conduct brief interviews (5–10 minutes each) to gather insights on: o Their pain points o Their reaction to your proposed solution o Willingness to pay or use your product/service 3. Summarize findings in a 1–1.5 page report that includes: o Key customer quotes or paraphrased insights o A revised Value Proposition or Customer Segment block (if needed) o A short reflection: key learnings and potential changes to your idea
4	Business Launch Plan – Marketing & Financial Snapshot	To develop a practical understanding of how marketing stratey and financial planning go hand-in-hand in launching a startup. Students will define a basic marketing campaign and align it with estimated costs, pricing, and projected revenue.	You are preparing to launch your business idea. Prepare a combined Marketing and Financial Snapshot including the following **Part A: Marketing Campaign Plan** • Define your target market by identifying primary customers. • Design a mini-campaign using one or more of the following channels: Social media (e.g., Instagram, LinkedIn) Print/digital flyers Email marketing • Describe the campaign content, including the message or offer to be promoted. • Optionally, create 1–2 sample marketing materials. • Write a 300-word explanation outlining your marketing strategy and expected impact.
			Part B: Financial Snapshot 1. Startup Costs – Estimate your initial costs (fixed + variable) 2. Pricing Strategy – State your pricing model and justification 3. Break-even Analysis – Basic cost vs. sales estimate 4. 6-Month Revenue Projection – Expected sales and income 5. Format: Use a simple table or spreadsheet (optional)

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5	Elevator Pitch Video	To help students develop confidence and clarity in presenting their business idea in a short, compelling format. The exercise simulates real-world investor or networking scenarios where entrepreneurs must grab attention quickly.	**Prepare a 90-second elevator pitch for your business idea** (the same or refined idea used in earlier assignments). Your pitch should cover the following elements: o The Problem – Problem Identification o The Solution – Description of your product/service. o Value Proposition – The unique value proposition. o Target Audience – Audience for your idea. o Call to Action – E.g. request for support, funding, feedback, etc. **Deliver Your Pitch:** o Record a video and submit it with written version of your pitch. o Ensure clear speech, confident body language (for video), and persuasive tone. **Reflection (Short Write-up):** o Share what you learned about communicating your idea o Describe challenges or rewards you experienced in the process

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
VEC-232-COM : Universal Human Values and Professional Ethics		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 02 Hours/Week	02	**CCE:** 20 Marks **End-Semester Exam**: 30 Marks

Prerequisite Courses, if any :

1. Student Induction Program (SIP)

Course Objectives: The course aims to:

1. To help the students develop a holistic, humane world-vision, and appreciate the essential complementarity between values and skills to ensure mutual happiness and prosperity
2. To elaborate on 'Self-exploration' as the process for Value Education.
3. To facilitate the understanding of harmony at various levels starting from self and going towards family and society.
4. To elaborate on the salient aspects of harmony in nature and the entire existence.
5. To explain how the Right understanding forms the basis of Universal human values and definitiveness of Ethical human conduct.
6. To provide the vision for a holistic way of living and facilitate transition from chaotic life to an orderly life.

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

1. **Recognize** the concept of self-exploration as the process of value education and see they have the potential to explore on their own right.
2. **Explore** the human being as the coexistence of self and body to see their real needs / basic aspirations clearly.
3. **Explain** relationship between one self and the other self as the essential part of relationship and harmony in the family.
4. **Interpret** the interconnectedness, harmony and mutual fulfilment inherent in the nature and the entire existence and **draw** ethical conclusions in the light of Right understanding

Course Contents

Unit I - Introduction to Value Education (07 Hours)

1. Understanding Value Education
2. Self-exploration as the Process for Value Education
3. Continuous Happiness and Prosperity - the Basic Human Aspirations and their Fulfilment
4. Right Understanding, Relationship and Physical Facility
5. Happiness and Prosperity - Current Scenario
6. Method to Fulfil the Basic Human Aspirations

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Unit II - Harmony in the Human Being (07 Hours)

1. Understanding Human being as the Co-existence of the Self and the Body
2. Distinguishing between the Needs of the Self and the Body
3. The Body as an Instrument of the Self
4. Understanding Harmony in the Self
5. Harmony of the Self with the Body
6. Programme to Ensure self-regulation and Health

Unit III -Harmony in the Family and Society (08 Hours)

1. Harmony in the Family - the Basic Unit of Human Interaction "Trust' - the Foundational Value in Relationship
2. 'Respect' - as the Right Evaluation
3. Values in Human-to-Human Relationship
4. Understanding Harmony in the Society
5. Vision for the Universal Human Order

Unit IV -Harmony in the Nature (Existence) (08 Hours)

1. Understanding Harmony in the Nature
2. Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
3. Realizing Existence as Co-existence at All Levels
4. The Holistic Perception of Harmony in Existence
5. Professional Ethics in the light of Right Understanding
6. Strategies for Transition towards Value-based Life and Profession

Learning Resources

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-7-3 (Printed Copy), 978-81-957703-6-6 (e-book)
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 3rd revised edition, UHV Publications, 2023, ISBN: 978-81-957703-5-9 (Printed Copy), 978-81-957703-0-4 (e-Book)

Reference Books:

1. P. L. Dhar, R. R. Gaur, 1990, Science and Humanism, Commonwealth Publishers.

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2. A. Nagaraj, 1999, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak

3. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.

4. A. N. Tripathy, 2003, Human Values, New Age International Publishers.

5. E. G. Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press

6. B. L. Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

7. M. Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics and Human Values, Eastern Economy Edition, Prentice Hall of India Ltd.

8. M. K. Gandhi, "The Story of my Experiments with Truth", Discovery Publisher

MOOC / NPTEL/YouTube Links: -

1. Swayam Course on "Understanding Human Being Nature and Existence Comprehensively" by Dr. Kumar Sambhav https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

2. NPTEL Course on "Exploring Human Values: Visions of Happiness and Perfect Society" by Prof. A. K. Sharma IIT Kanpur https://nptel.ac.in/courses/109104068

E-Resources: -

1. https://fdp-si.aicte-india.org/download.php#1/

2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
CEP-241- COM : Community Engagement Project		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 04 Hours/Week	02	**Term Work :** 50 Marks

Prerequisite : Students should have prior knowledge of

1. Basic understanding of social and ethical responsibilities
2. Teamwork and communication skills acquired in prior coursework or group activities
3. Familiarity with problem-solving methodologies and project planning
4. Conversation in local language

Companion Course :

- CEP is an experiential learning approach that combines education, learning, community development, and meaningful community service.
- Project involves students in community development and service activities and applies the experience to personal and academic development.
- The targeted contribution of college students to the village/local development will benefit the community.
- The college has an opportunity to help students become more socially conscious and responsible while simultaneously becoming a socially conscious organization.

Course Objectives: The course aims to:

1. Establish a mutually beneficial relationship between the college and the community
2. Opportunities to engage with their local community, fostering empathy, teamwork, and problem-solving skills while contributing positively to their surroundings.
3. An understanding of the challenges faced by the local community and the role of engineering in addressing those challenges.
4. The ability to apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.
5. The skills to evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact

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

- CO1 - **Identify** and **Analyze** local community needs and challenges by engaging with stakeholders and evaluating real-world problems.
- CO2 - **Design** and **Implement** practical, creative, and context-specific solutions using engineering principles to address community issues.
- CO3 - **Reflect** and **Evaluate** the effectiveness of their interventions and articulate lessons learned through reports and presentations.

Course Contents

Implementation

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- A group of 3 to 4 students could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay/college premise.
- Each group /practical batch is allotted to a faculty member of the department as a mentor.
- A division of 60 students can have 3 batches of minimum 20 students. Practical load of 4 hours to be allocated to each batch.
- The group of students will be associated with a government official / village authorities /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
- The Community Engagement Project should be different from the regular programmes of NSS/NCC /Green Club/Hobby Clubs, Special Interests Groups etc
- An activity book has to be maintained by each of the students to record the activities undertaken/involved and will be countersigned by the concerned mentor/HoD.
- Project report shall be submitted by each student/group of students.
- An internal evaluation shall also be conducted by a committee constituted by the HoD. Evaluation to be done based on the active participation of the student and marks could be awarded by the mentor/HoD.
- Students groups can conduct an awareness programme on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e-waste management or any other activity in an area of their studies and as per his/her aptitude.
- Oral Examination shall consist of presentation and demonstration of the project work carried out by the project groups.

Suggestive list of topics under Community Engagement Project

The below lists are not exhaustive and open for HoD's or mentors to add, delete or modify. It is expected that the focus should be on specific local issues in their nearby areas. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a student/group of students shall

- Use/ miss-use of cell phones
- Career orientation of youth
- Water facilities and drinking water availability
- Health and hygiene of the school going students, home makers and old personals
- Health intervention and awareness programmes
- Horticulture
- Herbal and Nutrition
- Traditional and Modern health care methods
- Food habits
- Air /Sound /Water pollution
- Plantation and Soil protection

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- Renewable energy and Solar Systems
- Yoga awareness and practice
- Health care awareness programmes and their impact
- Organic farming
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Blood groups and blood levels
- Chemicals in daily life
- Music and dance
- Women education and empowerment

Project Scope

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustainability, mental health, or career planning for local stakeholders.
- Develop a simple prototype or solution that addresses a real-world problem (e.g., a water-saving device, simple mobile apps, or tools for community use).
- Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
- Promote health through awareness programs on hygiene, nutrition, and exercise.
- Teach basic computer or technical skills to students, staff, or the community

Proposal Submission

CEP Group should Submit a two-page project proposal, preferably prior to the term commencement outlining the following:-

- Title of the project
- Aim, Objective and expected outcome
- Plan of execution (timeline and activities).
- Place of the CEP and involvement of any local authority, NGP
- Required resources (if any).
- Get approval from the designated faculty mentor.

Learning Resources

Text Books:

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.

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2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.

3. Design Thinking for Social Innovation. IDEO Press, 2015.

4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

MOOC / NPTEL/YouTube Links:

1. NPTEL course: Ecology and Society, https://onlinecourses.nptel.ac.in/noc20_hs77/preview

Web Links: -

1. UNESCO: Education for Sustainable Development https://www.unesco.org
2. EPICS (Engineering Projects in Community Service) https://engineering.purdue.edu/EPICS
3. Ashoka: Innovators for the Public https://www.ashoka.org
4. Design for Change https://www.dfcworld.com

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Savitribai Phule Pune University, Pune

Maharashtra, India

SE - Computer Engineering

Semester IV



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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-251- COM : Database Management Systems		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hours/Week	03	**CCE** : 40 Marks **End-Semester:** 60 Marks

Prerequisite Courses :

1. Discrete Mathematics, Data Structures and Algorithms

Course Objectives: The course aims to:

1. To understand database concepts, design principles, and ER/EER modeling.
2. To develop SQL and PL/SQL skills for efficient database operations and procedural programming.
3. To apply normalization techniques for designing well-structured relational databases.
4. To explore database transactions, concurrency control methods, and recovery mechanisms.
5. To analyse NoSQL database models and their role in managing unstructured data.

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

- CO1: **Explain** the fundamentals of database management systems, including data models, ER modeling, and database design.
- CO2: **Develop** and **execute** SQL and PL/SQL programs to manage and manipulate relational data.
- CO3: **Apply** normalization techniques to improve database design and ensure data integrity.
- CO4: **Analyze** transaction management concepts and concurrency control techniques for reliable database systems
- CO5: **Evaluate** NoSQL database types and **explain** their suitability for handling unstructured data.

Course Contents

Unit I - Introduction to Database Management System (09 Hours)

Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Enterprise Constraints Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, Converting E-R & EER diagram into tables.

Case Study: Study of Architecture of any DBMS like Oracle or MySQL. Design a database schema for any problem given in previous Question Papers.

Unit II - SQL and PL/SQL (09 Hours)

SQL: DDL, DML, Select Queries, String, Date and Numerical Functions, Aggregate Functions ,View, Indexes, Group by and Having Clause, Join Queries, Set, Set operation, Set membership, Nested queries, DCL, TCL

PL/SQL: Control Statement, Cursor, Stored Procedure and Function, Trigger

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Case Study : Design and implement a Student Course Management System using SQL and PL/SQL to manage students, courses, and faculty members efficiently. The system should store and retrieve relevant data, ensuring integrity, security, and performance optimization.

Unit III - Relational Database Design (09 Hours)

Relational Model: Basic concepts, Attributes and Domains, CODD's Rules, Relational Integrity, Referential Integrities, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, 2NF, 3NF, BCNF.

Case study: Design and Optimization of a Relational Database for a University Management System

Unit IV - Database Transactions (09 Hours)

Basic concept of a Transaction, Transaction Management, Properties of Transactions, ACID, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods.

Case study : Design Online Shopping Cart Transaction Management In an e-commerce platform, multiple users simultaneously add, update, and purchase products. To ensure data consistency and reliability, the system must handle concurrent transactions effectively.

Unit V - NoSQL Database (09 Hours)

Introduction to NoSQL Database, NoSQL data models, CAP theorem and BASE Properties, Comparative study of SQL and NoSQL, MongoDB: CRUD Operations, Indexing and Aggregation.

Case study: Study NoSQL Database Selection for a Social Media Platform.

Learning Resources

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
3. D T Editorial Services "BIG DATA Black Book", Dreamtech Press ISBN 13 : 9789351199311

Reference Books:

1. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
3. Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O Reilly Publications, ISBN: 978-1-449-34468-9
4. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628
5. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereopty Limited, ISBN: 1743045743, 9781743045749
6. Joy A. Kreibich, "Using SQLite", O'REILLY, ISBN: 13:978-93-5110-934-1
7. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications ISBN: 9788176569644, 9788176569644

MOOC / NPTEL/YouTube Links: -

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1. https://nptel.ac.in/courses/106106220
2. https://nptel.ac.in/courses/106105175
3. https://www.mongodb.com/resources/basics/databases/nosql-explained
4. https://learn.microsoft.com/en-us/azure/cosmos-db/nosql/modeling-data

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-252-COM : Discrete Mathematics		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hours/Week	03	**CCE** : 40 Marks **End-Semester**: 60 Marks

Prerequisite Courses : Students should have prior knowledge of Basic Mathematics

Course Objectives: The course aims to introduce several Discrete Mathematical Structures found to be serving as tools even today in the development of theoretical computer science.

1. To introduce students to understand, explain, and apply the foundational mathematical concepts at the core of computer science.
2. To understand use of set, function and relation models to understand practical examples, and interpret the associated operations and terminologies in context.
3. To acquire knowledge of logic and proof techniques to expand mathematical maturity.
4. To learn the fundamental counting principle, permutations, and combinations.
5. To study how to model problems using graphs and trees.
6. To learn algebraic structures

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

- CO1: **Apply** and **Analyze** Set Theory and Propositional Logic
- CO2: **Evaluate** and **Construct** Models using Relations and Functions
- CO3: **Design** and **Implement** Tree Structures and Network Flow Algorithms
- CO4: **Analyze** and **Develop** Solutions using Graph Theory
- CO5: **Apply** and **Solve** Problems using Counting Principles, **Understand** Algebraic structures

Course Contents

Unit I - Set and Propositions (09 Hours)

Introduction and significance of Discrete Mathematics, Propositional Logic- logic, Propositional Equivalences, Application of Propositional Logic- Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction. Sets– Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principle of inclusion and exclusion. Types of Sets – Bounded and Unbounded Sets, Diagonalization Argument, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, Power set.

Case study: Know about the great philosophers- Georg Cantor, Richard Dedekind and Aristotle. Design a recommendation system using logical propositions and predicates to filter movies based on user preferences.

Unit II - Relations and Functions (09 Hours)

Introduction to Relations and their Properties Representation of Relations using Matrices and Digraphs Equivalence relations, Partial orderings, Partitions, Hasse diagram, Lattices, Chains and Anti-Chains, Transitive closure and Warshall's algorithm.

Functions: Types of Functions (Injective, Surjective, Bijective) , Composition and Inverse of Functions , Recursive Functions and Applications in Algorithms, Counting Functions and Growth of Functions

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Cast Study - Know about the great philosophers-Dirichlet

Unit III - Introduction to Trees (09 Hours)

Introduction to Trees and Properties decision tree, prefix codes and Huffman coding, Applications of Trees in File Systems, cut sets, The Max flow- Min Cut Theorem in Transport network, Minimum Spanning Tree Algorithms Prims and Kruskal algorithm

Case Studies - Algebraic Expression Tree, Tic-Tac-Toe Game Tree, implement a file directory system using a tree structure, allowing hierarchical organization of files and folders

Unit IV - Introduction to Graph Theory (09 Hours)

Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path- Dijkstra's Algorithm, Planar Graphs, Graph Colouring

Case study : Model a social media platform using directed graphs to represent relationships such as "follower" or "friend." Three utility problem, Web Graph, Google map

Unit V - Counting Principles and Algebraic Structures - (09 Hours)

Basic Counting Techniques: Addition and Multiplication Principles, Permutations and Combinations, Binomial Coefficients and Pascal's Triangle, Pigeonhole Principle and its Applications, Inclusion-Exclusion Principle, Generating Functions for Counting Problems.

The structure of algebra - Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups and Congruence relations, Rings, Integral Domains and Fields.

Case Studies - Study Sudoku solving algorithms and algorithm for generation of new SUDOKU. Study Hank-shake Puzzle and algorithm to solve it Calculate the number of possible password combinations given specific constraints on length, character types, and repetition

Learning Resources

Text Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw-Hill, ISBN 978-0-07-288008-3
2. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures", Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.
6. Herstein, I. N. Topics in Algebra. 2nd ed., Indian Adaptation, Wiley India Pvt. Ltd., 2006. ISBN: 9788126510184.

E-Book

1. https://www.ebookphp.com/discrete-mathematical-structures-6th-edition-epub-pdf/
2. http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
3. http://home.iitk.ac.in/~arlal/book/mth202.pdf
4. https://web.stanford.edu/class/cs103x/cs103x-notes.pdf

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5. http://home.iitk.ac.in/∼arlal/book/mth202.pdf

MOOC/NPTEL/SWAYAM Course Links:

1. https://onlinecourses.nptel.ac.in/noc20_cs82/preview
2. https://nptel.ac.in/courses/106108227
3. https://nptel.ac.in/courses/106106094

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-253-COM : Computer Organization and Microprocessor		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 02 Hours/Week	02	**CCE** : 40 Marks **End-Semester:** 60 Marks

Prerequisite Courses : Digital Electronics and Logic Design

Course Objectives: To provide students with a foundational understanding of computer evolution, memory management, the 8086 microprocessor, memory organization, interrupts, and parallel organization in computer systems.

1. Learn about the history and development of computers and how their performance has improved over time.
2. Understand how memory is managed in a computer and the techniques used to store and access data efficiently.
3. Get familiar with the 8086 microprocessor, its basic functions, and its role in computer systems.
4. Learn how memory is organized in a computer and how interrupts help manage tasks.
5. Understand the basics of parallel organization and how it improves the speed and performance of computer systems.

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

- CO1: Understand and analyze computer system design and historical development of computers and foundational architectures like Von Neumann and Harvard.
- CO2: To design and optimize internal, and external memory systems for high-performance computing.
- CO3: To understand fundamental knowledge of the 8086-microprocessor architecture, programming model, addressing modes, and instruction set.
- CO4: To understand memory management, I/O operations and interrupt handling, including address translation, memory banks and interrupt controllers.
- CO5: To explore the multiprocessor systems, Flynn's Taxonomy and RISC design principles, including memory architectures

Course Contents

Unit I - Computer Evolution and Performance (06 Hours)

A Brief History of Computers, Von Neumann Architecture, Harvard Architecture, Designing for Performance, Evolution of Intel processor architecture- 4 bit to 64 bit, performance assessment. A top level view of Computer function and interconnection Computer Components, Interconnection structure, bus interconnection,

Computer Arithmetic- The Arithmetic and Logic Unit, addition and subtraction of signed numbers, design of adder and fast adder, carry look ahead addition, multiplication of positive numbers, signed operand multiplication, Booths algorithm for multiplying binary integers.

Case Study: Evolution (Brief History) of Microprocessors

Unit II - Memory Management (06 Hours)

Characteristics of Memory System, The memory hierarchy.

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Cache Memory- Cache memory principles, Elements of cache design cache address, size, and mapping functions. Replacement algorithms, write policy, line size, number of cache, one level and two level cache. Performance characteristics of two level cache- locality & operations.
Internal Memory- semiconductor main memory, advanced DRAM organization. External Memory- Hard Disk organization. RAID- level 1 to level 6.

Case Study : Memory Management in ATMs

Unit III - Introduction to 8086 Microprocessor (06 Hours)

8086 Architecture: Introduction to 16 bit microprocessor, Architecture and Pin diagram of 8086, Programmers model of 8086 (Registers).
Addressing modes of 8086: Immediate Addressing, Register Addressing, Direct Addressing, Indirect Addressing, Indexed Addressing, Based Addressing, Based Indexed Addressing
Instruction set of 8086: Data Movement Instructions, Arithmetic Instructions, Logic Instructions, Control Transfer Instructions, String Instructions, Input / Output Instructions, Flag Control Instructions, Process Control Instructions, Other Instructions.

Case study: Design of Basic Calculator Using 8086

Unit IV - Memory Organization and Interrupts (06 Hours)

Memory Organization: Segmentation, logical to physical address translation, even and odd memory banks, Read write cycle timing diagrams, Address mapping and decoding, I/O: memory mapped I/O & I/O Mapped I/O.
Interrupts: Interrupt Control & status registers, Interrupt Vector Table (IVT), ISR, Hardware and software Interrupts, 8259 (Programmable Interrupt Controller): Features, Block Diagram, Control & Status registers.

Case study : Memory and Interrupt Management in an Automated Railway Reservation System

Unit V - Parallel Organization (06 Hours)

Multiprocessors, Clusters, Flynn's Taxonomy for Multiple Processor Organizations, Closely and Loosely Coupled Multiprocessors Systems, Symmetric Multiprocessor (SMP) Organization, UMA, NUMA.
RISC: Instruction execution characteristics, use of large register file, compiler-based register optimization, RISC architecture and pipelining. RISC Vs CISC.

Case study:Multi-core System

Learning Resources

Text Books:

1. W. Stallings, Computer Organization and Architecture: Designing for performance, Pearson Education/ Prentice Hall of India, 2003, ISBN 978-93-325-1870-4, 7 th Edition.
2. Zaky S, Hamacher, —Computer Organization, 5th Edition, McGraw-Hill Publications, 2001, ISBN- 978-1-25-900537-5, 5th Edition.
3. Douglas Hall, "Microprocessors & Interfacing", McGraw Hill, Revised 2 Edition,
4. A. Ray, K. Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing" Tata McGraw Hill,2004 ISBN 0-07-463841.

Reference Books:

1. John P Hays, —Computer Architecture and Organization, McGraw-Hill Publication, 1998, ISBN:978-1-25-902856-4, 3rd Edition.
2. Miles Murdocca and Vincent Heuring, —Computer Architecture and Organization- an integrated approach, Wiley India Pvt. Ltd, ISBN:978-81-265-1198-3, 2nd Edition

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3. A. Tanenbaum, —Structured Computer Organization||, Prentice Hall of India, 1991 ISBN: 81 – 203 – 1553 – 7, 4th Edition.

4. Patterson and Hennessy, —Computer Organization and Design, Morgan Kaufmann Publishers In, ISBN 978-0-12-374750-1, 4th Edition.

5. Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2 nd Edition, PHI,2005.

6. Kenneth Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC"

MOOC / NPTEL/YouTube Links: -

1. NPTEL course on "Computer architecture and organization" By Prof. Indranil Sengupta, Prof. Kamalika Datta, IIT Kharagpur https://swayam.gov.in/nd1_noc21_cs61/preview

2. NPTEL course on "Microprocessor & Interfacing" By Prof. Shaik Rafi Ahamed, IIT Guwahati https://archive.nptel.ac.in/courses/108/103/108103157/

3. Complete COA Computer Organization & Architecture in one shot, Semester Exam, Hindi, https://www.youtube.com/watch?v=DsK35f8wyUw

4. 8086 Microprocessor Architecture - Bharat Acharya, Hindi, https://www.youtube.com/watch?v=Dmw

5. Microprocessor 8086 - YouTube Playlist https://www.youtube.com/playlist?list=PLgwJf8NK-2e4oAeDid0hwuiol_RJdscrp

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-254-COM : Database Management Laboratory		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 02 Hours/Week	01	**Term Work :** 25 Marks **Practical :** 25 Marks

Companion Course : Database Management Systems

Course Objectives: The course aims to:

1. To understand and apply the concepts of database design by formulating case studies, creating E-R diagrams, and mapping them to the relational model.
2. To develop and execute SQL queries for creating, modifying, and managing database structures using DDL, DML, DCL, and TCL commands.
3. To implement advanced SQL operations, including aggregate functions, joins, subqueries, views, stored procedures, and triggers, for efficient database management.
4. To explore NoSQL databases by designing and implementing CRUD operations in MongoDB, understanding document-based storage and retrieval.

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

1. **Apply** the concepts of database design by creating E-R diagrams and converting them into relational models.
2. **Develop** and **execute** SQL queries for data manipulation, transaction control, and access management using DML, DCL, and TCL commands.
3. **Analyze** and **implement** SQL operations, including joins, views, subqueries, stored procedures, and triggers, to optimize data retrieval and integrity.
4. **Design** and **Implement** CRUD operations in MongoDB, demonstrating an understanding of NoSQL database concepts and their practical applications.

Course Contents

Guidelines for Instructor's Manual

The instructor's manual/Lab Manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/guidelines, references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title,

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Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Students programs maintained on cloud or college server by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory for accreditation purpose.

Guidelines for Laboratory/Term Work Assessment

Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include timely completion performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute them among batches of students.

It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructors may assign one real life application in the form of a mini-project based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to respective branch beyond the scope of the syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - MYSQL/Oracle, MongoDB, ERD plus, ER Win

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Suggested List of Laboratory Experiments/Assignments

Sr.	Name of Assignment

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1	**Case Study and ER Diagram** Develop a case study and design its Entity-Relationship (ER) Diagram. Convert the ER model into a relational model.
2	**Write and execute SQL Data Definition Language** (DDL) commands such as CREATE, ALTER, DROP, RENAME, and TRUNCATE to define and modify tables. Insert data into the tables and apply appropriate integrity constraints such as NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, and CHECK. (The application may vary as per the subject teacher's requirement.)
3	**SQL Queries for Data Manipulation, Access Control, and Transactions** Design and run SQL queries to demonstrate the following: a) Data Manipulation (DML): Use SQL statements to INSERT, UPDATE, and DELETE records. Apply arithmetic, logical, set operators, pattern matching, and string functions. b) Access Control (DCL): Use GRANT, REVOKE, and ROLE commands to manage user access. c) Transaction Control (TCL): Apply START TRANSACTION, COMMIT, ROLLBACK, and SAVEPOINT commands to manage transactions.
4	**Aggregate Functions and Grouping** Use aggregate functions along with GROUP BY and HAVING clauses to retrieve summarized data from the database.
5	**JOIN Operations and Views** Perform various types of JOIN operations to extract meaningful relationships between tables. Create and manage different database views.
6	**Subqueries** Write and execute subqueries to retrieve data from one table based on results from another.
7	**Stored Procedures or Function with Cursors** Create and execute stored procedures / function using cursors.
8	**Database Triggers** Implement and test triggers to maintain data integrity in database.
9	**CRUD Operations using MongoDB** Design and implement basic Create, Read, Update, and Delete (CRUD) operations using MongoDB. Use the save method and logical operators where necessary.
10	**Aggregation and Indexing in MongoDB** Design and execute MongoDB queries using aggregation and indexing techniques with suitable examples.

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11	Using the database concepts covered in above assignments, develop an application with following details: 1. Follow the Software Development Life cycle and other concepts learnt in Software Engineering Course throughout the implementation. 2. Develop application considering: • Front End: Java/Perl/PHP/Python/Ruby/.net/any other language • Backend : MongoDB/ MySQL/Oracle 3. Test and validate application using Manual/Automation testing. 4. Student should develop application in group of 2-3 students and submit the Project Report which will consist of documentation related to different phases of Software Development Life Cycle: • Title of the Project, Abstract, Introduction • Software Requirement Specification • Conceptual Design using ER features, Relational Model in appropriate Normalize form • Graphical User Interface, Source Code • Testing document • Conclusion
Note • Instructor should maintain progress report of mini project throughout the semester from project group. • The practical exam will be based on Assignments 1 through 10 provided above. • Mini Project in this course should facilitate the Project Based Learning among students	

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
PCC-255-COM : Microprocessor Lab		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 02 Hours/Week	01	**Oral :** 25 Marks

Prerequisite Courses : Microprocessor

Course Objectives: The course aims to:

1. To understand assembly language programming instruction set
2. To understand different assembler directives with example
3. To apply instruction set for implementing X86/64 bit assembly language programs

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

- CO1 - **Understand** and **apply** various addressing modes and instruction set to implement assembly language programs
- CO2 - **Apply** logic to implement code conversion
- CO3 - **Analyze** and apply logic to demonstrate processor mode of operation

Course Contents

Guidelines for Instructor's Manual

The instructor's manual/Lab Manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/guidelines, references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Students programs maintained on cloud or college server by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory for accreditation purpose.

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Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include timely completion performance, innovation, efficient codes, punctuality and neatness.

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Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute them among batches of students.

It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructors may assign one real life application in the form of a mini-project based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to respective branch beyond the scope of the syllabus.

Operating System: Latest 64-bit Version and update of Microsoft Windows 7/ Windows 8 Operating System onwards or 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM 64x or equivalent, Microsoft Visual Studio x64 Intrinsic

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Suggested List of Assignment (Any NINE)	
1	Write an X86/64 ALP to accept five 64 bit Hexadecimal numbers from user and store them in an array and display the accepted numbers.
2	Write an X86/64 ALP to accept a string and to display its length.
3	Write an X86/64 ALP to count number of positive and negative numbers from the array.
4	Write X86/64 ALP to perform non-overlapped block transfer without string specific instructions. Block containing data can be defined in the data segment.
5	Write X86/64 ALP to perform overlapped block transfer with string specific instructions Block containing data can be defined in the data segment
6	Write X86/64 ALP to perform multiplication of two 8-bit hexadecimal numbers. Use successive addition method only.
7	Write an X86/64 ALP to find the largest of given Byte/Word/Dword/64-bit numbers.
8	Write a switch case driven X86/64 ALP to perform 64-bit hexadecimal arithmetic operations (+,-,*, /) using suitable macros. Define procedure for each operation
9	Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number
10	Write X86/64 ALP to convert 5- digit BCD number into its equivalent HEX number.

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Suggested List of Assignment (Any NINE)	
11	Study of Motherboard. Motherboards are complex. Break them down, component by component, and Understand how they work. Choosing a motherboard is a hugely important part of building a PC. Study- Block diagram, Processor Socket, Expansion Slots, SATA, RAM, Form Factor, BIOS, Internal Connectors, External Ports, Peripherals and Data Transfer, Display, Audio, Networking, Overclocking, and Cooling.

Learning Resources

Text Books:

1. Douglas Hall, “Microprocessors & Interfacing”, McGraw Hill, Revised 2 Edition,

2. A. Ray, K.Bhurchandi, ”Advanced Microprocessors and peripherals: Arch, Programming & Interfacing”Tata McGraw Hill,2004 ISBN 0-07-463841

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
MDM-271-COM : Internet of Things		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 02 Hours/Week	02	**CCE** : 40 Marks **End-Semester:** 60 Marks

Prerequisite Courses, if any :

1. Digital Electronics and Logic Design

Course Objectives: The course aims to:

1. To study the fundamentals about IoT
2. To acquire knowledge of sensor, actuators
3. To understand about IoT Access technologies and understand application protocols for IoT
4. To comprehend cloud and services in the field of IoT
5. To develop various application in IoT

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

- CO1: **Understand** fundamental and ecosystem of IoT.
- CO2: Interface different sensors and actuators with IoT development boards.
- CO3: **Illustrate** different layers of IoT protocols.
- CO4: **Use** of cloud and its services.
- CO5:**Apply** and **develop** domain specific IoT applications.

Course Contents

Unit I - Introduction to IoT (06 Hours)

What is Internet of Things: Definition & Characteristics of IoT, Evolution of IoT, Convergence of IoT, IoT Challenges, M2M Communication, Things in IoT, IoT Protocols, Functional blocks of IoT Ecosystem, Communication Models, Communication APIs, IoT enabled Technologies: Wireless Sensor Network, Cloud Computing, Big Data Analytics, Embedded Systems, IoT enabled Applications.

Case Study: Home Automation

Unit II - Introduction to Sensors, Actuator (06 Hours)

Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications,

Actuators -– Definition, Principles, Classifications, Types, Characteristics and Specifications

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IoT Development Boards: Arduino IDE and Board Types, Raspberry Pi, NodeMCU, ESP 32, Beaglebone

Case Study : Interfacing Sensors

Unit III - Protocols for IoT (06 Hours)

IoT Access Technologies: Physical and MAC layers, IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer- IP versions 4 & 6 ,6LoWPAN, IoT Application Layer Protocols – CoAP and MQTT, Transport Protocols - Zigbee, Bluetooth, BLE, ZWave

Case study: MQTT

Unit IV -Cloud for IoT (06 Hours)

Fundamentals of Cloud Computing, Types of Cloud services- AWS, Azure, Adafruit, IoT with Cloud, Challenges faced in cloud services, selection of cloud for IoT applications

Case study : How to use Adafruit cloud

Unit V -IoT Applications (06 Hours)

Smart Cities – Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance

Energy – Smart Grids, Renewable Energy Systems, Prognostics

Environment – Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection

Agriculture – Smart Irrigation, GreenHouse Control

Industry – Machine Diagnostics & Prognosis, Indoor Air Quality Monitoring

Health & Lifestyle – Health & Fitness Monitoring, Wearable Electronics

Case study: IoT Analytics: Thingspeak

Learning Resources

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017.

2. Hakima Chaouchi, “The Internet of Things - Connecting Objects to the Web”, 1st Edition, Wiley, 2010.

3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – Hands-On Approach”, 2nd Edition, Universities Press, 2016.

4. Perry Lea, “Internet of things For Architects”, 1st Edition, Packt Publication, 2018

5. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, “Internet of Things:Architectures, Protocols and Standards”, Wiley

Reference Books:

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1. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill Education, 1st Edition, 2017

2. Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, 1st Edition, Wiley, 2014.

3. David Hanes, Gonzalo Salgueiro, IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 1st Edition, 2017.

4. Donald Norris, “Raspberry Pi – Projects for the Evil Genius”, 2nd Edition, McGraw Hill, 2014.

MOOC / NPTEL/YouTube Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

E-Books :

1. https://pg.its.edu.in/sites/default/files/KCA043%20Internet%20of%20things%20IoT%20by%20Raj%
2. https://aitskadapa.ac.in/e-books/CSE/IOT/Internet%20of%20Things_%20Architectures,%20Protocol
3. https://jcer.in/jcer-docs/E-Learning/Digital%20Library%20/E-Books/Internet-of-things-a-hands-on-approach-%20Arshadeep.pdf

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
VSE-281-COM : Web Development		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 04 Hours/Week	02	**Term Work** : 25 Marks **Practical :** 25 Marks

Course Objectives: The course aims to:

1. Understand Internet basics, including protocols, client-server architecture, and network security essentials.
2. Develop structured web pages using HTML, CSS, and Bootstrap for responsive front-end design.
3. Implement interactivity with JavaScript and DOM manipulation techniques.
4. Build dynamic web applications using PHP for back-end logic and server-side processing.

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

- CO1: **Explain** the fundamentals of Internet architecture, protocols, and client-server interactions.
- CO2: **Design** responsive web pages using HTML, CSS, and Bootstrap frameworks
- CO3: **Apply** JavaScript and DOM to **create** dynamic and interactive web content
- CO4: **Develop** server-side functionality using PHP for dynamic content generation and form handling

Course Contents

Unit I - Introduction to Internet and Web Development (05 Hours)

Introduction to Internet Basics: Protocols, Servers and Clients, Functions of server and client, web Development

Case Study: Users (students) act as clients accessing the system through HTTP.

Unit II - Hyper Text Markup Language (05 Hours)

Static & dynamic web Application, HTML: Fundamentals/ Basic HTML, Text formatting on Web Pages, Incorporate images, Creating hyperlinks, complex image maps, tables and nested tables, Inserting web page, Setting & modifying field properties.

Case Study : Create a feedback form using HTML <form>, <input>, <textarea>, <select>, and <button>.

Unit III - Cascading Style Sheet (CSS) (05Hours)

CSS: Introduction, types of CSS: Internal, External & inline, Designing with Style Sheets, Style Sheet Syntax, ID, types of Selectors. Bootstrap: Overview, Bootstrap Works, Component.

Case study: Style the feedback form using internal or external CSS.

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Unit IV - JavaScript- (05 Hours)

Javascript & DoM: Introduction to JavaScript, Variables and Objects, Decision Making Statement, Loops, Arrays, Functions & Prototypes, Core JavaScript Objects, DOM Introduction, DOM Structure.

Case study : Show a popup (alert) for confirmation using JavaScript.

Unit V - Back End Technologies - (05 Hours)

PHP: Introduction, PHP Document, Language Fundamentals, Decision Making Statement, Loops, Statements, Operators, PHP functions, Arrays & Functions, String Functions.

Case study: Print submitted data back as confirmation or save to a .txt or database (optional).

Practical Assignments

Week	Topics to be covered
1	Create a simple HTML page displaying personal details using text formatting tags.
2	Design a web page that includes an image, hyperlink, and a nested table.
3	Create a form with fields: name, email, gender, date of birth, and submit button.
4	Apply internal, external, and inline CSS to style a web page with headings and tables.
5	Develop a responsive web page using Bootstrap Grid and Components.
6	Write a JavaScript program to validate form inputs (e.g., email, empty fields).
7	Create a web page that uses JavaScript to display dynamic content using DOM.
8	Write a JavaScript program for a simple calculator using functions and switch-case.
9	Design a PHP script to display "Welcome" message and current date & time.
10	Write a PHP program to accept form input and display it using the POST method.
11	Implement a PHP program for string manipulation (e.g., reverse, length, substring).
12	Create a PHP script to store and display values in an array.

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
AEC-282- COM: Modern Indian Language (Marathi)		
Teaching Scheme	**Credits**	**Examination Scheme**
Tutorial : 01 Hour/Week **Practical** : 02 Hours/Week	01 01	**Term Work** : 50 Marks

Course Objectives: The course aims to:

अभ्यासक्रमाची उद्दिष्टे :

१. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.
२. प्रसारमाध्यमांतील संज्ञापनातील स्वरूप आणि स्थान स्पष्ट करणे.
३. व्यक्तिमत्त्व विकास आणि भाषा यांच्यातील सहसंबंध स्पष्ट करणे.
४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.
५. प्रसारमाध्यमांसाठी लेखनक्षमता विकसित करणे.

Course Contents

Unit I & II (07 Hours & 08 Hours)

घटक	तपशील
१	१. भाषा आणि व्यक्तिमत्त्व विकास : सहसंबंध २. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे
२	प्रसारमाध्यमांसाठी लेखन १ वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितशोधन २ नभोवाणीसाठी भाषणाची संहितालेखन ३ दूरचित्रवाणीसाठी माहितीपटासाठी संहितालेखन

Case Study:

Unit III & IV (07 Hours & 08 Hours)

१	१. भाषा, जीवन व्यवहार आणि नवमाध्यमे, समाजमाध्यमे २. नवमाध्यमे आणि समाजमाध्यमांचे प्रकार : ब्लॉग, फेसबुक, ट्विटर. ३. नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर आणि परिणाम
२	१. वेबसाईट आणि ब्लॉग, ट्विटरसाठी लेखन २. व्यावसायिक पत्रव्यवहार

Learning Resources

Text Books:

संदर्भ ग्रंथ :

१ सायबर संस्कृती, डॉ. रमेश वरखेडे
२ उपयोजित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई
३ ओळख माहिती तंत्रज्ञानाची, टिमोथी जे. ओ लिअरी
४ संगणक, अच्युत गोडबोले, मौज प्रकाशन, मुंबई.
५ इंटरनेट, डॉ. प्रबोध चोबे, मनोरमा प्रकाशन, मुंबई.
६ व्यावहारिक मराठी, डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर.
७ आधुनिक माहिती तंत्रज्ञानाच्या विश्वात, शिक्रापूरकर दीपक, मराठे उज्ज्वल, उत्कर्ष प्रकाशन, पुणे.

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Guidelines Term Work conduction and Evaluation

Implementation Guidelines

1. Subject teacher should frame minimum 08 assignments-based covering on all four units.
2. Scaffolding: Start with simpler tasks and gradually increase complexity. Provide necessary vocabulary and grammatical structures beforehand.
3. Differentiation: Offer varied levels of support for students with different proficiency.
4. Pair Work & Group Work: Encourage collaborative learning and peer correction.
5. Feedback: Provide constructive feedback on all assignments, focusing on both accuracy and fluency.
6. Authentic Materials: Use real-world Marathi materials (simple songs, short videos, advertisements) as much as possible.
7. Cultural Context: Integrate cultural aspects into the assignments (e.g., describing a Marathi festival, a famous personality).
8. Fun & Engaging: Make the activities enjoyable to keep students motivated. Use games and competitive elements where appropriate.
9. Technology Integration: Use online dictionaries, translation tools (with caution), and Marathi typing tools.
10. These assignments can be adapted based on the students' proficiency level and the specific learning objectives of the Marathi course.

Suggested List of Assignments

1. "Samvad Sadara Kara" (Present a Dialogue): Role-Playing Everyday Scenarios: Objective is to practice conversational Marathi, understanding social cues. In pairs or small groups, students create and perform a short dialogue based on a given scenario.
2. Vartamanpatra Vachan" (Newspaper Reading): (Columns like Sports, political, finance, editorial, education, international news etc) in the daily Marathi newspapers, summarize and present in the practical. A summary should be added as part of the journal.
3. Creative writing: Write blogs and posts on social media up to 200 words on recent development in their field of study
4. "Mala He Sangayche Aahe" (I Want to Say This): Students are expected to show the objects and describe it to the class in Marathi. They should mention its color, size, use, why it's important to them, etc.
5. Professional letter / report writing
   (a) Write a letter to the principal/director for organizing NSS camp in nearby village. Preparation of the budget, permission letters and report submission in the University
   (b) Write a letter for internship sponsorship to any organization.
6. Book Review – Students are expected to read any novel, fiction or literature book of their choice and write a review on post it on social media of their choice.

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7. Participation in Competitions (in college/out side the college) debate, declamation, elocution – A Report should be submitted

8. Group Activity: Road show, skit play, one-act play

9. Participation in One-Act-Play - Participation in Purushottam karandam, Firodia karandak, Dajikaka Gadgil Karandak and Shreetej Karandak.

10. Marathi Film Review – Watch the Marathi movie widely available on an OTT (Over-The-Top) platform , broadcaster in Television or availle on YouTube and write a review.

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
EEM-283-COM : Engineering Product Design		
Teaching Scheme	**Credits**	**Examination Scheme**
Tutorial : 01 Hour/Week **Practical** : 02 Hours/Week	01 01	**Term Work :** 25 Marks

Course Objectives: The course aims to:

1. Apply and learn about the product design life cycle, giving particular attention to market demand and user needs.
2. Promote innovative thinking and ideation to address practical issues with a product-focused strategy.
3. Use both digital and physical tools to create low- to high-fidelity prototypes.
4. Incorporate multidisciplinary knowledge into product design, such as accessibility, ethics, cost-effectiveness, and sustainability.
5. Collaborate in groups to jointly create and showcase product concepts with functional models and supporting documentation.

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

- CO1: **Use** the design thinking technique to identify and characterize user-centric problems and generate innovative product concepts.
- CO2: **Create** and **present** working prototypes while taking accessibility, sustainability, and usability into account.
- CO3: **Collaborate** in groups to properly study, **evaluate**, and communicate the entire product design process in order to document and present it.

Course Contents

Guidelines for Instructor's Manual

The instructor's manual/Lab Manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/guidelines, references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Students programs maintained on cloud or college server by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory for accreditation purpose.

Guidelines for Laboratory/Term Work Assessment

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Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include timely completion performance, innovation, efficient codes, punctuality and neatness.

Suggested List of Assignment (Any SIX)	
1	Ideation and Problem Identification: Identify a real-world problem in the domains of healthcare, agriculture, education, or urban living that can be addressed through a technological product. Tools: Mira, Figma, or Canva
2	User-Centred Design and Wireframing: Develop wireframes for a mobile or web application focusing on user experience and interface design. Tools: Figma, Adobe XD
3	Rapid Prototyping with IoT Integration: Create a functional prototype of a smart device (e.g., smart irrigation system, health monitoring wearable) integrating sensors and microcontrollers. Tools: Arduino, Raspberry Pi, Tinkercad
4	Design for Sustainability: Redesign an existing electronic product to enhance its sustainability by focusing on energy efficiency, recyclability, and minimal environmental impact. Tools: AutoCAD, SolidWorks, or Fusion 360
5	Human-Computer Interaction (HCI) Evaluation: Conduct usability testing on a software application to assess its user-friendliness and accessibility. Tools: UsabilityHub, Google Forms, or Hotjar
6	Value Engineering and Cost Analysis: Analyze the cost components of a tech product and propose design modifications to reduce costs without compromising quality. Tools: Excel, Costimator, or custom spreadsheets
7	Inclusive Design Challenge: Design a product interface that is accessible to users with disabilities, ensuring compliance with accessibility standards. Tools: WAVE, Axe, or Lighthouse
8	Ethical and Legal Aspects in Product Design: Understand and evaluate the ethical, legal, and societal implications of a tech-based product. Tools: Word processors, Canva for presentations

Learning Resources

Text Books:

1. Dr. M. A. Bulsara, Dr. H. R. Thakkar, Charotar Publishing House Pvt. Ltd., 2nd Edition 2015 (Revised & Enlarged) ISBN : 9789385039140
2. Product Design for Engineers by Devdas Shetty, Cengage Publishing, ISBN: 9788131533031
3. Product Design and Development, Karl T. Ulrich, Steven D. Eppinger, McGraw-Hill Education, ISBN:9-78-1259060380
4. The Design of Everyday Things, Don Norman, Basic Books, ISBN:9780465050659
5. Design Thinking for Strategic Innovation, Idris Mootee, Wiley, ISBN: 9781118620120

Reference Books:

1. Change by Design, Tim Brown (IDEO), HarperBusiness, ISBN: 9780061766084
2. Engineering Design: A Project-Based Introduction, Clive Dym, Patrick Little, Wiley, ISBN: 97811183245
3. Creative Confidence: Unleashing the Creative Potential Within Us All, Tom Kelley, David Kelley, Crown Business, ISBN:9780385349369

NPTEL Online Courses:

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1. Product Design and Manufacturing, [NPTEL Link](https://onlinecourses.nptel.ac.in/noc21_me66/prev
   Prof. J. Ramkumar, Prof. Amandeep Singh, IIT Kanpur

2. Design Thinking - A Primer, [NPTEL Link](https://onlinecourses.nptel.ac.in/noc22_mg32/preview),
   Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras

3. Human-Computer Interaction, [NPTEL Link](https://onlinecourses.nptel.ac.in/noc25_cs38/preview),
   Prof. Rajiv Ratn Shah, IIIT Delhi

4. Product Design & Innovation, [NPTEL Link](https://onlinecourses.nptel.ac.in/noc21_de01/preview),
   Prof. Supradip Das, Prof. Swati Pal, Prof. Debayan Dhar, IIT Guwahati

Online Resources:

1. [IDEO.org Design Kit](https://www.designkit.org/), Design Thinking tutorials, Empathy, Ideation, Prototyping

2. [Interaction Design Foundation](https://www.interaction-design.org/), HCI & UX Design Learning, Assignments on usability and evaluation

3. [TinkerCAD](https://www.tinkercad.com/), Online prototyping and circuit simulation, Prototyping with Arduino, IoT,

4. [Figma](https://www.figma.com/), Wireframing & UI Design, Assignments on user-centered design

5. [MIT D-Lab](https://d-lab.mit.edu/), Sustainable design & inclusive innovation, Assignments on design for sustainability and inclusion

6. [Canva](https://www.canva.com/), Design mockups and visuals, Sketches and presentation of product ideas

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Savitribai Phule Pune University **Second Year of Computer Engineering - 2024 Pattern - Revised**		
VEC-284- COM - Environmental Studies		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 02 Hours/Week	02	**CCE :** 20 Marks **End-Sem Examination :** 30 Marks

Course Objectives: The course aims to:

1. To introduce the multidisciplinary nature and scope of environmental studies.
2. To understand ecosystem structures, biodiversity, and ecological balance through hands-on observation and documentation.
3. To examine the use and impact of natural resources on environmental sustainability.
4. To explore biodiversity conservation practices and develop eco-sensitive thinking through field-based inquiry.

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

- CO1. **Illustrate** the interdependence of ecosystems through activity-based exploration
- CO2. **Analyze** the role of natural resources in sustainable development using real-world data.
- CO3. **Investigate** biodiversity threats and conservation strategies through surveys and projects
- CO4. **Create** awareness tools or **reports** promoting sustainability based on their findings.

Course Contents

Unit I - Environment and its issues (07 Hours)

a) Environment Meaning of Environment, Types of Environment, Components of Environment,
b) Man- Environment relationship, importance of environment,
c) Need for Public Awareness
d) Ecosystem-Meaning, Major Components of Ecosystem
e) Case studies of Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem
f) Stability of Ecosystem in Sustainable Environment

Unit III - Environment Pollution (07 Hours)

a) Definition of Pollution, Types of Pollution
b) Air Pollution-Meaning, Sources, effects of air pollution, Air Pollution Act
c) Water Pollution Meaning, Sources, Effects of Water pollution, Water Pollution Act
d) Noise Pollution Meaning, Sources, Effect of Noise Pollution
e) Solid Waste Pollution Meaning, sources, Effect of Waste Pollution

Unit III - E-Waste Managements and Acts (08 Hours)

E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.

Unit IV - E-waste Control and measures

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Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source

Practical Assignments

Week	Topic to be covered
1	Introduction : Group discussion and poster making on "Why Environmental Studies Matter for Technologists"
2	Eco Mapping: Identify and document elements of an ecosystem within the college campus
3	Model the Food Web: Create food chains and food webs using flowcharts (digital tools like Canva / Lucid chart)
4	Case Study Review: Present real-world examples of forest, grassland, and aquatic ecosystems
5	Soil and Water Testing Activity: Test soil pH, water quality (use school-level kits), and interpret results
6	Field Visit / Virtual Tour: Document deforestation or mining impact in a chosen region; students prepare a comparative report
7	Water Audit Exercise: Estimate water usage at home/hostel and identify areas of overuse; propose conservation measures
8	Renewable Energy Models: Create a simple model or PPT on any renewable energy source (e.g., solar cooker, wind energy demo)
9	Biodiversity Documentation: Survey nearby areas for plant/animal species; identify any endemic/endangered species
10	Conservation Proposal Pitch: In groups, students prepare a mini proposal for biodiversity conservation at local level
11	Group Project Work: Work on mini project report/documentation on any ecosystem/natural resource/e-waste management topics
12	Presentation & Viva: Final presentation and oral examination based on project work and learning portfolio

Learning Resources

Text Books:

1. Odum, Eugene P. “Fundamentals of Ecology”
2. R. Rajagopalan, “Environmental Studies – From Crisis to Cure”, Oxford
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books:

1. Erach Bharucha, “Textbook of Environmental Studies”, UGC
2. Anubha Kaushik and C.P. Kaushik, “Environmental Studies”, New Age International

E-Books Links: -

1. https://www.environment.gov.in
2. https://www.unep.org
3. https://news.mit.edu/2013/ewaste-mit

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Savitribai Phule Pune University, Pune

Maharashtra, India

Task Force for Curriculum Design and Development

Programme Coordinator

Dr. Dipak Patil - Member, Board of Studies - Computer Engineering

Team Members for Course Design

Data Structures	
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Operating Systems	
Dr. Shweta Koparde	DIP Pimpri Pune
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Discrete Mathematics	
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Mr. Amol J Shakadwipi	SNJB's K.B. Jain College of Engineering, Chandwad
Ms. Sheetal Wagh	Matoshree COE, Nashik
Mr. Swapnil V. Ghorpade	Weoto Technologies Private Limited

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Database Management Systems	
Dr. Sharmila Kishor Wagh	MES Wadia College of Engineering, Pune
Dr. Sharayu Lokhande	Army Institute of Technology, Pune
Prof. Ratnakar Jagale	R H Sapat College of Engineering, Management Studies and Research
Prof. Sagar Shinde	MES Wadia College of Engineering, Pune
Prof. Manoj Kharde	Pravara Rural Engineering College, Loni
Mr. Bhushan Pawar	Nagarro Enterprise Private Limited, Pune

Financial Accounting and Financial Management	
Prof. Rahul Paikrao	Amrutvahini College of Engineering, Sangamner
Dr. D. V. Patil	GES's R H Sapat COEMSR, Nashik
Dr. Vinodkumar Pathade	Amrutvahini College of Engineering, Sangamner

Computer Organization & Microprocessor and Digital Electronics & Logic Design	
Dr. D.V. Patil	R.H. Sapat College of Engineering, Management Studies & Research
Dr. Swati Bhawsar	Matoshri College of Engineering, Nashik
Prof. S.A. Shinde	R.H. Sapat College of Engineering, Management Studies & Research
Dr. Uday Patkar	Bharati Vidyapeeth College of Engineering Lavale, Pune
Prof. R.B. Mandlik	MET Institute of Engineering, Nashik
Dr. Shanti Kumaraguru	DY Patil COE, Akurdi

Microprocessor Laboratory	
Dr. Chhaya Gosavi	MKSSS Cummins College of Engineering for Women
Prof. Geeta M Kodabagi	Ajeenkya DY Patil school of engineering Lohegaon Pune
Prof. Jitendra Garud	Dr. D.Y. Patil Institute of Engineering, Management and Research
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