Hope Foundation's
INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY (I²IT)
An Autonomous Institute affiliated to Savitribai Phule Pune University
AICTE Permanent ID : 1-448945341 | DTE Code : EN6754 | AISHE Code : C-41681
Accredited by NAAC with "A" Grade in Cycle 2 | NBA Accredited - CE and E&TC (A.Y. 2023-24 to A.Y. 2025-26)

DEPARTMENT OF COMPUTER ENGINEERING

S.Y. B. TECH. COMPUTER ENGINEERING

Curriculum Structure

(w.e.f. Academic Year 2026-27)

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A Project of Hope Foundation - **FINOLEX**

Preamble

The Computer Engineering programme, designed under the autonomous framework and aligned with the principles of National Education Policy 2020 and outcome-based education, aims to build a strong foundation in computing while keeping learning flexible and relevant. It blends core subjects like programming, data structures, and computer systems with modern areas such as artificial intelligence, data science, and cybersecurity. The program focuses on practical learning, projects, and real-world applications to help students develop problem-solving skills, creativity, and industry readiness. At the same time, it encourages continuous learning, ethical practices, and a sense of responsibility towards society, preparing graduates to adapt and succeed in a rapidly changing technological world.

DEPARTMENT OF COMPUTER ENGINEERING

NEP 2020 Compliant Curriculum Structure

S.Y. B. TECH. COMPUTER ENGINEERING

Curriculum Structure (w.e.f. Academic Year 2026-27)

Semester - III			Teaching Scheme (Hours/ Week)			Credits				Examination / Evaluation Scheme and Marks						
Course Type	Course Code	Course Title	L	T	P	L	T	P	Total	CCE [40]		ESE [60]	TW	PR	OR	Total
										CCE1 [16]	CCE2 [24]					
PCC	CE-PCC-S01	Discrete Mathematics	3	0	0	3	0	0	3	16	24	60	-	-	-	100
PCC	CE-PCC-S02	Data Structures	3	0	0	3	0	0	3	16	24	60	-	-	-	100
PCC	CE-PCC-S03	Data Structures Laboratory	0	0	4	0	0	2	2	-	-	-	25	25	-	50
PCC	CE-PCC-S04	Object Oriented Programming	2	0	0	2	0	0	2	16	24	60	-	-	-	100
PCC	CE-PCC-S05	Object Oriented Programming Laboratory	0	0	2	0	0	1	1	-	-	-	25	-	25	50
MDM	CE-MDM-SO6	Multidisciplinary Minor (MDM)-I	2	0	0	2	0	0	2	16	24	60	-	-	-	100
OE	CE-OE1-S07	Open Elective (OE) -I	3	0	0	3	0	0	3	16	24	60	-	-	-	100
EEM	CE-EEM-S08	Entrepreneurship Development	0	1	2	0	1	1	2	-	-	-	25	-	25	50
VEC	CE-VEC-S09	Professional Communication and Ethics	1	0	2	1	0	1	2	-	-	-	50	-	-	50
CEP	CE-CEP-S10	Community Engagement Project	0	0	4	0	0	2	2	-	-	-	50	-	-	50
Total			**29**			**22**			**22**	**80**	**120**	**300**	**175**	**25**	**50**	**750**
Honours Course	CE-HNR-S01	Foundations of Data Science	2			2			2	16	24	60				100

Multidisciplinary Minor (MDM)-I	Open Elective (OE) -I
CE-MDM-SO6:Digital Circuits and Logic Design	CE-OE1-S07A:Probability & Statistics
	CE-OE1-S07B:Intellectual Property Rights
	CE-OE1-S07C:Financial Literacy and Investment Planning

Semester - IV			Teaching Scheme (Hours/Week)			Credits				Examination / Evaluation Scheme and Marks						
Course Type	Course Code	Course Title	L	T	P	L	T	P	Total	CCE [40]		ESE [60]	TW	PR	OR	Total
										CCE1 [16]	CCE2 [24]					
PCC	CE-PCC-S11	Database Management System	3	0	0	3	0	0	3	16	24	60	-	-	-	100
PCC	CE-PCC-S12	Database Management System Laboratory	0	0	2	0	0	1	1	-	-	-	25	25	-	50
PCC	CE-PCC-S13	Theory of Computation	3	0	0	3	0	0	3	16	24	60	-	-	-	100
PCC	CE-PCC-S14	Computer Organization	2	0	0	2	0	0	2	16	24	60	-	-	-	100
MDM	CE-MDM–S15	Multidisciplinary Minor (MDM)–II	2	0	0	2	0	0	2	16	24	60	-	-	-	100
OE	CE-OE2-S16	Open Elective (OE) - II	3	0	0	3	0	0	3	16	24	60	-	-	-	100
VSEC	CE-VSEC-S17	Web Technology Laboratory	0	0	4	0	0	2	2	-	-	-	25	25	-	50
AEC	CE-AEC-S18	Employability Skills Development	0	2	0	0	2	0	2	-	-	-	25	-	25	50
EEM	CE-EEM-S19	Project Management	0	2	0	0	2	0	2	-	-	-	25	-	25	50
VEC	CE-VEC-S20	Environmental Studies	2	0	0	2	0	0	2	-	-	-	50	-	-	50
Total			**25**			**22**			**22**	**80**	**120**	**300**	**150**	**50**	**50**	**750**
Honours Course	CE-HNR-S02	Data Science using Python	3			3			3	16	24	60				100
	CE-HNR-S03	Data Science using Python Lab			2			1	1				25			25

Multidisciplinary Minor (MDM) - II	Open Elective (OE) -II
CE- MDM –S15:Microprocessor and Microcontroller	CE-OE2-S16A:Mathematical Foundation for Machine Learning
	CE-OE2-S16B:Economics: Policies and its impact on Business Sectors
	CE-OE2-S16C:Financial & Cost Accounting

# L = Lecture
CCE = Continuous and Comprehensive Evaluation
P = Practical
ESE = End Semester Examination
T = Tutorial
TW = Term work
SS = Self Study
PR/OR = Practical/Oral

Dr. Ajitkumar Shitole
HOD, CE

International Institute of Information Technology (I²IT) * Pune *

Dr. Vaishali Patil
Principal, I2IT

SEMESTER - I

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Discrete Mathematics (CE-PCC-S01)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

Introduction to discrete mathematical structures; Formal logic and predicate calculus; Sets, relations and functions; Proof techniques; Graphs and trees; Primes, factorization, greatest common divisor, residues and application to cryptology; Permutations, combinations and partitions; Recurrence relations.

Prerequisites:

- Basic number theory, set theory

Course Objectives: The objective of this course is:

1. To understand bivalent logic and its applications in programming
2. To understand the basic counting principles and related methods
3. To understand binary relations and functions
4. To understand the graph and tree as a discrete structure and its applications
5. To understand abstract structures like group, ring and its applications.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-SO1.1: Apply principles of logic and propositional reasoning to analyze problems in computer programming and algorithm design.
- PCC-CO-SO1.2: Apply counting principles to solve discrete problems.
- PCC-CO-SO1.3: Analyze and model problems using binary relations and functions.
- PCC-CO-SO1.4: Apply graphs and trees as discrete structures in solving real computational problems.
- PCC-CO-SO1.5: Apply concepts of group theory to prepare a group code system.

Course Contents

Unit I	Propositional Logic and its Applications	08 Hours

Introduction to logic, basic concepts in propositional logic, operators on propositions, knowledge representation in propositional logic, propositional equivalence using truth tables, equivalence laws, and fundamentals of predicate logic, quantifier expressions, knowledge representation in predicate logic, applications in procedural languages.

Unit II	Counting Principles	08 Hours

Basic counting, addition, multiplication principle, inclusion-exclusion principle, sets and counting, permutation and combination, pigeonhole principle, Applications of counting in algorithms.

Unit III	Relations and Functions	08 Hours

Binary relations and its types, Equivalence Relations, Partial Order Relations, Lattices, recurrence relations, functions, one-one, onto functions. Generating functions.

Unit IV	Graphs and Trees	08 Hours

Introduction to graph theory, directed and undirected graphs, handshaking theorem, special graph structures, graph representations and isomorphism of graphs, connectedness, components, Euler, Hamilton paths and cycles, trees, binary trees, spanning trees, minimum spanning trees – Prim's and Kruskal's algorithms.

Unit V	Abstract Structures	08 Hours

Binary operation, semigroup, monoid, group, ring and field definitions and examples, subgroups, normal subgroup, Group codes, encoding and decoding of codes, parity matrix and Boolean operations, Maximum likelihood estimate.

Learning Resources

Textbooks

T1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill, 7th Ed., 2011.
T2. Kolman, Busby, Ross and Rehman, Discrete Mathematical Structures for Computer Science, Pearson Education, 6th Edition, 2017.

Reference Books

R1. D.S. Malik and M.K. Sen, Discrete Mathematical Structures: Theory and Applications, Thomson, 2004.
R2. Goodaire & Parmenter : Discrete Mathematics & Graph Theory, Pearson Education, 3rd Edition 2002.
R3. C.L. Liu, Elements of Discrete Mathematics, 2nd Edition, McGraw Hill, 1986.

Web Resources

1. GeeksforGeeks Web tutorial for Discrete Mathematics
   https://www.geeksforgeeks.org/engineering-mathematics/discrete-mathematics-tutorial/

Massive Open Online Courses (MOOCs)

1. NPTEL course: https://nptel.ac.in/courses/10610822

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	-	-	-

International Institute of Information Technology (I²IT) Pune

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Semester – I

Data Structures (CE-PCC-S02)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

Data structures are essential in engineering as they help organize and manage data efficiently. They enable faster processing, better memory utilization, and optimized algorithm design. Understanding data structures improves problem-solving and logical thinking skills. They are widely used in areas like software development, networking, and artificial intelligence.

Prerequisites:

- Introduction to Procedural Programming Language in C
- Programming and Problem Solving

Course Objectives: The objective of this course is:

1. To understand the standard and abstract data representation methods.
2. To understand various data searching and sorting methods.
3. To understand various linear data structures, operations on it and the memory requirements.
4. To suggest appropriate data structure and algorithm for graphical solutions of the problems.
5. To understand advanced data structures to solve complex problems in various domains.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-SO2.1: Design and analyze algorithms for programming problems using appropriate algorithmic strategies, and implementation of array data structures.
- PCC-CO-SO2.2: Analyze the computational efficiency of the principal algorithms for searching and sorting.
- PCC-CO-SO2.3: Apply linear data structures such as Stack, Queue and Linked List to solve computational problems.
- PCC-CO-SO2.4: Analyze different hashing techniques and collision resolution strategies.
- PCC-CO-SO2.5: Analyze and design the solution of real-world problem using appropriate Non-linear data structures.

Course Contents

Unit I	Introduction to Data Structures, Algorithms and Arrays	08 Hours

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: Divide & Conquer, and Greedy strategy.

Arrays: Array (ADT), Operations on Array, Storage Representation and their Address Calculation: Row Major and Column Major, 2-Dimensional array, Multidimensional Arrays.

Case Study: Study use of sparse matrix in Social Networks and Maps.

Unit II	Searching, Sorting and Linked List	08 Hours

Searching: Sequential 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.

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 List, Linear and Doubly Linked List, Circular Linked List.

Case Study: Garbage Collection.

Unit III	Stack and Queue	08 Hours

Stack: Stack as an ADT, Stack Operations, Representation of Stacks Using Sequential Organization and Linked List, multiple stacks. Application of Stack: Conversion of infix to postfix notation using stack, evaluation of postfix expression, Recursion.

Queue: Queue as an ADT, Queue Operations, Representation of Queue Using Sequential Organization and Linked List, Circular queue and its advantages, Double Ended Queue (Deque)- Basic concepts, Deque types (Input restricted and Output restricted), Priority Queue- Basic concepts, types (Ascending and Descending), Application of queues:Job Scheduling & Multi programming

Case Study: Priority queue in bandwidth management.

Unit IV	Hashing	08 Hours

Hash Table : Basic Concepts, properties of good hash function, Hash Functions/Methods- division, multiplication, digit extraction, mid-square, folding and universal methods, Hash basic operations (Insert, Delete, Search)

Hashing and Collision Resolution Techniques : Types of Hashing (Open and Closed Hashing), Collision Resolutions Techniques- **Closed Hashing** (Linear Probing, Quadratic Probing, Double Hashing, Chaining with and without Replacement) **Open Hashing** (Separate Chaining), Rehashing, Extendible hashing.

Case Study: Dictionary and File System Management using Hashing.

Unit V	Trees and Graphs	08 Hours

Trees: Basic Concepts, Binary tree- representation: sequential and linked organization, properties, converting general tree into binary tree, Binary tree traversals (recursive and non-recursive) - inorder, preorder, postorder, Operations on binary tree, Binary Search Tree (BST) and its operation,Applications of trees.

Graphs: Basic Concepts, Storage representation Adjacency matrix, adjacency list, Elementary graph operations- Breadth First Search (BFS), Depth First Search (DFS),Minimum Spanning Tree (MST), Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Single source shortest paths using Dijkstra's algorithm. Applications of Graphs.

Case Study: GPS Navigation and File Compression System, Huffman coding.

Learning Resources

Textbooks

T1. E. Horowitz, S. Sahni, S.Anderson-freed, "Fundamentals of Data Structures in C", Second Edition, University Press, ISBN 978-81-7371-605-8.
T2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9.

Reference Books

R1. Brassard and Bratley "Fundamentals of Algorithmic", Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
R2. Ellis Horowitz, S. Sahni, D. Mehta "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi 1995 ISBN 16782928.

Web Resources

1. https://www.tutorialspoint.com/introduction-to-searching-algorithms
2. https://www.tutorialspoint.com/data_structures_algorithms/graph_data_structure.html

Massive Open Online Courses (MOOCs)

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://nptel.ac.in/courses/106/105/106105085

CO PO Mapping

CO\PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	1	2	1	1	-	-	-	-	-	-	1	1	2	1
CO2	1	2	1	1	-	-	-	-	-	-	1	1	2	1
CO3	1	2	1	1	-	-	-	-	-	-	1	1	2	1
CO4	1	2	1	1	-	-	-	-	-	-	1	1	2	1
CO5	1	2	1	1	-	-	-	-	-	-	1	1	2	1

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S.Y. B.Tech. Computer Engineering Curriculum
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Semester – I

Data Structures Laboratory (CE-PCC-S03)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 04 Hrs/Week	**PR:** 2	**Term work:** 25 Marks **Practical:** 25 Marks **Total Marks:** 50 Marks

Course Introduction:

To understand basic techniques and strategies of algorithm analysis, the memory requirement for various linear and nonlinear data structures like array, linked list, stack, queue, tree and graph etc using concepts of C, C++ and python programs language through practical.

Prerequisites:

- Introduction to procedural programming language in C
- Programming and Problem Solving

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students in the form of a 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 students. 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 conduct **2** assignments from group A, C, D and 3 assignments from group B and 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 Languages:C, Python, C++.

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 students 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.

Course Objectives: The objective of this course is:

1. To understand basic techniques and strategies of algorithm analysis.
2. To understand the memory requirement for data structures, sorting and searching algorithms using python programming language.
3. To understand practical implementation and usage of linear and non linear data structures for solving problems of different domains.
4. To strengthen the ability to identify and apply the suitable data structure for the given real-world problems.
5. To analyze advanced data structures including hash tables, dictionary, trees and graphs.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-SO3.1: Analyze problems to apply suitable searching and sorting algorithms to various applications.
- PCC-CO-SO3.2: Apply and analyze Stack, Queue and Linked List implementations to solve real life problems.
- PCC-CO-SO3.3: Apply ADT/libraries, hash tables and dictionaries to design algorithms for a specific problem.
- PCC-CO-SO3.4: Apply and analyze Trees and Graphs non linear data structures to solve real world complex problems.
- PCC-CO-SO3.5: Analyze the efficiency of the most appropriate data structure for creating efficient solutions for engineering design situations.

List of Laboratory Experiments/Assignments

Group A: Arrays

- Write a **C** program to store marks scored in subject "Data Structures" by N students in the class. Write functions to compute following:
  - The average score of class
  - Highest score and lowest score of class
  - Count of students who were absent for the test
  - Display mark with highest frequency

- Write a **C** program to remove duplicate elements from an array of type double. The program should include a function with return type void that accepts an array of doubles, removes the duplicate values from the array, and updates the array.

- Write a **C** program to compute following computation on matrix:
  - Addition of two matrices
  - Subtraction of two matrices
  - Multiplication of two matrices
  - Transpose of a matrix

- Write a **C** program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices.

- Write a **C** program to compute following operations on String:
  - To display word with the longest length
  - To determine the frequency of occurrence of particular character in the string
  - To check whether given string is palindrome or not
  - To display index of first appearance of the substring
  - To count the occurrences of each word in a given string

Group B: Searching, Sorting and Linked List

1. Write a **Python** program to store roll numbers of students in an array who attended a training program in random order. Write a function for searching whether a particular student attended a training program or not, using Linear search and Binary search.

2. Write a **Python** program to store the first year percentage of students in an array. Write function for sorting array of floating point numbers in ascending order using
   - Selection Sort
   - Bubble sort
   - Insertion Sort and display top five scores.

3. Write a **Python** program to store the first year percentage of students in an array. Write function for sorting array of floating point numbers in ascending order using quick sort/Merge Sort and display top five scores.

4. Create a Student Record Management System using a linked list in **C++**.
   Use a singly linked list to store student data (RollNo, Name, Marks).
   Perform operations: Add, Delete, Update, Search
   Display records in ascending/descending order based on marks or roll number.

5. The ticket booking system of Cinemax Theater has to be implemented using **C++** program. There are 10 rows and 7 seats in each row. A doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use an array to store pointers (Head pointer)

to each row. On demand

- The list of available seats is to be displayed
- The seats are to be booked
- The booking can be cancelled.

6. A class stores present students' roll numbers using a Doubly linked list. Write a C++ program to:
   - Insert roll numbers in sorted order
   - Search for a given roll number
   - Count total present students
   - Display the list.

Group C: Stacks and Queues

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 in C++:
   - 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. A palindrome is a string of characters that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor dan is in a droop" and observing that they are the same forward and backward. One way to check 25 26 for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions-
   - To print original string followed by reversed string using stack
   - To check whether a given string is palindrome or not.

3. Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job, delete job and display job from queue.

4. Pizza parlor accepting maximum M orders. Orders are served on a first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using a circular queue using arrays.

5. Write a C++ program to implement the following data structures and its operations using linked list: i) Stack ii) Queue.

Group D Hashing

1. Write C++ program to manage the telephone book database of N clients. Make use of a hash table implementation to quickly look up a client's telephone number. Make use of two collision handling techniques and compare them using the number of comparisons required to find a set of telephone numbers.

2. Write C++ program to implement all the functions of a dictionary (ADT) using hashing and handle collisions using chaining with / without replacement. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique Standard Operations: Insert(key, value), Find(key), Delete(key)

3. Design and implement C++ program for 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

4. Write C++ program to 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 E Tree and Graph

1. Write a C++ program that starts with an empty Binary Search Tree (BST) and constructs the tree by inserting values in the given order. After constructing the BST, perform the following operations:
   - Insert a new node into the tree
   - Find the number of nodes in the longest path from the root (height of the tree)
   - Find the minimum data value in the tree
   - Convert the tree into its mirror image by swapping the left and right child pointers at every node
2. Search for a specified value in the tree.Write C++ program to 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.

3. Write a C++ program to implement a Binary Search Tree (BST) for managing bank information, where each node stores the branch name and the number of customers in that branch. The perform following operations:
   - Insert a new bank branch
   - Delete an existing branch
   - Update the customer count of a branch
   - Display the branch names in ascending and descending order
   - Determine the maximum number of comparisons required to search for a branch in the tree
4. A university has several campuses spread across different locations. The administration wants to

establish an optical fiber network connecting all campuses. The cost of laying fiber between two campuses varies depending on distance and terrain. Design a cost-effective network that connects all campuses with the **least total cost**, using appropriate data structures and algorithms in C++.

5. A smart city planning department wants to analyze connectivity between major locations near a college campus, such as parking areas, academic buildings, hostels, canteens, and nearby metro stations. 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 in C++ to perform DFS and an adjacency list to perform BFS.

6. Write a C++ program to represent a pizza delivery system using a weighted graph, where nodes represent delivery locations and edge weights represent travel time between locations. Using Dijkstra's algorithm; compute the shortest path and minimum delivery time from the pizza shop to all customer locations in the graph.

Mini project

1. Implement any application based mini project. Sample mini projects can be selected from the list given here [not limited to]
   a. Implementation of Snake and Ladder [BFS]
   b. Implementation of Maze generation [DFS]
   c. Implementation of Flight Reservation System [Searching and Sorting]
   d. Implementation of Student Database Management system [Hashing]
   e. Implementation of Job Scheduling [Graphs]
   f. Implementation of Palindrome checker [Stacks and Queues]
   g. Implementation of Queue using Two Stacks
   h. Implementation of Keyword Frequency Counter [Hash Table]
   i. Implementation of a basic version of a web browser's back button functionality [Stack]

2. Design a mini project for automated Term work assessment of students based on parameters like daily attendance, Unit Test / Prelim performance, Students achievements if any, Mock Practical.

Learning Resources

Textbooks:

T1. Data structures and algorithms in python by Michael T. Goodrich, ISBN-13: 978- 1118290279, ISBN-10: 1118290275, Publisher: Wiley; 1st edition (March 18, 2013).
T2. 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

R1. 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.

R2. Core Python Programming -R. Nageswara Rao, ISBN-10: 9789351199427, ISBN-13: 978-9351199427, Willy; 1st edition (January 1, 2016).

Web Resources

1. https://www.youtube.com/playlist?list=PLeo1K3hjS3uu_n_a___MI_KktGTLYopZ12

Massive Open Online Courses (MOOCs)

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/

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	1	2	1	2	2	-	-	-	-	-	1	1	2	1
CO2	1	2	1	2	2	-	-	-	-	-	1	1	2	1
CO3	1	2	1	2	2	-	-	-	-	-	1	1	2	1
CO4	1	2	1	2	2	-	-	-	-	-	1	1	2	1
CO5	1	2	1	2	2	-	-	-	-	-	1	1	2	1

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Object Oriented Programming (CE-PCC-S04)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02 Hrs/Week	**TH:** 2	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

Object-Oriented Programming is a programming paradigm that models real-world entities as "objects," which encapsulate data (attributes) and behavior (methods). OOP emphasizes reusability, modularity, and abstraction, allowing developers to create scalable and efficient software systems.

Prerequisites:

- Fundamentals of Programming
- Problem Solving

Course Objectives: The objective of this course is:

1. To learn the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design.
2. To learn the syntax and semantics of the C++ programming language.
3. To understand the concept of data abstraction and encapsulation, how to design C++ classes for code reuse, how to implement copy constructors and class member functions, to overload functions and operators in C++.
4. To learn how inheritance and virtual functions implement dynamic binding with Polymorphism.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-SO4.1: Apply constructs- sequence, selection and iteration; classes, objects, constructor.
- PCC-CO-SO4.2: Design and develop object-oriented solutions using the concepts of inheritance and pointer.
- PCC-CO-SO4.3: Use the concepts of polymorphism in complex programming situation
- PCC-CO-SO4.4: Apply object-oriented software principles like file and streams in problem solving.
- PCC-CO-SO4.5: Analyze the strengths of object-oriented programming by employing exception handling and templates.

Course Contents

Unit I	Fundamentals of Object Oriented Programming	05 Hours

Introduction to object-oriented programming, 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, C++ as object oriented programming language.

C++ Programming- C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, Access specifiers, separating interface from implementation. **Functions-** Function, function prototype, accessing function and utility function, Constructors and destructor, Types of constructor, Objects and Memory requirements, Static members: variable and functions, inline function, friend function.

Unit II	Inheritance and Pointers	05 Hours

Inheritance- Base Class and derived Class, protected members, relationship between base Class and derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class, Nested Class.

Pointers: declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.

Unit III	Polymorphism	05 Hours

Polymorphism- Introduction to Polymorphism, Types of Polymorphism,
Operator Overloading- concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Function overloading,
Run Time Polymorphism- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.

Unit IV	Files and Streams	05 Hours

Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output.

Unit V	Exception Handling and Templates	06 Hours

Exception Handling- Fundamentals, other error handling techniques, simple exception handling- Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance. **Templates-** The Power of Templates, Function template, overloading Function templates, and class template, class template and Non type parameters, template and friends Generic Functions, The type name and export keywords.

Learning Resources

Textbooks

T1. Deitel,"C++ How to Program", 4th Edition, Pearson Education, ISBN:81-297-0276-2
T2. Robert Lafore, "Object-Oriented Programming in C++", fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089

Reference Books

R1. Herbert Schildt, "C++-The complete reference", Eighth Edition, McGraw Hill Professional, 2011

ISBN:978-00-72226805
R2. Matt Weisfeld, "The Object-Oriented Thought Process", Third Edition Pearson ISBN-13:075-2063330166
R3. E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, Graw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
R4. Cox Brad, Andrew J. Novobilski, "Object –Oriented Programming: An Evolutionary Approach"‖, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

Web Resources

1. https://www.springer.com/gp/book/9781852334505
2. https://www.ebookphp.com/object-oriented-programming-in-c-epub-pdf/
3. https://www.springer.com/gp/book/9781447133780

Massive Open Online Courses (MOOCs)

1. https://nptel.ac.in/courses/106/105/106105151/
2. https://swayam.gov.in/nd1_noc20_cs07/preview
3. https://www.classcentral.com/course/swayam-programming-in-c-6704

CO PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	-	-	-	-	1	1	1	1
CO2	1	2	1	1	-	-	-	-	-	-	1	1	1	1
CO3	-	-	1	2	-	-	-	-	-	-	-	1	1	1
CO4	1	1	1	1	-	-	-	-	-	-	-	1	1	1
CO5	-	1	-	1	-	-	-	-	-	-	-	1	1	1

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Object Oriented Programming Laboratory (CE-PCC-S05)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 Hrs/Week	**PR:** 1	**Term work:** 25 Marks
		Oral: 25 Marks
		Total Marks: 50 Marks

Course Introduction:

In this laboratory, students will develop programs using an object-oriented language such as C++. The lab exercises are designed to strengthen problem-solving skills, logical thinking, and the ability to implement real-world scenarios using OOP principles.

Prerequisites:

- Fundamentals of Programming
- Problem Solving

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, 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 must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory/Term Work Assessment

Continuous assessment of laboratory work should be based on the overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes and punctuality

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 need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Guidelines for Oral Examination

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 need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Course Objectives: The objective of this course is:

1. To learn the concept of constructor, default constructor, operator overloading using member function and friend function.
2. To learn the concept of constructor, default constructor, copy, destructor, static member functions, friend class, this pointer, inline code exception handling.
3. File handing, dynamic memory allocation operators-new and delete.
4. To understand the concept of data abstraction and encapsulation.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-SO5.1: Apply the fundamental concepts of Object-Oriented Programming, including classes, objects, and constructors.
- PCC-CO-SO5.2: Apply OOP principles such as inheritance and polymorphism to design modular and reusable software components.
- PCC-CO-SO5.3: Implement advanced features like file handling and exception handling to develop robust and error-resilient programs.
- PCC-CO-SO5.4: Evaluate and test mini-projects to ensure correctness, efficiency, and robustness of the implemented solutions.

List of Assignments

1. Implement a class Complex which represents the Complex Number data type. Implement the following
   a. Constructor (including a default constructor which creates the complex number 0+0i).
   b. Overload operator+ to add two complex numbers.
   c. Overload operator* to multiply two complex numbers.
   d. Overload operators << and >> to print and read Complex Numbers.

2. Develop a program in C++ to create a database of student's information system containing the following information: Name, Roll number, Class, Division, Date of Birth, Blood group, Contact address, Telephone number, Driving license no. and other. Construct the database with suitable member functions. Make use of constructor, default constructor, copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete as well as exception handling.

3. Imagine a publishing company which does marketing for book and audio cassette versions. Create a class publication that stores the title (a string) and price (type float) of publications. From this class

derive two classes: book which adds a page count (type int) and tape which adds a playing time in minutes (type float).
Write a program that instantiates the book and tape class, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values.

4. A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book, the sales person inputs the title and author and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed. If it is, then the system displays the book details and requests for the number of copies required. If the requested copies book details and requests for the number of copies required. If the requested copies are available, the total cost of the requested copies is displayed; otherwise the message —Required copies not in stock is displayed. Design a system using a class called books with suitable member functions and Constructors. Use new operator in constructors to allocate memory space required. Implement C++ program for the system.

5. Create employee bio-data using following classes
   a. Personal record
   b. Professional record
   c. Academic record Assume appropriate data members and member function to accept required data & print bio-data.

   Create bio-data using multiple inheritance using C++.

6. Write a C++ program that creates an output file, writes information to it, closes the file, open it again as an input file and read the information from the file.

7. Create User defined exception to check the following conditions and throw the exception if the criterion does not meet.
   a. User has age between 18 and 55
   b. User stays has income between Rs. 50,000 – Rs. 1,00,000 per month
   c. User stays in Pune/ Mumbai/ Bangalore / Chennai d.

   User has 4-wheeler Accept age, Income, City, Vehicle from the user and check for the conditions mentioned above. If any of the condition not met then throw the exception.

Mini-Projects

1. Design and develop the Tic-Tac-Toe Game using C++.
2. Design and Develop Library Management system using OOP Concepts.
3. Develop a Supermarket Billing System using C++. The key features of this application are listed below:
   a. Bill Report: It shows the bill report of all the items added in supermarket billing system.
   b. Add, Remove or Edit items: With this feature one can add, remove and modify item details. In add items, one can add information or details such as item no., item name, manufacturing date, price, quantity, tax percent, and many more.
   c. Show item details: This feature allows users to see the items and the corresponding details

given for the item while adding the item. Use file to store the data.

4. Write a C++ program to implement a small database mini project to understand persistent objects and operations on sequential files (ex- library information, inventory systems, automated banking system, reservation systems etc.) For example, write a program to create a database for reservation system using information such as Name, sex, age, starting place of journey and destination. Program should have following facilities a) To display entire passenger list b) To display particular record c) To update record d) To delete and sort record. Use Exception Handling for data verification.

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	1	2	2	1	-	-	1	-	-	1	1	1	1
CO2	1	1	2	2	1	-	-	1	-	-	1	1	1	1
CO3	1	1	2	2	1	-	-	1	-	-	1	1	1	1
CO4	2	1	2	2	1	-	-	1	-	-	1	1	1	1

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Digital Circuits and Logic Design (CE-MDM-S06)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02 Hrs/Week	**TH:** 2	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

The course covers how numbers and information are represented, how logic circuits are built, and how complex operations are performed using combinational and sequential circuits.Students learn to design adders, counters, registers, and state machines while understanding the behavior of logic families like TTL and CMOS. It also provides exposure to programmable logic devices, enabling flexible digital system design. This foundation supports advanced study in computer architecture, VLSI, and embedded systems.

Prerequisites:

- Basic Electronics Engineering

Course Objectives: The objective of this course is:

1. Understand number systems, Boolean algebra, and the operation of basic logic gates.
2. Analyze and design optimized combinational logic circuits using K-maps and tabular Methods.
3. Develop sequential circuits using flip-flops, registers, and counters for practical digital Applications.
4. Design and interpret finite state machines and algorithmic state machines for control-based systems.
5. Explore logic families and programmable logic devices to implement efficient and scalable digital systems.

Course Outcomes: After successful completion of the course, the learner will be able to:

- MDM-CO-SO6.1: Apply number systems, Boolean algebra, and logic simplification techniques to analyze digital circuits.
- MDM-CO-SO6.2: Design optimized combinational circuits such as adders, subtractors, multiplexers, decoders, and comparators.
- MDM-CO-SO6.3: Construct sequential circuits using flip-flops, registers, and counters for timing-based Applications.
- MDM-CO-SO6.4: Develop finite state machines and algorithmic state machines to model and implement control-oriented digital systems.
- MDM-CO-SO6.5: Evaluate logic families and programmable logic devices to select appropriate technologies for digital system design.

Course Contents

Unit I	Number Systems & Boolean Algebra	06 Hours

Number Systems:Binary, octal,decimal, hexadecimal number systems,Conversions between number systems.Binary arithmetic (addition, subtraction using 1's & 2's complement), Code converters (Binary to Gray, BCD)
Study of basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) including their symbols and truth tables.Implementation using NAND/NOR gates
Boolean Algebra: Basic theorems and properties of Boolean algebra, DeMorgan's rules.

Unit II	Combinational Logic Design	05 Hours

Canonical forms: (SOP, POS), Boolean function minimization using K-maps and tabular (Quine–McCluskey) methods (up to 4 variables).

Combinational Circuit: Half Adder, Full Adder,Half Subtractor,Full Subtractor, Comparators,Multiplexers & Demultiplexers, Encoders & decoders.

Unit III	Sequential Logic Circuits	05 Hours

Flip-Flops: SR, JK, D, T; Preset & Clear, Master Slave JK Flip Flops, Flip-Flop conversions (SR ↔ JK ↔ D ↔ T),
Registers: SISO, SIPO, PISO, PIPO, Shift Registers
Counters: Ring Counter, BCD Counter, Johnson Counter, Synchronous vs Asynchronous Counters.

Unit IV	State Machine Design & Logic Families	05 Hours

State Machine: Finite State Machines (FSM): Moore and Mealy models, Algorithmic State Machines (ASM), ASM charts: symbols and notations, Construction of ASM charts, Realization of sequential circuits using ASM ,
Logic Families:Classification: Unipolar (CMOS), Bipolar (TTL, ECL),
Digital IC characteristics: fan-in, fan-out, voltage/current levels, noise immunity, propagation delay, power dissipation, figure of merit, temperature range, power supply, Comparison between TTL & CMOS.

Unit V	Advanced Programmable Logic Devices (PLDs)	05 Hours

PLDs:Introduction to PLDs, ROM as PLD, Programmable Logic Array (PLA): architecture and implementation, Programmable Array Logic (PAL): architecture and programming, Designing combinational circuits using PLDs, Advantages of PLDs, Applications of PLDs.

Learning Resources

Textbooks

T1. Modern Digital Electronics by R. P. Jain, 4th Edition, Tata McGraw-Hill, ISBN: 978-0-07-066911-6.

T2. Digital Logic and Computer Design by M. Morris Mano, Pearson, ISBN: 978-93-325-4252-5
T3. Digital Principles and Applications by Donald P. Leach & Albert Paul Malvino, McGraw-Hill, ISBN: 978-0-07-063046-8.
T4. Digital Systems: Principles and Applications by Ronald J. Tocci, Neal Widmer & Gregory Moss,
Pearson, ISBN: 978-0-13-422013-8.

Reference Books

R1. Digital Design: Principles and Practices by John F. Wakerly, Pearson, ISBN: 978-0-13-454989-5.
R2. Fundamentals of Digital Logic with VHDL Design by Stephen Brown & Zvonko Vranesic, McGraw-Hill, ISBN: 978-0-07-338054-4.
R3. Digital Logic and Microprocessor Design with VHDL by Enoch O. Hwang, Cengage Learning, ISBN: 978-0-534-46593-7.
R4. Digital Logic Applications and Design by John M. Yarbrough, Cengage Learning, ISBN: 978-0-534-95098-3.
R5. Digital Electronics: Principles, Devices and Applications by Anil K. Maini, Wiley, ISBN: 978-0-470-03214-5

Web Resources

1. NPTEL –nptel.ac.in/courses/108105132.
2. NPTEL –Digital Electronics - Course.
3. GeeksforGeeks – Digital Electronics and Logic Design Tutorials - GeeksforGeeks.
4. TutorialsPoint – Digital Electronics Tutorial
5. Intel & Xilinx (AMD) – PLD/FPGA Resources
https://www.youtube.com/watch?v=0Q0n5D_caq0

CO PO Mapping

CO\PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	3	1	-	-	-	-	2	3	3	1
CO2	3	3	3	1	3	1	-	-	-	-	1	3	3	2
CO3	3	3	3	1	3	1	-	-	-	-	1	3	3	2
CO4	3	3	3	3	3	1	-	-	-	-	1	3	3	2
CO5	3	2	3	1	3	2	1	-	-	-	3	3	2	3

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Probability & Statistics (CE-OE1-S07A)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This course introduces fundamental concepts of probability and statistical analysis required to model uncertainty and analyze data in computer engineering applications. The course provides essential tools for understanding random phenomena, data interpretation, and decision-making, forming a strong foundation for areas such as data analytics, machine learning, and system analysis.

Prerequisites:

- Set Theory and Logic
- Basics of Statistics and Probability

Course Objectives: The objective of this course is:

1. Introduce fundamental concepts of probability and random variables.
2. Develop mathematical modeling skills for uncertainty in computer engineering problems.
3. Understand discrete and continuous probability distributions and their applications.
4. Apply statistical methods for data analysis and interpretation.
5. Enable students to use statistical inference techniques for decision-making in engineering applications.

Course Outcomes: After successful completion of the course, the learner will be able to:

- OE1-CO-SO7A.1: Apply conditional probability and Bayes Theorem.
- OE1-CO-SO7A.2: Apply probability distributions.
- OE1-CO-SO7A.3: Apply hypothesis testing and estimation.
- OE1-CO-SO7A.4: Apply correlation and regression.
- OE1-CO-SO7A.5: Apply time series models.

Course Contents

Unit I	Probability Theory	08 Hours

Classical probability, Addition and Multiplication theorem of probability, independent events, Conditional probability, Bayes' theorem and its applications.

Unit II	Random Variable and Probability Distributions	08 Hours

Definition of random variables, Probability mass function, Probability density function, CDF, Mathematical expectation, Joint and marginal distributions, Binomial, Poisson, Normal, distribution.

Unit III	Sampling Distributions and Hypothesis Testing	08 Hours

Sample and population, central limit theorem, point and interval estimate, Hypothesis testing for mean, proportion, z-test, paired and unpaired t-test, chi-square test for independence.

Unit IV	Correlation and Regression	08 Hours

Covariance, correlation, Linear regression, multiple regression, Analysis of variance (one way, two ways).

Unit V	Time series analysis	08 Hours

Introduction to time series, components of time series, Trend analysis, Holt's method, Moving average, Autoregression and Autocovariance. AR and MA model.

Learning Resources

Textbooks

T1. Probability and Statistics for Engineering and Sciences, Jay L Devore, Cengage Publication
T2. Introduction to Time series and Forecasting, 2nd edition Peter J. Brockwell, Richard A Davis, Springer Publication

Reference Books

R1. Introduction to Probability and Statistics for Engineers and Scientists Author(s): Sheldon M. Ross Publisher: Academic Press (Elsevier) Edition/Year: 5th Edition, 2014 ISBN: 978-0123948113 https://minerva.it.manchester.ac.uk/~saralees/statbook3.pdf
R2. An Introduction to Probability and Statistics Author(s): Vijay K. Rohatgi, A.K. Md. Ehsanes Saleh, Publisher: Wiley Edition/Year: 2nd Edition, 2000 ISBN: 978-0471326724\ https://www.usb.ac.ir/FileStaff/5518_20232-8-8-33-53.pdf
R3. Modern Mathematical Statistics Author(s): Edward J. Dudewicz, Satya N. MishraPublisher: Wiley Edition/Year: 1st Edition, 1988 ISBN: 978-0471814726 https://archive.org/details/modernmathematic0000dude/page/n5/mode/2up

Web Resources

1. Online tutorials and material https://www.statlearning.com/

Massive Open Online Courses (MOOCs)

1. NPTEL - Probability and Statistics by Prof. H.K. Kesavan (IIT Madras)
2. NPTEL - Probability and Statistics by Prof. Somesh Kumar (IIT Kharagpur)
3. SWAYAM – Fundamentals of Probability and Statistics

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	1	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	1	-	-	-
CO4	2	3	2	3	3	-	-	-	-	1	2	-	-	-
CO5	2	3	2	3	3	-	-	-	-	2	2	-	-	-

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Intellectual Property Rights (CE-OE1-S07B)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

Intellectual Property Rights (IPR) have become a cornerstone of the modern knowledge economy, fostering innovation, creativity, and competitiveness across industries. This course introduces students to the fundamental concepts, legal frameworks, and practical applications of IPR, including patents, copyrights, trademarks, industrial designs, and geographical indications. It explores both national and international perspectives, highlighting the role of organizations such as WIPO and WTO in shaping global IPR policies.

Prerequisites:

- Basic knowledge of law and legal systems.
- Understanding of business, economics, or management fundamentals to appreciate the role of IPR in innovation and trade.
- General awareness of science and technology (especially for patents and industrial designs).
- Analytical and critical thinking skills to evaluate case studies and legal disputes.
- Communication skills for discussions, debates, and presentations on IPR issues.

Course Objectives: The objective of this course is:

1. To introduce the concept, scope, and importance of Intellectual Property Rights (IPR).
2. To provide knowledge of patents, copyrights, trademarks, and industrial designs.
3. To understand international treaties and conventions related to IPR.
4. To analyze the role of IPR in innovation, entrepreneurship, and global trade.
5. To critically evaluate emerging issues and case studies in IPR.

Course Outcomes: After successful completion of the course, the learner will be able to:

- OE1-CO-SO7B.1: Students will be able to identify and classify different forms of IPR.
- OE1-CO-SO7B.2: Apply IPR concepts to protect innovations and creative works.
- OE1-CO-SO7B.3: Interpret international IPR agreements and their implications.
- OE1-CO-SO7B.4: Evaluate the impact of IPR on business, R&D, and entrepreneurship.
- OE1-CO-SO7B.5: Analyze real-world case studies and propose solutions to IPR disputes.

Course Contents

Unit I	**Introduction to IPR**	**08 Hours**

Meaning and nature of property, origin of IPR, Scope and importance of IPR in knowledge economy, **Types of IPR:** patents, copyrights, trademarks, industrial designs, geographical indications, trade secrets, Role of IPR in academia, industry, and entrepreneurship.

Unit II	Patents and Industrial Designs	08 Hours

Patent law: definition, objectives, and scope, Patentability criteria: novelty, inventive step, industrial applicability, Patent filing process in India and abroad, Rights and obligations of patent holders, **Industrial designs:** definition, registration, and protection, Case studies: patents in pharmaceuticals, IT, and engineering.

Unit III	Copyrights and Trademarks	08 Hours

Copyright law: scope, subject matter, duration, Rights of authors: moral rights and economic rights, Infringement and exceptions (fair use, educational use), **Trademark law:** definition, registration, infringement, remedies, Importance of trademarks in branding and consumer protection, Case studies: copyright disputes in music/film industry; trademark disputes (e.g., Coca-Cola vs. Pepsi).

Unit IV	International Framework of IPR	08 Hours

World Intellectual Property Organization (WIPO), **WTO and TRIPS Agreement:** objectives, provisions, and impact, Paris Convention, Berne Convention, Madrid Protocol, International enforcement of IPR and dispute resolution mechanisms, Cross-border challenges in IPR (piracy, counterfeiting, digital rights).

Unit V	Emerging Issues and Case Studies	08 Hours

IPR in biotechnology, pharmaceuticals, and genetic resources, IPR in software, AI, and digital media, Digital rights management, open-source licensing, Creative Commons, IPR and entrepreneurship/startups: strategies for protection, **Case studies:** Neem patent case, Basmati rice GI dispute, Google vs. Oracle copyright case.

Learning Resources

Textbooks

T1. Intellectual Property Rights: Unleashing the Knowledge Economy – Prabuddha Ganguli
T2. Intellectual Property Rights: Law and Practice – V.K. Ahuja

Reference Books

R1. Principles of Intellectual Property – N.S. Gopalakrishnan & T.G. Agitha.
R2. Intellectual Property Rights: Legal and Economic Challenges – P. Narayanan
R3. Patent Law in India – B.L. Wadhera

Web Resources

1. WIPO
2. WTO – TRIPS Agreement
3. DPIIT – India IPR Policy

Massive Open Online Courses (MOOCs)

1. NPTEL: Intellectual Property Rights (IIT Madras/IIT Kharagpur)
2. Coursera: Intellectual Property Law and Policy (University of Pennsylvania)
3. SWAYAM: Intellectual Property Rights: A Management Perspective.

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	-	-	1	-	-	-	1	-	-
CO2	2	-	2	-	2	-	-	1	-	-	-	1	2	-
CO3	2	1	-	2	-	2	-	-	-	-	-	-	-	-
CO4	-	1	2	2	-	-	-	1	-	-	1	-	2	-
CO5	-	-	2	2	-	-	-	-	1	1	-	-	1	1

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S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Financial Literacy and Investment Planning (CE-OE1-S07C)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

The Financial Literacy and Investment Planning course provides learners with the essential tools needed to oversee individual and family wealth effectively. The curriculum explores the fundamentals of capital growth, expense tracking, and diverse asset classes. Students learn basic concepts of mutual funds, SIPs, and the stock market, along with Post Office financial services. The course emphasizes financial discipline, risk management, and digital tools for planning. By the end, students will be empowered to execute strategic financial choices aligned with their long-term objectives.

Prerequisites:

- Basic Finance and Economics
- Cyber Security & Digital Payments

Course Objectives: The objective of this course is:

1. To develop understanding of basic financial concepts, financial literacy, and its importance in daily life.
2. To enable learners to plan personal and household budgets, savings, and financial goals effectively.
3. To familiarize students with banking services, digital finance tools, credit/debit cards, loans, and credit scores.
4. To introduce students to investment avenues, risk-return analysis, mutual funds, SIPs, and stock market basics.
5. To provide awareness of Post Office financial services, money transfer systems, and financial planning apps/tools.

Course Outcomes: After successful completion of the course, the learner will be able to:

- OE1-CO-SO7C.1: Explain the concepts and importance of financial literacy and financial planning.
- OE1-CO-SO7C.2: Prepare personal and family budgets and manage income, expenditure, and savings effectively.
- OE1-CO-SO7C.3: Identify and use banking products, digital finance tools, credit/debit cards, and loans responsibly.
- OE1-CO-SO7C.4: Understand and analyze basic investment options, mutual funds, SIPs, and stock market instruments.
- OE1-CO-SO7C.5: Utilize Post Office financial services, money transfer facilities, and digital financial planning tools for informed decision-making.

Course Contents

Unit I	Introduction to Financial Literacy and Planning	08 Hours

Meaning, importance, and scope of financial literacy, Prerequisites: education, numerical and communication skills, Financial goal setting: short-term, medium-term, and long-term goals, Personal income and expenditure planning, Budgeting techniques and tracking tools (manual and digital), Emergency fund planning, Financial discipline and behavioral aspects of money.

Unit II	Banking Services and Digital Finance	08 Hours

Basics of banking: types of accounts, bank statements, interest, minimum balance norms, KYC, Digital banking tools: UPI, NEFT, RTGS, IMPS, mobile banking, internet banking, e-wallets, QR payments, AEPS, PoS, Credit and debit cards: responsible use, differences, EMIs, rewards, online payment security, Loans: student, personal, vehicle, home, business, secured vs unsecured, EMI, interest, documentation, Credit score: concept, importance, factors, role of credit bureaus, Digital security: phishing, fraud prevention, cyber hygiene and Cashback, Loyalty Programs, Contactless Payments, Online Payment Security, Card Statement Monitoring, PIN Safety.

Unit III	Saving and Investment Basics	08 Hours

Importance of saving, Types of saving schemes: FD, RD, PPF, SCSS, SSY, KVP, MIS, TD, Savings Bank, Introduction to investment: risk vs return, Investment avenues: gold, real estate, stock market (basic concepts), Concept of compounding, Time value of money, Mutual funds and SIPs, Goal-based saving and investment planning.

Unit IV	Stock Market and Post Office Financial Services	08 Hours

Stock market basics: equity, debentures, IPO, FPO, trading, risk, returns, blue-chip and defensive stocks, Post Office Savings Schemes: Savings Bank, RD, TD, MIS, KVP, NSC, PPF, SCSS, SSY, Post Office Payments Bank, Money transfer services: Money Order, e-Money Order, Instant Money Order, Mo Videsh, International Money Transfer, MoneyGram, Indian Postal Order, Collaboration with Western Union and other international financial services.

Unit V	Financial Planning Tools and Applications	08 Hours

Financial planning apps and digital tools for budgeting, tracking, and investment, Mobile apps for savings, mutual funds, SIPs, and insurance, Personal finance software and online calculators, Integrating digital tools with traditional financial planning, Case studies of practical financial planning.

Learning Resources

Textbooks:

T1. Paul, R. R. "Financial Literacy and Planning" S. Chand Publishing, New Delhi.
T2. Kumar, A. "Financial Planning and Wealth Management" Himalaya Publishing, Mumbai.
T3. Bodie, Z., Kane, A., Marcus, A. "Investments" McGraw Hill Education, New Delhi.
T4. Sinha, M. "Financial Planning: A Ready Reckoner" McGraw Hill Education, New York.
T5. Tripathi, V. "Fundamentals of Investment" Taxmann Publication, New Delhi.

T6. Lohana, Sarika R. "Digital Banking and Cyber Security" Taxmann Publication, New Delhi.

Reference Books

R1. Pathak, Bharati V. "Indian Financial System: Markets, Institutions and Services" Pearson / McGraw Hill Education, New Delhi.
R2. Raghunathan, V. "Personal Financial Planning" McGraw Hill Education, New Delhi.
R3. IIBF. "Digital Banking" Taxmann Publication, New Delhi.
R4. RBI Publications. "Payment and Settlement Systems in India" Reserve Bank of India, Mumbai.
R5. SEBI Publications. "Investor Education and Protection" Securities and Exchange Board of India, Mumbai.

Web Resources

1. **NISM –** https://www.nism.ac.in.
2. **RBI –** https://www.rbi.org.in
3. **SEBI –** https://www.sebi.gov.in.
4. **NPCI –** https://www.npci.org.in.
5. **India Post –** https://www.indiapost.gov.in

Massive Open Online Courses (MOOCs)

1. Financial Literacy: https://onlinecourses.swayam2.ac.in/ini25_ge12/preview
2. Personal Finance Management:https://onlinecourses.swayam2.ac.in/imb26_mg149/preview

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	2	-	-	-	2	-	3	-	-	-
CO2	1	1	-	-	3	-	-	2	3	3	2	-	-	-
CO3	1	1	-	-	3	-	3	2	3	3	2	3	3	-
CO4	1	3	3	3	3	-	1	-	3	3	2	3	3	-
CO5	1	2	3	2	3	-	2	2	3	3	2	3	3	-

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Entrepreneurship Development (CE-EEM-S08)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial: 01 Hr/Week	**TUT:** 1	**Term Work:** 25 Marks
Practical: 02 Hrs/Week	**PR:** 1	**Oral:** 25 Marks
		Total Marks: 50 Marks

Course Introduction:

The course introduces students to the fundamentals of entrepreneurship, including entrepreneurial traits, opportunity identification, business model development, market validation, financial planning, branding, and pitching. It emphasizes experiential learning through practical assignments, case studies, and hands-on project work. Students develop an entrepreneurial mindset and learn to convert ideas into feasible business concepts.

Course Objectives: The objective of this course is:

1. To understand and internalize entrepreneurial traits through self-reflection and real-world case studies.
2. To identify and evaluate business opportunities using structured frameworks and customer-centric approaches.
3. To develop and validate business models using tools like the Business Model Canvas and market research techniques.
4. To apply essential startup strategies in marketing, branding, and financial planning.
5. To communicate and pitch business ideas effectively using storytelling and structured presentation techniques.

Course Outcomes: After successful completion of the course, the learner will be able to:

- EEM-CO-SO8.1: Analyze personal entrepreneurial potential and identify areas for growth.
- EEM-CO-SO8.2: Generate and refine business ideas based on customer needs and market gaps.
- EEM-CO-SO8.3: Design a viable business model incorporating key elements like value proposition, revenue streams, and customer segments.
- EEM-CO-SO8.4: Create and implement basic marketing and branding strategies suitable for startups.
- EEM-CO-SO8.5: Deliver a compelling business pitch using storytelling, visual aids, and persuasive communication.

Guidelines for Laboratory/Term Work Assessment

• Assessment will be based on:

- Regularity and punctuality in submissions
- Quality and completeness of journal entries
- Understanding of concepts demonstrated in assignments
- Active participation in practical sessions
- Final project/pitch quality
- Viva performance related to each activity

Marks should reflect both effort and conceptual understanding.

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Guidelines for Laboratory Conduction

- Each practical session should begin with a brief introduction to the activity.
- Faculty should demonstrate tools or frameworks before students begin work.
- Students should work individually or in small groups depending on the activity.
- Faculty must ensure continuous monitoring and guidance.
- Real-world examples and case studies should be integrated to enhance understanding.
- At the end of each session, students must summarize their learning in the journal.

Guidelines for Practical/Oral Examination

- The exam will evaluate both practical skills and conceptual clarity.
- Students must present their final business idea/project along with supporting documents (BMC, marketing plan, financials, etc.)
- Viva questions will test:
  - -Understanding of entrepreneurial concepts
  - -Application of frameworks used during the course
  - -Ability to justify decisions made in the project
- Students must demonstrate confidence, clarity, and structured communication.
- Examiners will assess originality, feasibility, and presentation quality.

List of Assignments

No	Title	Objective	Description
1	Entrepreneurial Trait Reflection	To help students understand key entrepreneurial traits and assess their own strengths and gaps.	Students analyze real-world entrepreneurs, identify essential traits, and write a self-reflection comparing their personal alignment with these traits.
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 1. 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	Customer Need Mapping	To understand what customers really need.	Students talk to people, ask simple questions, find out their problems, and think of ideas that can help solve those problems.
4	Business Model Canvas Development	To enable students to design a structured business model.	1. Choose a business idea (from Assignment 2 or a new one). 2. Create a Business Model Canvas with all 9 key blocks: 1. Customer Segments 2. Value Propositions 3. Channels 4. Customer Relationships 5. Revenue Streams 6. Key Resources 7. Key Activities 8. Key Partnerships 9. Cost Structure 3. Present the BMC in visual or tabular format.
5	Financial Planning Basics	To introduce students to startup financial planning.	Students prepare a simple financial plan including cost estimation, revenue projections, and break-even analysis.
6	Market Validation Report	To help students validate the feasibility of their business idea.	Students perform competitor analysis, gather customer feedback, and test assumptions through Market survey .
7	Startup Marketing Strategy	To build foundational marketing skills for early-stage startups.	Students design a marketing plan covering target audience, positioning, channels, and customer acquisition strategies.
8	Branding Essentials Workshop	To develop branding and identity creation skills.	Students create brand elements such as name, logo, tagline, and brand story aligned with their business idea.
9	Pitch Deck Development	To teach students structured storytelling for	Students prepare a professional pitch deck including problem, solution

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		business communication.	market, business model, financials, and go-to-market strategy.
10	Live Pitch Presentation	To enhance communication, persuasion, and presentation skills.	Students deliver a concise pitch of their business idea to evaluators, demonstrating clarity, confidence, and structured storytelling.

Learning Resources

Textbooks:

T1. Bygrave, W.D., Zacharakis, A., & Corbett, A.C. Entrepreneurship, 6th Edition, Wiley, 2025. ISBN: 9781394262809.
T2. Drucker, Peter F. Innovation and Entrepreneurship: Practice and Principles, Reprint Edition, Harper Business, 2006. ISBN: 9780060851132.
T3. Osterwalder, Alexander & Pigneur, Yves. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, 1st Edition, Wiley, 2010. ISBN: 9780470876411.

Reference Books

R1. Ries, Eric. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, Crown Business, 2011. ISBN: 9780307887894.

R2. 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

Web Resources

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

Massive Open Online Courses (MOOCs)

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/

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	1	2	-	-	-	1	2	2	2	-	3	1	-	3
CO2	1	3	2	2	1	2	-	1	2	-	2	1	2	3
CO3	1	2	3	2	2	2	-	1	2	2	2	1	2	3
CO4	-	1	2	-	1	2	-	1	2	2	1	-	1	3
CO5	-	-	1	-	-	-	-	2	3	1	1			3

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Professional Communication and Ethics (CE-VEC-S09)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 01 Hr/Week	**TH-1**	**Term Work:** 50 Marks
Practical: 02 Hrs/Week	**PR -1**	**Total Marks:** 50 Marks

Course Introduction:

This course aims to develop students' professional communication competence and ethical awareness required for academic success, employability, and responsible engineering practice. It equips learners with skills to interpret information accurately, respond effectively in professional contexts, and make ethical decisions in academic, workplace, and digital environments. The course emphasizes self-awareness, communication judgment, teamwork, and ethical responsibility in line with the industry expectations.

Prerequisites:

- Professional and Interpersonal Skills in First Year.
- Basic Communication Skills.

Course Objectives: The objective of this course is:

1. To develop the ability to analyze academic and professional communication using intent, context, and impact.
2. To equip students to apply effective written and oral communication strategies in professional interactions.
3. To build ethical awareness and ethical decision-making in professional communication.

Course Outcomes: After successful completion of the course, the learner will be able to:

- VEC-CO-SO9.1: Analyze spoken and written communication to identify expectations and clarification needs.
- VEC-CO-SO9.2: Apply appropriate communication strategies to respond professionally in academic and workplace situations.
- VEC-CO-SO9.3: Evaluate ethical dilemmas and formulate responsible communication responses.

Guidelines for Student's Laboratory Journal

- Every student shall maintain a File / Laboratory Journal/ Workbook (hard copy or digital, as prescribed by the Institute/Department).
- The Laboratory Journal shall include:
  - Title and objectives of each assignment
  - Brief description of the activities performed
  - Observations, reflections, and learning outcomes
  - Relevant supporting documents such as worksheets, reports, resumes, feedback forms, or reflection notes
- All entries shall be neatly written, dated, and authenticated by the concerned faculty.

- The Laboratory Journal shall be submitted for periodic verification and during the final term work assessment.
- The journal shall reflect original work carried out by the student, adhering to academic integrity norms.

Guidelines for Laboratory/Term Work Assessment

- The assessment for this course shall be continuous and activity-based (case-study / role-play/ quiz).
- Term Work evaluation shall be based on:
  - Completion of prescribed assignments/activities/worksheets/workbook
  - Quality and relevance of submissions as per the rubrics
  - Participation and engagement during practical sessions.
- Faculty members may use structured rubrics to ensure uniformity and transparency in assessment.
- Students must submit all the assignments and/or Laboratory Journal within the stipulated time.
- The final Term Work marks shall be awarded based on the overall performance of the student across all assignments and maintenance of the Laboratory Journal, as per university/institute Norms.

Unit I	Understanding Academic and Professional Communication	05 Hrs(T) + 08 Hrs(P)

Foundations of Professional Communication

1. Communication process and components
2. Principles of effective communication – 7 C's
3. Role of listening and reading in academic and professional success
4. Review of LSRW skills in higher education and workplace contexts

Intent–Context–Impact in Communication

- Understanding intent: purpose, expectations, urgency
- Context in communication:
  a. Academic, organizational, cultural, and relational contexts
- Impact of communication:
  a. Expected outcomes, responsibilities, and actions
- Linking intent, context, and impact for accurate interpretation

Advanced Listening Skills

Listening beyond words: Tone, emphasis, urgency, and implicit expectations

1. Identifying assumptions, bias, and ambiguity
2. Listening in lectures, meetings, reviews, and digital interactions
3. Challenges in listening: distractions, overload, premature judgment.

Reading and Interpreting Professional Texts

1. Reading academic and professional documents:
   a. Assignment instructions, project briefs, emails, notices

b. Job descriptions, internship guidelines, policies
2. Skimming, scanning, and critical reading
3. Identifying key requirements, priorities, and risks

Questioning and Clarification Skills

1. Importance of professional questioning
2. Types of questions: Clarifying, probing, confirmatory
3. When to ask questions and when to wait
4. Avoiding misinterpretation and assumptions

Managing Information and Medium Awareness

1. Managing information overload:
   a. Prioritization and relevance
2. Medium and channel awareness:
   a. Email, meetings, chats, formal documents
3. Interpreting communication across multiple channels
4. Responsible use of digital tools for comprehension and note-making

Practical 1	**Self-Exploration – Learning & Communication Styles** **BTL Level:** BTL 1 (Identify), BTL 2 (Understand), BTL 4 (Analyze), BTL 5 (Evaluate) **Task:** Identify personal learning style using the VARK model and dominant communication style (Assertive/Passive/Aggressive/Passive-Aggressive), and write a brief reflection on their impact on learning, teamwork, and professional communication, including strategies for improvement.
Practical 2	**Listening and Interpretation** **BTL Level:** BTL 3 (Apply), BTL 4 (Analyze) **Task:** Listen to a simulated client/academic meeting and identify expectations, deliverables, responsibilities, deadlines, and frame appropriate professional clarification questions.
Practical 3	**Reading and Analysis** **BTL Level:** BTL 4 (Analyze), BTL 5 (Evaluate) **Task:** Analyze academic/project documents to identify requirements, assumptions, risks, gaps, and examine a case of miscommunication and its consequences.

Unit II	**Responding and Interacting Professionally**	**04 Hrs(T) + 10 Hrs(P)**

Principles of Professional Writing

1. Characteristics of effective professional writing:
   a. Clarity, structure, tone, accuracy
2. Accountability and ownership of written communication
3. Ethical responsibility in written responses

Professional Written Communication

1. Email etiquette and professional correspondence.
2. Writing for different stakeholders:

Faculty, supervisors, clients, peers.

3. Professional documents:
   Reports, resumes, proposals, project updates.

Oral Communication and Professional Presence

1. Speaking with clarity and confidence.
2. Non-verbal communication:
   a. Posture, eye contact, gestures, voice.
3. Managing nervousness and speaking anxiety.
4. Professional presence in academic and workplace settings.

Structured Communication Frameworks.

- SBAR for reporting and escalation
- DESC for assertive communication and conflict handling
- PREP for structured speaking and presentations
- SBI for giving and receiving feedback
- Choosing appropriate frameworks based on situation.

Persuasion, Interaction, and Response Strategy

1. Aristotle's rhetorical framework:
   a. Ethos, Pathos, Logos
2. Response strategies:
   a. Immediate vs delayed responses
   b. Synchronous vs asynchronous communication
3. Communicating under time pressure

Professional Judgment, Failure, and Interaction.

1. Interactive communication:
   - Handling feedback and disagreement
2. Decision-making in communication:
   - When to speak, listen, ask questions, escalate ethically
3. Handling failure and rejection professionally:
   - Academic setbacks, interview rejection, project criticism
4. Maintaining professionalism and resilience

Practical 4	**Email / Technical Writing** **BTL Level:** BTL 3 (Apply), BTL 5 (Evaluate) **Task:** Draft professional emails **or** technical document for academic/workplace scenarios and improve a poorly written draft for clarity, tone, and accountability.
Practical 5	**Applications and Proposals** **BTL Level:** BTL 3 (Apply), BTL 6 (Create) **Task:**

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	Prepare a resume and cover letter **or** draft a project/research proposal or Statement of Purpose aligned with a given opportunity
Practical 6	**Group Discussion and Team Interaction** **BTL Level:** BTL 4 (Analyze), BTL 5 (Evaluate) **Task:** Participate in a structured group discussion or role-based team task and submit a brief reflection on contribution, listening, and interaction effectiveness.
Practical 7	**Presentations** **BTL Level:** BTL 5 (Evaluate), BTL 6 (Create) **Task:** Deliver an academic/project PPT presentation or startup pitch and respond to questions while incorporating peer and faculty feedback.

Unit III	**Ethics and Ethical Communication**	**04 Hrs(T) + 08 Hrs(P)**

Foundations of Ethics – Indian Context

1. Morals, values, and ethics: meaning and distinction
2. Ethics in ancient Indian thought:
    a. Dharma (give Purushartha context), Satya, Ahimsa, Karma–Phala, Nyaya
    b. Trigunas /3 Gunas: Sattva, Rajas, and Tamas
3. Ethical decision-making and justice delivery
4. Ethics in modern Indian culture: Constitutional values
5. Ethical Philosophies and frameworks.
6. Ethics in transition: technology, globalization, AI.

Professional Ethics and Ethical Decision-Making

1. Meaning and importance of professional ethics
2. Ethical responsibilities of engineers and professionals
3. Professional dilemmas:
    - Quality vs deadline, honesty vs pressure
4. Codes of conduct and organizational ethics
5. Ethical decision-making:
    - Stakeholders, consequences, escalation
6. Whistleblower protection and ethical responsibility.

Ethical Communication

1. Meaning and principles of ethical communication
2. Ethical risks:
    a. Misrepresentation, exaggeration, withholding information
3. Ethical communication in professional settings:

a. Reporting errors, giving feedback, handling disagreement
4. Ethics in digital communication:
   a. Email, social media, AI-assisted communication
5. Ethical escalation, documentation, and trust-building

Practical 8	**Conflict Resolution** **BTL Level:** BTL 3 (Apply), BTL 5 (Evaluate) **Task:** Perform intern–manager/peer role-plays involving a conflict on reporting/meetings/feedback handling. Showcase use of professional ethics and code of conduct to solve the conflict. Prepare a report on 1)Both Parties' explanation 2) Method used for resolving the conflict
Practical 9	**Moral Dilemmas** **BTL Level:** BTL 4 (Analyze), BTL 5 (Evaluate) **Task:** Analyze academic or peer-related moral dilemmas and write a reflective response based on personal values and responsibilities.
Practical 10	**Ethical Dilemmas** **BTL Level:** BTL 5 (Evaluate), BTL 6 (Create) **Task:** Analyze workplace ethics case studies and propose ethically reasoned responses considering individual, organizational, and societal impact.

Learning Resources

Textbooks

T1. Technical Communication: Principles and Practice - Raman, Meenakshi, and Sangeeta Sharma, 3rd ed., Oxford University Press, 2015.
T2. A foundation course in Human Values and Professional Ethics -R.R. Gaur, R. Asthana, G.P. Bagaria

Reference Books:

R1. Effective Technical Communication – M. Ashraf Rizvi, McGraw Hill Education
R2. Ethics in Business and Management – Dr. R.P. Banerjee, Himalaya Publishing House

Web Resources:

1. Think Fast, Talk Smart: Communication Techniques – Matt Abrahams
   https://www.youtube.com/watch?v=HAnw168huqA
2. Exploring VARK Learning Styles: Which One Boosts Your Learning Potential – Kendra Cherry
   https://www.verywellmind.com/vark-learning-styles-2795156

Massive Open Online Courses (MOOCs):

1. Fluent Communication: Developing Listening, Speaking, and Writing Skills for Professionals - By Dr. Vaseemahmed G Qureshi - Vishwakarma Government Engineering College, Ahmedabad
   https://onlinecourses.swayam2.ac.in/imb26_mg128/preview

2. Communication Skills – Dr. T. Ravichandran – IIT Kanpur https://nptel.ac.in/courses/109104030
3. Ethics in Engineering Practice- Prof Susmita Mukhopadhay – IIT Kharagpur https://onlinecourses.nptel.ac.in/noc26_mg42/preview

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PS O3
CO1	1	2	-	-	1	1	-	1	3	-	2	2	2	1
CO2	-	2	2	-	2	1	1	3	3	2	2	2	3	2
CO3	-	2	1	-	1	3	3	2	2	2	2	1	2	3

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S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester – I

Community Engagement Project (CE-CEP-S10)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 04 Hrs/Week	**PR:** 2	**Term Work:** 50 Marks
		Total Marks: 50 Marks

Course Introduction:

A community engagement project connects students with local communities to address real-life problems and promote sustainable development. Guided by the motto **"Campus to Community,"** students identify socially relevant issues and propose and implement solutions under faculty guidance. The project fosters collaboration, empathy, and social responsibility. Activities may focus on health, education, livelihood, or environmental sustainability. Students gain practical experience while contributing positively to society.

Prerequisites:

- Basic understanding of social and ethical responsibilities.
- Teamwork and communication skills.
- Familiarity with problem-solving methodologies and project planning techniques

Guidelines for Student's Laboratory Journal

- Students should clearly mention group details (3–4 members), batch information, faculty mentor, allotted village/ward, and the duration of the project.
- Students must define the purpose and objectives of the activity, plan the tasks, prepare a schedule, and coordinate with community stakeholders before execution.
- Students are required to maintain a log of activities performed, including time spent, observations, and individual participation.
- Students should record the outcomes of the project, reflect on community impact, skills developed, challenges faced, and lessons learned.
- Students must attach relevant supporting documents such as photographs and project report references and obtain verification through mentor and HoD signatures.

Guidelines for Laboratory/Term Work Assessment

- Assessment shall be continuous and based on regular attendance, active participation, and timely completion of assigned activities.
- Evaluation shall consider the quality of work, including planning, execution, technical accuracy, and relevance of the tasks performed.
- Laboratory journal or activity book shall be assessed for clarity, completeness, and proper maintenance of records.
- Student understanding, problem-solving ability, teamwork, and reflection on achieved outcomes shall be considered during evaluation.

- Final assessment shall include project presentation, demonstration, and oral examination conducted by the mentor or internal committee.

Guidelines for Laboratory Conduction

Team Formation, Guide Allocation, and Project Identification:

- 3-4 students can form a team within the same or different disciplines.
- Students are expected to explore and understand environmental challenges that communities face, such as pollution, waste management, water scarcity, resource depletion, climate change, energy transition, natural disasters, biodiversity loss, land degradation, etc.
- The project coordinator, in consultation with a panel of experts, assigns project guides from the same program to provide guidance and support to the teams throughout the project.
- The identified problem statement addressing environmental challenges must be registered with the project coordinator by the team after consulting with their respective project guide.
- Field visits are encouraged to identify the problem statements.

Collaborative Work and Progress Reporting:

- Each student on the team must work collaboratively and contribute significantly to the design and development of solutions for registered problem statements, focusing on environmental challenges faced by the community.
- Students should work at least 4 hours per week and shall meet their assigned project guide regularly (at least twice a week) and report the progress of the project work, emphasizing the application of community engineering principles.
- Students are expected to incorporate suggestions from the earlier review.

Documentation and Reporting:

- Students shall maintain a record of all meetings, remarks given by the guide/reviewers, and progress of the work in the project diary, presented during each review presentation.
- For the final assessment, students shall complete the project report in all aspects, including formatting, duly signed by the project guide, Head of the Department.

Data Submission and Additional Outputs:

Students shall submit all data related to project work in soft copy to their guides, including the project report, A3 size poster, presentation, paper, etc., focusing on community engineering solutions.

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

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Guidelines for Practical/Oral Examination

- Students shall present and demonstrate the work carried out during the project, highlighting their planning, execution, and outcomes.
- The presentation should clearly explain the project objectives, methodology, activities conducted, results achieved, and impact on the community or target group.
- Students are expected to reflect on challenges faced, problem-solving strategies used, and lessons learned throughout the project.
- Oral examination shall assess understanding of concepts, application of knowledge, teamwork, and ability to communicate findings effectively.
- Each team's presentation and demonstration shall typically last 5–7 minutes, evaluated by faculty members or an internal committee, with provision for questions and discussion.

Course Objectives: The objective of this course is:

1. Establish a mutually beneficial relationship between the college and the local community.
2. Provide opportunities for community engagement that foster empathy, teamwork, and problem-solving skills.
3. Develop understanding of local community challenges and the role of engineering in addressing them.
4. Apply technical knowledge and skills to design solutions with positive community impact.
5. Evaluate and critically analyze engagement outcomes for sustainable impact.

Course Outcomes: After successful completion of the course, the learner will be able to:

- CEP-CO-S10.1: Recognize and assess local community needs and challenges through stakeholder interaction and real-world problem analysis.
- CEP-CO-S10.2: Develop and execute feasible, innovative, and context-appropriate solutions using engineering concepts to address community concerns.
- CEP-CO-S10.3: Review and appraise the effectiveness of implemented interventions and communicate insights and learning through reports and presentations.

List of Assignments

Suggestive list of topics under Community Engagement Project

- Use/misuse of cell phones.
- Career orientation of youth.
- Water facilities and drinking water availability.
- Health and hygiene of the school-going students, homemakers, and old personals.
- Health intervention and awareness programs.
- Horticulture
- Herbs and Nutrition
- Traditional and Modern health care methods
- Food habits

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Air Sound / Water pollution
- Plantation and Soil protection
- 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's education and empowerment.

Learning Resources

Textbooks

T1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
T2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact.Stylus Publishing, 2016.
T3. Design Thinking for Social Innovation. IDEO Press, 2015.
T4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

Reference Link

R1. https://www.socialpinpoint.com/how-to-create-a-community-engagement-report-withexamples/

Web Resources

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

Massive Open Online Courses (MOOCs)

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

CO PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	3	2	2	1	3	2	3	2	2	2	2	3	2
CO2	3	3	3	2	2	3	2	3	3	2	2	3	3	3
CO3	2	2	2	2	2	3	2	2	3	2	3	2	2	3

SEMESTER - II

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Database Management System (CE-PCC-S11)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This course provides a comprehensive introduction to Database Management Systems, covering data modeling, relational database design, SQL and PL/SQL programming, transaction management, concurrency control, and NoSQL databases. The course emphasizes both theoretical foundations and practical skills required for efficient data storage, retrieval, and management in modern applications.

Prerequisites:

- Discrete Mathematics
- Data Structures

Course Objectives: The objective of this course is:

1. To understand fundamental concepts of database systems and design relational database schemas using appropriate data models and normalization techniques.
2. To develop and implement SQL and PL/SQL programs to manage and manipulate relational databases effectively.
3. To analyze transaction management and concurrency control mechanisms to ensure data consistency and Integrity.
4. To apply NoSQL database concepts and techniques to design and query modern non-relational Databases.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-S11.1: Analyze system requirements and Design an Entity–Relationship (E-R) model based on given requirements.
- PCC-CO-S11.2: Apply normalization techniques to design an efficient database schema.
- PCC-CO-S11.3: Formulate SQL queries and PL/SQL code for given requirements.
- PCC-CO-S11.4: Explain database transaction management mechanisms and concepts.
- PCC-CO-S11.5: Analyze NoSQL data models and Apply MongoDB queries for suitable use cases.

Course Contents

Unit I	Introduction To Database Management Systems	08 Hours

Introduction: Concept of Database Management Systems, Purpose and Applications of DBMS, DBMS Components and overall Architecture, View of Data, Database Languages

Database Design: Entity Relationship (ER) Model- Entities, Attributes, Relationships & Constraints

Extended ER Model, Converting ER and EER diagram into tables.

Unit II	Relational Database Model and Design	08 Hours

Relational Model: Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Codd's Rules, Relational Integrity, Referential Integrity

Relational Database Design: Need of Normalizations, Functional Dependencies, Normal Forms- 1NF, 2NF, 3NF and BCNF

Functional Dependencies Closure Set and Canonical Cover, 3NF and BCNF Decomposition.

Unit III	SQL and PLSQL	08 Hours

SQL: SQL Datatypes & Literals, DDL, DML, Select Queries & Clauses, SQL Operators, SQL Aggregate Functions, SQL Joins and Subqueries

PLSQL: SQL Vs PLSQL, Control Structures, Unnamed PLSQL Blocks, Stored Procedures & Functions, Triggers.

Unit IV	Transaction Management & Concurrency Control	08 Hours

Transaction Management: Basic concept of a Transaction, ACID Properties of Transactions, Concept of Schedule, Serial Schedule, **Serializability:** Conflict and View, Cascaded Aborts

Concurrency Control: Concurrency Protocols - Locking Methods, Timestamp-based Protocol.

Unit V	NoSQL Databases	08 Hours

Structured Vs Unstructured Data, Introduction to NoSQL Databases, Types of NoSQL Databases, RDBMS Vs NoSQL, BASE Properties and CAP Theorem

Introduction to MongoDB, CRUD Operations, Indexing, Aggregation Pipeline, Replication and Sharding.

Learning Resources

Textbooks

T1. Database System Concepts, Silberschatz A., Korth H., Sudarshan S McGraw Hill Publishers, Sixth Edition.
T2. Database Systems, Connally T, Begg C. Pearson Education, ISBN 81-7808-861-4.
T3. NoSQL Distilled, Pramod J. Sadalage and Martin Fowler Addison Wesley.

Reference Books

R1. An Introduction to Database Systems, C J Date Addison-Wesley.
R2. Database Systems: Concepts, Design and Application, S. K.Singh Pearson Education.
R3. NoSQL For Dummies, Adam Fowler O'Reilly Publications.
R4. MongoDB: The Definitive Guide, Kristina Chodorow, Michael Dirolf.

Web Resources

1. https://www.db-book.com/
2. https://www.mongodb.com/docs/get-started/

Massive Open Online Courses (MOOCs)

1. NPTEL Lecture Videos by Dr. Arnab Bhattacharya from IIT Kanpur. NOC: Fundamentals of Database Systems - http://www.nptelvideos.com/course.php?id=426

CO PO Mapping

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

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Database Management System Laboratory (CE-PCC-S12)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 Hrs/ Week	**PR:** 1	**Term work:** 25 Marks **Practical:** 25 Marks **Total Marks:** 50 Marks

Course Introduction:

The Database Management Systems Lab provides hands-on experience in designing, implementing, and managing databases using relational and NoSQL technologies. The course emphasizes practical skills in SQL, PL/SQL, and MongoDB to support efficient data storage, retrieval, and manipulation for real-world applications.

Prerequisites:

- Database Management System

Guidelines for Student's Laboratory Journal

Students are required to submit their laboratory assignments in the form of a journal. The journal should include a certificate, table of contents, and a handwritten write-up for each assignment containing: Title, Objectives, Problem Statement, Outcomes, Software and Hardware Requirements, Date of Completion, Assessment Grade/Marks and Course In-charge's Signature, Brief Theory Concept, Algorithm, Flowchart, and Conclusion/Analysis. Additionally, program codes along with sample outputs for all assignments must be submitted as a hard copy.

Guidelines for Laboratory/Term Work Assessment

Continuous assessment of laboratory work should be conducted based on the student's overall performance and the quality of their laboratory assignments. Each assignment should be graded or scored according to defined parameters with suitable weightage. Suggested criteria for both overall and individual assignment assessment include timely completion, creativity/innovation, code efficiency, punctuality, and presentation/neatness.

Guidelines for Laboratory Conduction

Course Instructors are expected to design assignments by considering the prerequisites, relevant technologies, practical utility, and recent trends related to the topic. The assignment design should cater to the average student while also including elements that challenge and engage advanced learners. Multiple sets of assignments can be created and distributed among different student batches. Assignments based on real-world problems or applications are highly encouraged. Students should be guided to use Hungarian notation, proper indentation, and meaningful comments in their code, and the use of open-source software should be promoted. Additionally, course instructors may assign a mini-project based on real-life applications of the concepts learned.

Guidelines for Practical/Oral Examination

Problem statements should be jointly prepared by both internal and external examiners. During practical assessment, the evaluator should assign the highest weightage to the successful implementation of the problem statement. Supplementary and relevant questions may also be asked to evaluate the student's understanding of fundamentals, advanced knowledge, and ability to implement solutions effectively and efficiently.

Course Objectives: The objective of this course is:

1. To develop proficiency in writing and executing SQL queries for data definition, manipulation, and retrieval.
2. To implement procedural database programming using PL/SQL for robust and secure database applications.
3. To understand and apply NoSQL concepts by designing and querying document databases using MongoDB.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-S12.1: Design and implement relational database schemas and perform complex data operations using SQL.
- PCC-CO-S12.2: Develop database programs using PL/SQL to handle control structures, procedures, functions, and exception handling.
- PCC-CO-S12.3: Create, manage, and query NoSQL databases using MongoDB.

List of Assignments

1. Design and implement **SQL queries** to create database tables using **DDL commands** with appropriate constraints such as NOT NULL, PRIMARY KEY, and FOREIGN KEY. Modify the database structure using various ALTER command options. Perform fundamental **DML operations** including INSERT, SELECT, UPDATE, and DELETE, and execute SELECT queries using different clauses to retrieve and manipulate data for the given database schema.

2. Write SQL queries using various **JOIN types** (Natural, Inner, Equi, Non-Equi, Outer, Left Outer, Right Outer), as well as **Subqueries** and Views to extract insights from the given database system.

3. A university intends to compute academic grades programmatically. Create a **PL/SQL function** that determines a grade point (0–10) based on a student's internal assessment marks and end-semester examination score.

4. An organization wants to automate annual salary revisions. Develop a **PL/SQL stored procedure** that accepts a department name and percentage increment as input parameters, updates the salaries of all employees in that department accordingly, and records the revision details in a salary audit table.

5. A bank wants to track account balance changes, maintain branch-level financial summaries, and record transaction history using row-level triggers. Implement BEFORE and AFTER triggers on Account, Branch_Info, and Transaction_Log tables for INSERT, UPDATE, and DELETE

operations.
Tables:
i. Account(Acc_No, Cust_Name, Branch_Id, Balance, Acc_Type, Status)
ii. Branch_Info(Branch_Id, Total_Accounts, Total_Balance)
iii. Transaction_Log(Acc_No, Old_Balance, New_Balance, Trans_Time, Operation)

6. Design and execute MongoDB queries to perform comprehensive **CRUD (Create, Read, Update, Delete) operations** on the given collection. Create the collection and insert appropriate documents, then implement update and retrieval queries using comparison and logical operators, along with MongoDB methods such as save(), to accomplish the specified tasks.

7. An e-commerce platform handles a large number of product reviews, and searches based on product ID, rating, keywords in reviews, and review date are slow. Create different types on **indexes** (text, compound, hash, sparse indexes etc.) on the MongoDB collection to improve query response time.

8. A hospital aims to evaluate patient treatments, doctor efficiency, and departmental workload using **MongoDB aggregation pipelines.** The hospital maintains a "treatments" collection that includes:
i. Patient details (age, gender, diagnosis)
ii. Doctor information (name, specialization, experience)
iii. Treatment details (admission date, discharge date, treatment cost, outcome)
Design aggregation pipelines to generate reports such as average treatment cost per department, doctor-wise patient count, and recovery statistics.

Learning Resources

Textbooks

T1. Database System Concepts, Silberschatz A., Korth H., Sudarshan S McGraw Hill Publishers, Sixth Edition
T2. Database Systems, Connally T, Begg C. Pearson Education, ISBN 81-7808-861-4
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R3. NoSQL For Dummies, Adam Fowler O'Reilly Publications
R4. MongoDB: The Definitive Guide, Kristina Chodorow, Michael Dirolf

Web Resources

1. https://www.db-book.com/
2. https://www.mongodb.com/docs/get-started/

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1. NPTEL Lecture Videos by Dr. Arnab Bhattacharya from IIT Kanpur. NOC:Fundamentals of Database Systems - http://www.nptelvideos.com/course.php?id=426

CO PO Mapping

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CO2	-	1	2	-	2	-	-	-	-	1	2	1	1	2
CO3	-	1	2	-	2	-	-	-	-	1	2	1	1	2

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Theory of Computation (CE-PCC-S13)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

Theory of Computation is a foundational course in Computer Engineering that introduces students to the mathematical models of computation. The course focuses on formal languages, automata, grammars, and Turing machines, which help in understanding the capabilities and limitations of computing systems. It provides theoretical support for subjects such as compiler design, artificial intelligence, algorithms, and software engineering, and builds a strong base for advanced studies in computer science.

Prerequisites:

- Discrete Mathematics

Course Objectives: The objective of this course is:

1. To understand the basic concepts of formal languages and finite automata used to represent computational models.
2. To apply regular expressions and properties of regular languages to solve simple pattern-matching problems.
3. To analyze context-free grammars and context-free languages for basic syntax specification and parsing tasks.
4. To apply pushdown automata concepts for recognizing given context-free languages.
5. To understand and analyze computational problems using Turing machines.

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

- PCC-CO-S13.1: Explain the fundamental concepts of formal languages and finite automata used in computational models.
- PCC-CO-S13.2: Apply regular expressions and properties of regular languages to solve basic pattern-matching problems.
- PCC-CO-S13.3: Analyze context-free grammars and context-free languages for simple syntax specification and parsing tasks.
- PCC-CO-S13.4: Apply pushdown automata concepts to recognize given context-free languages.
- PCC-CO-S13.5: Explain and analyze computational problems using Turing machines to understand the limits of computation.

Course Contents

Unit I	Formal Languages and Finite Automata	08 Hours

Introduction to Formal Language Theory, **Finite Automata (FA):** Informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, **FA without output:** Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA), ε-NFA, NFA to DFA and inter-conversion, Minimization of DFA, **FA with output:** Moore and Mealy machines, Definitions and models, Inter-conversion between Moore and Mealy machines. **Case Study:** Modeling Control Systems using Finite State Machines (FSMs) in traffic light controllers

Unit II	Regular Expressions and Regular Languages	08 Hours

Introduction to Regular Expressions (RE), Operators of RE and precedence rules, Algebraic laws of regular expressions, Conversion of language to regular expression, Equivalence of regular expressions, **Conversions:** RE to NFA, DFA to RE using Arden's Theorem, Pumping Lemma for Regular Languages, Closure properties of Regular Languages, Decision properties of Regular Languages, **Case Study:** Use of Regular Expressions in feature extraction for ML Models.

Unit III	Context-Free Grammar and Context-Free Languages	08 Hours

Grammar and its components, Context-Free Grammar (CFG): formal definition, Sentential forms, Derivation and Parse Tree, Context-Free Languages (CFL), Chomsky Hierarchy, Ambiguous grammar, Writing CFG for given languages, Simplification of CFG: ε-productions, Unit productions, Useless productions and symbols, **Normal Forms:** Chomsky Normal Form (CNF), Greibach Normal Form (GNF), **Case Study:** Use of CFGs to model sentence structure and generate parse trees for NLP tasks.

Unit IV	Pushdown Automata	08 Hours

Pushdown Automata (PDA): Formal definition, Acceptance by Final State and Empty Stack, Equivalence of acceptance methods, Non-deterministic PDA (NPDA), PDA and Context-Free Languages, Equivalence of PDA and CFG, **Case Study:** Use of PDA concepts in shift-reduce parsers and dependency parsing for NLP applications.

Unit V	Turing Machines	08 Hours

Turing Machine (TM): Model and formal definition, Language acceptability by TM, Design techniques and description, Computing functions using TM, Variants of Turing Machines, Halting Problem, Halting vs Looping, Turing-unrecognizable languages, Linear Bounded Automata (LBA), **Case Study:** Algorithms using Turing Machine.

Learning Resources

Textbooks

T1. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGraw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
T2. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458

Reference Books

R1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley,ISBN 0-201-44124-1
R2. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 97881265133454
R3. J.Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-45
R4. Kavi Mahesh, "Theory of Computation: A Problem-Solving Approach", Wiley India, ISBN1081265331106
R5. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN- 13: 97811331878137

Web Resources

1. NPTEL – Theory of Computation- IIT Kanpur
   https://nptel.ac.in/courses/106104028
2. NPTEL: Theory of Automata, Formal Languages and Computation - IIT Madras
   https://nptel.ac.in/courses/106106049
3. NPTEL: Introduction to Automata, Languages and Computation - IIT Kharagpur
   https://nptel.ac.in/courses/106105196
4. MIT OCW — Theory of Computation
   https://www.classcentral.com/course/mit-ocw-18-404j-theory-of-computation-fall-2020-292268

Massive Open Online Courses (MOOCs)

1. Coursera- Automata and Computability
   https://www.coursera.org/learn/automata-and-computability-odc
2. NPTEL (SWAYAM) MOOCs- Theory of Computation
   https://onlinecourses.nptel.ac.in/noc26_cs85/preview
3. edX Courses- Automata Theory by Stanford University
   https://www.edx.org/learn/coding/stanford-university-automata-theory
4. Udemy Courses- Theory of Computation (TOC) / Automata: Complete Pack
   https://www.udemy.com/course/theory-of-computation-automata-theory-for-2021/

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
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CO3	2	2	2	2	-	-	-	-	-	-	-	-	-	1
CO4	2	2	2	2	-	-	-	-	-	-	-	-	-	1
CO5	2	2	2	2	-	-	-	-	-	-	-	-	-	1

Hope Foundation's
INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY (I²IT)
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Accredited by NAAC with "A" Grade in Cycle 2 | NBA Accredited - CE and E&TC (A.Y. 2023-24 to A.Y. 2025-26)

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Computer Organization (CE-PCC-S14)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02 Hrs/Week	**TH:** 2	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

Computer Organization deals with the internal structure of a computer system and how its hardware components are interconnected and function together to execute programs. It focuses on the operational units of a computer and their interactions, rather than on high-level programming concepts. At its core, computer organization explains how instructions are executed and how data flows inside the system.

Prerequisites:

- Digital Logic and Boolean Algebra
- Programming Fundamentals

Course Objectives: The objective of this course is:

1. Understand the working of basic computer components and CPU operation.
2. Understand the concepts related to computer memory.
3. How I/O devices are accessed and its principles.
4. Instruction Level Architecture and Instruction Execution.
5. To provide the knowledge on Instruction and Data Level Parallelism.

Course Outcomes: After successful completion of the course, the learner will be able to:

- PCC-CO-S14.1: Apply the fundamental concepts of Computer Organization to analyze basic computing Systems.
- PCC-CO-S14.2: Apply memory concepts to compare different types of computer memory.
- PCC-CO-S14.3: Describe the methods of accessing I/O devices and their working principles.
- PCC-CO-S14.4: Explain instruction formats, addressing modes, instruction pipelining, and pipeline hazards.
- PCC-CO-S14.5: Explain data dependencies in pipelines and describe Flynn's classification of processors including SIMD, MIMD, and GPU architectures.

Course Contents

Unit I	Introduction to Computer Fundamentals	06 Hours

A top level view of Computer function and inter connection Computer Components, Computer Function, 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, fast

multiplication, integer division. **Floating point representation and operations** – IEEE standard, arithmetic operations, guard bits and truncation.

Unit II	Memory System	05 Hours

Characteristics of memory system, The memory hierarchy. **Cache Memory-** Cache memory principles, **Elements of cache design-** cache address, size, 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.

Unit III	Input and Output System	05 Hours

External devices, **I/O modules-** Module function and I/O module structure, Programmed I/O overview, I/O commands, I/O instructions, **Interrupt driven I/O-** interrupt processing, design issues. **Direct Memory Access-** drawbacks of programmed and interrupt driven I/O, DMA functions.
Case Study- DMA Controller Intel 8237A-study in brief, I/O channels and processors- evolution and characteristics, The external Interface- Thunderbolt and Infinite Band.

Unit IV	Representation of Instructions and Pipelining	05 Hours

Representation of Instructions: Machine instructions, Operands, **Addressing**: Machine instructions, Operands, addressing modes, Instruction formats, Instruction sets, **Instruction set architectures** - CISC and RISC architecture.
Instruction Pipeline: Instruction Pipeline and Performance, Pipeline Hazards and Analysis, Branch Prediction, MIPS Pipeline for Multi-Cycle Operations.

Unit V	Instruction and Data Level Parallelism	05 Hours

Instruction-level parallelism (ILP): Pipeline data-path, data-dependence. Challenges in ILP realization.
Data Level Parallelism: Flynn's Processor classification, SIMD, MIMD, GPU architectures.

Learning Resources

Textbooks:

T1. W. Stallings, —Computer Organization and Architecture: Designing for performance, Pearson
T2. Education/ Prentice Hall of India, 2010, 8th Edition. Zaky S, Hamacher, Computer Organization‖, 5th Edition, McGraw-Hill Publications, 2011, ISBN- 5th Edition

Reference Books

R1. Tanenbaum, Andrew S. —Structured Computer Organization, 2011, 5th Edition.
R2. Patterson and Hennessy, —Computer Organization and Design, Morgan Kaufmann Publishers In, ISBN 978-0-12-374750-1, 4th Edition.
R3. John P Hays, —Computer Architecture and Organization‖, McGraw-Hill Publication, 1998, ISBN:978-1-25-902856-4, 3rd Edition.

Web Resources

1. https://www.geeksforgeeks.org/computer-organization-architecture/computer-organization-and-architecture-tutorials/
2. https://www.youtube.com/watch?v=oAneKttKjtA&list=PL5Rc9H5eTGY6MHqCKAarxhxqT7nipKgun
3. https://www.youtube.com/watch?v=L9X7XXfHYdU&list=PLxCzCOWd7aiHMonh3G6QNKq53C6oNXGrX

Massive Open Online Courses (MOOCs)

1. https://www.coursera.org/learn/comparch
2. https://onlinecourses.nptel.ac.in/noc20_cs64/preview

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	-	-	-	-	-	-	1	1	1	1
CO2	1	1	1	1	-	-	-	-	-	-	1	1	1	1
CO3	1	2	1	1	-	-	-	-	-	-	1	1	1	1
CO4	1	2	1	1	-	-	-	-	-	-	1	1	1	1
CO5	1	1	1	1	-	-	-	-	-	-	1	1	1	1

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Microprocessor and Microcontroller (CE- MDM –S15)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02 Hrs/Week	**TH:** 2	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This course provides a comprehensive understanding of Intel microprocessor architecture, tracing its evolution from 4-bit to modern 64-bit processors with an emphasis on performance improvements. It focuses on the 80386DX processor, covering its architecture, programming model, instruction set, protection, multitasking, debugging, and Virtual 8086 mode, and concludes with an introduction to Pentium, multicore processors, and cache memory organization, enabling students to understand modern processor design concepts.

Prerequisites:

- Digital Electronics
- Operating Systems

Course Objectives: The objective of this course is:

1. To introduce the 80386DX processor, its features, and internal architecture.
2. To understand the instruction set and addressing modes of the 80386DX.
3. To study different registers, interrupts and exceptions.
4. To understand debugging and testing techniques confined to 80386 DX
5. To understand microcontroller architecture, peripherals, and interfacing for real-time embedded applications.

Course Outcomes: After successful completion of the course, the learner will be able to:

- MDM-CO-S15.1: Explain the features and functions of the different blocks of the 80386DX processor
- MDM-CO-S15.2: Implement an assembly language program by using different types of instruction sets
- MDM-CO-S15.3: Understand different registers, interrupts, and exceptions.
- MDM-CO-S15.4: Analyze debugging features and debug registers.
- MDM-CO-S15.5: Analyze microcontrollers and implement basic real-time embedded systems.

Course Contents

Unit I	**80386DX System Architecture and Memory Organisation**	**05 Hours**

Evolution of Intel processor architecture- 4 bit to 64 bit performance assessment. Introduction to 80386dx Processor - 80386dx Features and Architecture Basic Programming Model- Memory Organization and Segmentation, Operating modes. Registers - General Registers, Segment Registers, Flags Register Addressing modes and Formats- Immediate, Direct, Indirect, Register, Register indirect, Displacement and stack.

Case Study: 80386dx addressing modes.

Unit II	Instruction Set	05 Hours

Instruction Set- Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and character translation Instructions, Flag Control Instructions.

Input-Output- I/O Addressing, I/O Instructions, Protection and I/O

Case Study: Intel 8086/80386dx Instruction Set Systems Architecture.

Unit III	Protection and Multitasking	05 Hours

Protected Mode - Systems Registers (Systems flags, Memory Management registers, Control registers, Debug registers, Test registers), Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, System Instructions Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, GDTR, LDTR, IDTR. Format of Descriptor and Selector, Segment Translation, Page Translation, Combining Segment and Page translation.

Unit IV	Debugging and Virtual 8086 Mode	05 Hours

Initialization- Processor State after Reset, Software Initialization for Real Address Mode, Switching to Protected Mode, Software Initialization for Protected Mode, Initialization Example, TLB Testing Debugging- Debugging Features of the Architecture, Debug Registers, Debug Exceptions, Breakpoint Exception Virtual 8086 Mode- Executing 8086 Code, Structure of V86 Stack, Entering and Leaving Virtual 8086 Mode.

Unit V	Introduction to 8051 and PIC microcontroller	06 Hours

Difference between microprocessor and microcontroller Introduction to the Microcontroller classification, Feature and block diagram of 8051 and explanation, Program Status Word (PSW), **Overview and comparison of PIC microcontroller families**, Key features, PIC18F architecture: block diagram, CPU, program and data memory organization, BSR, Pin diagram, I/O port structure, reset operations, watchdog timer, Configuration registers, oscillator options, power-down modes, Timers (Timer0 & Timer1) and interrupt structure, **Serial communication basics:** SPI, I²C and USART (MSSP overview), Interfacing of LED, LCD and basic sensors.

Case Study: Real-time applications: Home security system and Traffic light controller.

Learning Resources

Textbooks

T1. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995.

T2. Mahumad Ali Mazadi, Janice Gillispie Mazadi, Rolin D McKinlay, "The 8051 Microcontroller &

Embedded Systems (Using Assembly and C)", PHI, 2nd Edition
T3. Mahumad Ali Mazadi, Rolin D McKinlay and Danny Causey, "PIC Microcontroller & Embedded System", Pearson Education, 3rd Edition

Reference Books

R1. Chris H. Pappas, William H. Murray, "80386 Microprocessor Handbooks", McGraw-Hill Osborne Media, 2nd edition 2010 ISBN-10: 0078812429, 13: 978-0078812422.
R2. Kenneth J. Ayala, 'The 8051 Microcontroller Architecture, Programming and Applications', Cengage Learning, 3rd Edition
R3. A. Ray, K. Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing", Tata McGraw Hill, 2016, ISBN 0-07-463841-6.

Web Resources

1. http://intel80386.com/386htm/toc.html
2. Intel 80386 Programmer's Reference Manual https://css.csail.mit.edu/6.858/2014/readings/i386.pdf

Massive Open Online Courses (MOOCs)

1. https://nptel.ac.in/courses/108105102

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	-	-	-	-	-	-	-	-	1	2	1	2
CO2	2	2	2	-	2	-	-	-	-	-	1	1	2	1
CO3	3	1	2	2	2	-	-	-	-	-	1	2	2	1
CO4	2	2	-	2	2	-	-	-	-	-	1	2	1	2
CO5	3	2	2	-	2	1	-	-	-	-	2	2	2	2

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Mathematical Foundation for Machine Learning (CE-OE2-S16A)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/ Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This course provides a strong mathematical foundation for machine learning, focusing on advanced linear algebra and optimization using calculus. Students will develop the theoretical understanding required to analyze and implement machine learning algorithms.

Prerequisites:

- Linear algebra basic concepts, functions, limits, ordinary and partial differentiation.

Course Objectives: The objective of this course is:

1. Introduce fundamental and advanced concepts of linear algebra and establish them as a mathematical foundation for machine learning.
2. Introduce vector calculus, including partial derivatives and multivariate Taylor series.
3. Develop an understanding of gradient-based optimization methods, including unconstrained, constrained, and convex optimization.
4. Introduce dimensionality reduction techniques such as Principal Component Analysis (PCA) and optimization concepts underlying Support Vector Machines (SVMs).

Course Outcomes: After successful completion of the course, the learner will be able to:

- OE2-CO-S16A.1: Apply concepts of vector spaces, matrices, eigenvalues, and eigenvectors to formulate and analyze machine learning problems.
- OE2-CO-S16A.2: Apply matrix properties and decomposition techniques to represent, analyze, and simplify machine learning models.
- OE2-CO-S16A.3: Use concepts of multivariate and vector calculus to model and analyze learning algorithms.
- OE2-CO-S16A.4: Implement and analyze gradient descent-based optimization techniques for unconstrained and constrained optimization problems.
- OE2-CO-S16A.5: Apply dimensionality reduction techniques such as PCA and understand the optimization framework of Support Vector Machines.

Course Contents

Unit I	**Vector Spaces**	**08 Hours**

Vectors Spaces, linear independence, basis and rank, affine spaces, Linear Transformation, Analytic Geometry norms, inner products, lengths and distances, angles and orthogonality, orthonormal basis.

Unit II	**Matrix Decomposition**	**08 Hours**

Determinant, Trace of a matrix, Eigen decomposition, diagonalization, Cholesky Decomposition, Singular Value Decomposition, Matrix Approximation.

Unit III	**Vector Calculus**	**08 Hours**

Hessian and its properties, vector differentiation, directional derivative, gradient of vector valued functions, Linearization and multivariate Taylor's series, Computing maxima and minima for unconstrained optimization.

Unit IV	**Optimization**	**08 Hours**

Optimization using gradient descent, convex function and its properties, convex optimization, Constraint optimization using Lagrange Multiplier Method.

Unit V	**Dimensionality Reduction and Clustering**	**08 Hours**

Dimensionality reduction using PCA, Low rank approximation, Maximum variance perspective, Projection perspective, Mathematical model for Linear support vector machine, Karush-Kuhn-Tucker Conditions.

Learning Resources

Textbooks:

T1. M.P. Diesenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
T2. Charu C. Aggarwal, Linear Algebra and Optimization, Springer Nature Switzerland AG, 2020

Reference Books

R1. K Hoffman and R Kunze, Linear Algebra, Pearson Education, 2nd Edition, 2005.
R2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2015

Web Resources

1. A freely available manuscript covering matrix differential calculus useful for gradient-based optimization (https://arxiv.org/abs/2501.14787?utm_source=chatgpt.com)
2. Practical explanations of calculus concepts with code examples, including optimization with constraints. (https://www.geeksforgeeks.org/machine-learning/multivariable-calculus-for-machine-learning/?utm_source=chatgpt.com)

Massive Open Online Courses (MOOCs)

1. NPTEL course for Optimization Theory and Algorithms (https://onlinecourses.nptel.ac.in/noc24_ee122/preview)

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	-	-
CO5	3	3	3	2	2	-	-	-	-	-	-	-	-	-

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Economics: Policies and its impact on Business Sectors (CE-OE2-S16B)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This course helps engineering students understand how economic policies and market conditions affect business and industrial activities. It focuses on the practical impact of government policies globalization, and economic changes on business decisions, investments, and industrial growth.

Prerequisites:

- Basic understanding of Fundamental economic concepts
- Familiarity with Basic business and industrial environment
- General awareness of current economic issues and government policies is desirable.

Course Objectives: The objective of this course is:

1. Understand the fundamental concepts, scope, and principles of business economics and explain their relevance to engineering and industrial decision-making.
2. Apply demand, supply, elasticity, and market equilibrium concepts to analyze market behaviour and support business and production decisions.
3. Analyze the impact of fiscal, monetary, and industrial policies, including economic reforms, on investment, production, and employment in the business sector.
4. Understand the legal and regulatory framework governing business and industrial activities in India and explain its influence on industrial growth and business operations.
5. Analyze the effects of globalization, inflation, business cycles, and economic instability on business performance and industrial competitiveness.

Course Outcomes: After successful completion of the course, the learner will be able to:

- OE2-CO-S16B.1: Explain the fundamental concepts, scope, and principles of business economics and their relevance to engineering and industrial decision-making.
- OE2-CO-S16B.2: Analyze demand, supply, elasticity, and market equilibrium to interpret market behavior and support business decisions.
- OE2-CO-S16B.3: Analyze the impact of fiscal, monetary, and industrial policies, including economic reforms, on business performance, investment, and employment.
- OE2-CO-S16B.4: Describe the legal and regulatory framework affecting business and industrial activities and explain its influence on industrial growth and operations.
- OE2-CO-S16B.5: Evaluate the effects of globalization, inflation, business cycles, and economic instability on business competitiveness and industrial performance.

Course Contents

Unit I	Business Economics	08 Hours

Nature and Scope of Business Economics: Meaning and scope of business economics; Objectives of firm, Exploring the subject matter of economics : Concept, methodology of economics; the basic economic problems; science of economics; role of price mechanism; economic systems.

Unit II	Demand and Supply Analysis	08 Hours

Demand—Meaning, Demand Schedule, Individual and Market Demand Curve, Determinants of Demand, Law of Demand, Changes in Demand; Supply—Meaning, Supply Schedule, Individual and Market Supply Curve, Determinants of Supply, Law of Supply, Changes in Supply; Equilibrium of Demand and Supply—Determination of Equilibrium Price and Quantity, Effect of a shift in Demand or Supply; Elasticity of Demand and Supply.

Unit III	Economic Policies and Business Sector	08 Hours

Meaning and objectives of Economic Policy, Fiscal Policy: instruments and impact on business, Monetary Policy: role of RBI and impact on industry, Industrial Policy: evolution and current framework, Economic reforms in India (1991 onwards), Impact of economic policies on investment, production, and employment.

Unit IV	Laws and Regulatory Framework for Business	08 Hours

Industrial Development and Regulation Act (IDRA), 1951 (overview), FEMA, 1999 – impact on business transactions, Foreign Trade (Development and Regulation) Act, 1992, Industrial Policy Resolutions and policy statements, Regulatory environment and ease of doing business.

Unit V	Economics Impact on Business Sector	08 Hours

Microeconomics vs. Macroeconomics, Globalization and the Indian Economy, Foreign Direct Investment (FDI), International trade and competitiveness, Inflation: causes and impact on business, Business cycles and industrial performance, Impact of economic instability on industries.

Learning Resources

Textbooks

T1. Dewett, K.K. & Varma, J.D., *Modern Economic Theory*, S. Chand & Company Ltd.
T2. Datt, R. & Sundaram, K.P.M., *Indian Economy*, S. Chand & Company Ltd.

Reference Books

R1. Panneerselvam, R., *Engineering Economics*, PHI Learning.
R2. Government of India, *Economic Survey*, Ministry of Finance.
R3. Reserve Bank of India (RBI) Annual Reports.
R4. Tulsian, P.C., *Business Law*, McGraw Hill Education.

Web Resources

1. edX (Economics Courses)
   https://www.edx.org/

2. Coursera – Economics Courses
   https://www.coursera.org/
3. Khan Academy – Economics
   https://www.khanacademy.org/economics-finance-domain

Massive Open Online Courses (MOOCs)

1. https://onlinecourses.nptel.ac.in/noc25_ec16/preview
2. https://onlinecourses.nptel.ac.in/noc25_ec13/preview

CO PO Mapping

CO\ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	2	-	-	-	-	-	2	3	1
CO2	3	3	1	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	-	-	-	2	-	-	–	-	2	2	3	2
CO4	2	1	-	-	-	3	-	2	-	-	-	1	3	2
CO5	2	3	-	-	-	3	2	-	-	-	2	2	3	3

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Financial & Cost Accounting (CE-OE2-S16C)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

A financial accounting course is designed to provide students with a systematic understanding of recording, summarizing, and reporting an organization's financial transactions to external stakeholders such as investors, creditors, and government authorities and A cost accounting course focuses on the internal aspects of a business, specifically tracking, recording, and analyzing the costs associated with the products or services offered.

Prerequisites:

- Mathematics
- Basic Accounting

Course Objectives: The objective of this course is:

1. To understand and apply the theoretical aspects of accounting
2. To study accounting standards and accounting in computerized environment
3. To study and interpret accounting for depreciation, inventory and valuation
4. To understand cost concepts and classification
5. To understand and analyze costing methods and techniques.

Course Outcomes: After successful completion of the course, the learner will be able to:

- OE2-CO-S16C.1: Apply accounting principles to real world scenario
- OE2-CO-S16C.2: Use computerized accounting systems to analyze financial data
- OE2-CO-S16C.3: Calculate and interpret depreciation, inventory and valuation using various methods
- OE2-CO-S16C.4: Demonstrating and understanding of cost concepts and classification
- OE2-CO-S16C.5: Evaluate and apply different costing methods and techniques.

Course Contents

Unit I	Introduction to Accounting	08 Hours

Meaning & scope of accounting, scope, objective, functions, process of accounting, limitations, Principles and policies, Accounting concepts, types of accounts.

Unit II	IFRS and Accounting in Computerised Environment	08 Hours

Introduction to IFRS, Accounting standards, Concepts, features, objective, benefits, challenges, equity, income, expenses, fair value, Computerized accounting system, features, advantages, disadvantages, Prepackaged accounting software.

Unit III	Accounting for depreciation, inventory and valuation	08 Hours

Definition of Depreciation, Depletion and Amortization ,Purpose, Factors affecting Depreciation, Methods of charging Depreciation, Store and Store keeping ,Purpose of Store keeping , Functions of the Store keeper ,Stores Layout , Types of Stores, Centralized Stores ,Decentralized Stores - Combination of Both, Valuation of Total Cost of Material Purchased - Trade Discount - Quantity Discount - Cash Discount - Materials Issue Procedure - Material Requisition - Bill of Materials; Methods of Materials Pricing Issues - First In First Out (FIFO) - Last In First Out (LIFO) - Specific Price Method - Base Stock Method - Highest In First Method (HIFO)

Unit IV	Cost Accounting	08 Hours

Cost Accounting, Cost Control, Cost Reduction, Cost Allocation, Cost Absorption, Cost Audit, Cost Unit, Cost Centre, Objectives of Cost Accounting, Difference between Financial Account and Cost Accounting, Management Accounting, Meaning - Cost Accounting Vs Management Accounting - Advantages of Cost Accounting - Limitations of Cost Accounting - Installation of Cost Accounting System - Practical Difficulties in Installation of Costing System - Steps to Overcome - Questions.

Unit V	Costing methods and Techniques	08 Hours

Methods of costing, techniques of costing, Classification of Cost, On the basis of Nature - Functions - Variability-Normality-Controllability On the basis of Controllability and Decision Making Controllable Cost, Uncontrollable Cost, Sunk Cost, Opportunity Cost, Replacement Cost and Conversion Cost.

Learning Resources

Textbooks

T1. Introduction to Financial Accounting, Dr. Nisikant Jha, Prof. Nimesh Jotaniya, Prof. Poonam Kakad, Himalaya Publishing house
T2. S.N. Maheshwari and S.K. Maheshwari, "Advanced Accountancy "12th Edition, S. Chand and Company.
T3. Financial, Cost and Management Accounting, Dr. P. Periasamy, Himalaya Publishing House.

Reference Books

R1. S.N. Maheshwari and S.K. Maheshwari, "Advanced Accountancy "12th Edition, S. Chand and Company
R2. Subramanyam and Wild, "Financial Statement Analysis handbook", Zebralearn publication.
R3. Benjamin Graham and Charles McGolrick," Interpretation of Financial Statements", Harper Business.

Web Resources

1. https://www.youtube.com/watch?v=Om0Ohf4sz78
2. https://www.geeksforgeeks.org/accountancy

Massive Open Online Courses (MOOCs)

1. https://onlinecourses.nptel.ac.in/noc25_ec10/preview

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	-	2	-	1	3	1	1	2	2
CO2	1	-	-	-	3	-	2	-	-	2	2	3	2	1
CO3	2	2	2	-	1	1	-	-	-	3	1	2	1	1
CO4	2	2	-	-	-	2	-	1	-	3	1	1	1	2
CO5	3	3	3	2	2	2	-	2	2	3	2	2	2	2

International Institute of Information Technology (I²IT) * Pune *

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INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY (I²IT)
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AICTE Permanent ID : 1-448945341 | DTE Code : EN6754 | AISHE Code : C-41681
Accredited by NAAC with "A" Grade in Cycle 2 | NBA Accredited - CE and E&TC (A.Y. 2023-24 to A.Y. 2025-26)

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Web Technology Laboratory (CE-VSEC-S17)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 04 Hrs/Week	**PR:** 2	**Term work:** 25 Marks **Practical:** 25 Marks **Total Marks:** 50 Marks

Course Introduction:

The Java & Web Technology Laboratory is a hands-on course designed to provide practical exposure to core programming and web development concepts. The course enables students to develop problem-solving skills using Java programming and to design interactive and responsive web applications using HTML, CSS, JavaScript, XML, and Bootstrap. Through structured laboratory experiments, students gain experience in creating static and dynamic web pages, implementing client-side validation, manipulating the Document Object Model (DOM), and designing validated XML documents.

Prerequisites:

- Basic understanding of computer systems and programming fundamentals
- Basic knowledge of internet concepts and web browsers

Guidelines for Student's Laboratory Journal

- The laboratory journal shall be maintained regularly and submitted at the end of the semester as term work.
- Each experiment must be written in a systematic format, including:
  - Aim / Problem Statement
  - Software/Hardware Requirements
  - Algorithm / Logic
  - Program Code (Java / HTML / CSS / JavaScript / XML as applicable)
  - Output (Screenshots where applicable)
  - Result / Conclusion
- Programs must be neatly written or printed, properly indented, and commented.
- For Java programs, concepts such as OOP, exception handling, multithreading, file handling, and applets must be clearly reflected.
- For Web Technology experiments, proper use of HTML elements, CSS styling, JavaScript validation, DOM manipulation, and XML validation must be demonstrated.
- Each experiment must be signed by the concerned faculty after successful Completion.

Guidelines for Laboratory/Term Work Assessment

- Assessment will be carried out considering:
  - Regularity and punctuality in lab sessions
  - Completion of assigned experiments

Quality of program logic and correctness
Understanding of concepts during lab interaction
Proper maintenance of laboratory journal

- Students must demonstrate independent problem-solving ability during practical sessions.
- Incomplete or poorly maintained journals may lead to reduction or denial of term work marks.

Guidelines for Laboratory Conduction

- Each practical session should begin with a brief explanation of concepts related to the experiment.
- Experiments should be performed strictly as per the approved syllabus.
- Students should be encouraged to:
  - Write optimized Java programs
  - Design responsive web pages
  - Use modern development practices and standards
- Faculty should ensure:
  - Equal opportunity for all students to perform experiments
  - Continuous monitoring and guidance
  - Emphasis on debugging and logical thinking
- Safety and discipline must be maintained inside the laboratory.
- Use of unauthorized software or unfair practices is strictly prohibited.

Guidelines for Practical/Oral Examination

- The Practical and Oral examination shall be conducted for 25 marks.
- The examination shall consist of:
  - Performing a practical based on Java or Web Technology
  - Oral examination to test conceptual understanding
- Students may be evaluated on:
  - Program logic and correctness
  - Syntax and use of programming constructs
  - Output verification
  - Ability to explain code and concepts
- The oral examination may include questions on:
  - OOP concepts
  - Multithreading and exception handling
  - Web technologies (HTML, CSS, JavaScript, XML)
  - DOM manipulation and validation techniques
- Students must bring their certified laboratory journal at the time of examination.
- Use of unfair means will result in disqualification as per university norms.

International Institute of Information Technology (I²IT) * Pune *

Course Objectives: The objective of this course is:

1. To understand and apply object-oriented programming concepts to solve computational problems using Java.
2. To develop the ability to write Java programs using multithreading concepts and to handle exceptions effectively.
3. To equip students with the skills to design and develop graphical user interfaces using Java Applets, Swing components.
4. To apply HTML, CSS, and XML technologies to design structured and styled web documents.
5. To apply JavaScript techniques to develop interactive and user-responsive web pages.
6. To create responsive and standards-compliant web applications following modern web development practices.

Course Outcomes: After successful completion of the course, the learner will be able to:

- VSEC-CO-S17.1: Understand and apply object-oriented programming concepts to analyze and solve computational problems using Java.
- VSEC-CO-S17.2: Design and implement Java programs using multithreading concepts and handle exceptions effectively.
- VSEC-CO-S17.3: Design and develop graphical user interfaces using Java Applets and Swing components.
- VSEC-CO-S17.4: Apply HTML and CSS concepts to design static and responsive web pages using forms, tables, and media queries.
- VSEC-CO-S17.5: Apply JavaScript programming to implement event handling, form validation, and DOM manipulation.
- VSEC-CO-S17.6: Create validated XML documents using DTD and XML Schema for structured data representation.

List of Assignments

Java

1. Write a Java program that prints all real solutions to the quadratic equation ax2 +bx + c = 0. Read in a, b, c and use the quadratic formula. If the discriminant b^2-4ac is negative, display a message stating that there are no real solutions.
2. Define a class with the Name, Basic salary and dearness allowance as data members.Calculate and print the Name, Basic salary(yearly), dearness allowance and tax deduced at source(TDS) and net salary, where TDS is charged on gross salary which is basic salary + dearness allowance and TDS rate is as per following.

Gross Salary	TDS
Rs. 100000 and below	NIL
Above Rs. 100000	10% on excess over 100000

3. Write a java program to implement parameterized constructor.
4. Write a JAVA program implements method overloading.
5. Write Java program(s) on use of inheritance, preventing inheritance using final, abstract classes.

6. Write a JAVA program for abstract class to find areas of different shape.
7. Write a Java program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.
8. Write a Java program compute factorial value using Applet.
9. Write a java program to Read content from file using BufferedReader.
10. Write a java program to determine number of bytes written to file using DataOutputStream

Web Technology

1. Design a basic web page using HTML elements such as headings, paragraphs, lists, images, and hyperlinks.
2. Create web pages using tables and forms with various input controls.
3. Apply CSS using inline, internal, and external stylesheets to enhance the appearance of web pages.
4. Develop responsive web pages using CSS media queries for different screen sizes.
5. Write JavaScript programs to demonstrate variables, operators, functions, and event handling.
6. Implement client-side form validation using JavaScript.
7. Create interactive web pages by dynamically accessing and modifying HTML elements using the DOM.
8. Design an XML document to store structured data (e.g., student details, book catalog, or employee records).
9. Define a DTD to validate the XML structure.
10. Define an XML Schema to validate the XML structure.

Learning Resources

Textbooks

T1. Core Java: Fundamentals, Prentice Hall By- Cay S. Horstmann
T2. Java: A Beginner's Guide, Sixth Edition, McGraw Hill Professional By- Herbert Schildt
T3. Java The Complete Refrence, Seventh edithion By- Thomas A.Powell.
T4. Web Technologies: HTML, CSS, JavaScript, XML and AJAX, PHI Learning By – Uttam K. Roy
T5. JavaScript: The Definitive Guide, O'Reilly MediaBy – David Flanagan
T6. Beginning Web Programming with HTML, XHTML, and CSS, Wiley By – Jon Duckett

Reference Books

R1. Java: How to Program, P.J.Deitel and H.M.Deitel, PHI.
R2. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
R3. Thinking in Java, Bruce Eckel, Pearson Education
R4. Web Programming with HTML, CSS, JavaScript and jQuery, Jon Duckett, Wiley India

R5. JavaScript: The Definitive Guide, David Flanagan, O'Reilly Media.
R6. XML and Web Technologies, S. G. Ganesh, Universities Press.

Web Resources

1. https://docs.oracle.com/javase/
2. https://www.geeksforgeeks.org/java/
3. https://www.tutorialspoint.com/java/
4. https://www.w3schools.com/
5. https://www.tutorialspoint.com/
6. https://www.youtube.com/watch?v=naxnRkOfh2Q

Massive Open Online Courses (MOOCs)

1. https://nptel.ac.in/courses/106105191
2. https://onlinecourses.swayam2.ac.in/aic20_sp13/preview
3. https://onlinecourses.swayam2.ac.in/aic20_sp14/preview
4. https://www.coursera.org/learn/java-for-programming-beginners
5. https://www.coursera.org/learn/introduction-html-css-javascript
6. https://onlinecourses.swayam2.ac.in/ntr25_ed123/preview

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	2	-	-	-	-	-	2	3	2	1
CO2	3	3	2	1	2	-	-	-	-	-	2	3	3	1
CO3	2	2	3	-	2	-	-	1	1	-	1	3	2	2
CO4	2	2	2	-	2	-	-	-	2	-	1	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	2	3	3	2
CO6	2	2	3	1	3	1	-	1	2	2	3	3	3	3

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Employability Skills Development (CE-AEC-S18)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial: 02 Hrs/Week	**TUT:** 2	**Term work:** 25 Marks **Oral:** 25 Marks **Total Marks:** 50 Marks

Course Introduction:

This course is designed to prepare students for a smooth transition from academic life to professional and corporate environments. This course emphasizes the development of essential employability competencies through tutorial-based and experiential learning methods. It focuses on career awareness, professional conduct, aptitude readiness, communication effectiveness, and workplace adaptability required for internships, employment, higher studies, and entrepreneurship. The course aims to enhance students' readiness for the dynamic demands of the professional world by engaging them in structured activities, self-reflection, and practical skill application.

Prerequisites:

- Basic exposure to academic and professional communication skills
- Prior exposure to foundational employability concepts such as goal setting, group discussions, and professional communication covered in earlier semesters.

Guidelines for Student's Laboratory Journal

- Every student shall maintain a File / Laboratory Journal/ Workbook (hard copy or digital, as prescribed by the Institute/Department).
- The Laboratory Journal shall include:
  a. Title and objectives of each assignment.
  b. Brief description of the activities performed.
  c. Observations, reflections, and learning outcomes.
  d. Relevant supporting documents such as worksheets, reports, resumes, feedback forms, or reflection notes
- All entries shall be neatly written, dated, and authenticated by the concerned faculty.
- The Laboratory Journal shall be submitted for periodic verification and during the final term work assessment.
- The journal shall reflect original work carried out by the student, adhering to academic integrity norms.

Guidelines for Laboratory/Term Work Assessment

- The assessment for this course shall be continuous and activity-based.
- Term Work evaluation shall be based on:
- Completion of prescribed assignments/worksheets/workbook
- Quality and relevance of submissions as per the rubrics

- Participation and engagement during tutorial scssions
- Faculty members may use structured rubrics to ensure uniformity and transparency in assessment.
- Students must submit all assignments and the Laboratory Journal within the stipulated time.
- The final Term Work marks shall be awarded based on the overall performance of the student across all assignments and maintenance of the Laboratory Journal, as per university/institute norms.

Guidelines for Session Conduction

- Sessions shall be conducted in theory and tutorial (activity-based) mode.
- Faculty shall facilitate learning through discussions, exercises, and simulations.
- Students are expected to participate actively and demonstrate professional behavior.
- Activities may include case studies, role plays, group discussions, aptitude tests, quiz, gamified learning, and mock interviews.
- Ethical conduct, originality, and continuous feedback shall be integral to all sessions.

Course Objectives: The objective of this course is:

1. To develop self-awareness and enable informed career planning through structured self-exploration.
2. To enhance students' ability to align personal goals with industry requirements and professional opportunities.
3. To strengthen professional communication and professional branding.
4. To prepare students for recruitment processes including aptitude tests, group discussions, and interviews.
5. To inculcate professional behavior, teamwork skills, adaptability, and continuous learning for workplace effectiveness.

Course Outcomes: After successful completion of the course, the learner will be able to:

- AEC-CO-S18.1: Assess personal strengths, interests, and career preferences using self-exploration tools to identify suitable professional domains.
- AEC-CO-S18.2: Analyze industry requirements and roles to set SMART career goals.
- AEC-CO-S18.3: Apply professional communication skills in introductions, resumes, and pitches.
- AEC-CO-S18.4: Demonstrate readiness for recruitment processes through aptitude performance, group discussions, and mock interviews.
- AEC-CO-S18.5: Exhibit professional conduct, teamwork competence, ethical behavior, and readiness for continuous learning in workplace settings.

Psychological Wellness Integration:

Subject Matter Experts or Facilitators are requested to include the following psychological components into relevant assignments/sessions to build student's emotional resilience.

1. Create psychological safety.
2. Normalize struggle and failure.
3. Fear Analysis (or Fear Inventory) and Motivation Analysis.
4. Stress and anxiety management techniques.
5. Social anxiety management strategies.
6. Cognitive reframing exercises.

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UNIT I	Self-Discovery and Career Planning	6 Hrs.

- Self-exploration frameworks: Interest Mapping, Ikigai, Career Anchors, SWOT analysis
- Introduction to MBTI / RIASEC (personality-career alignment)
- Understanding interests, values, motivations, and behavioral tendencies
- Realistic career expectations and developing growth mindset
- SMART goal setting for career pathways

UNIT II	Industry Awareness and Professional Branding	5 Hrs.

- Industry research parameters and reliable sources
- Role analysis: skills, competencies, and future prospects
- LinkedIn as a professional research tool
- Resume fundamentals: structure, prioritization, common errors
- Personal branding and digital professionalism

UNIT III	Professional Communication and Interaction Skills	5 Hrs.

- Structured self-introduction and elevator pitch
- Verbal and non-verbal communication.
- Managing public speaking anxiety, communication barriers, cognitive reframing techniques.
- Group Discussion norms and evaluation criteria
- Importance of listening, reasoning, collaboration skills and emotional intelligence in team interactions.

UNIT IV	Recruitment Readiness	5 Hrs.

- Aptitude test patterns for MNCs.
- Logical reasoning and language readiness strategies.
- Resume and cover letter/email writing.
- Interview skills and frameworks to answer common questions.
- Managing interview anxiety and handling rejection.

UNIT V	Professional Conduct and Workplace Adaptability	5 Hrs.

- Organizational expectations and workplace norms.
- Professional ethics and responsible conduct.
- Time and self-management - principles and frameworks.
- Ego management, emotional intelligence, and teamwork dynamics.
- Continuous learning and career adaptability.

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List of Assignments

Sr No	Assignments	BTL Level
1	**Self-Exploration and Career Analysis** Perform a structured self-assessment using self exploration and career frameworks (Ikigai/Interest mapping/SWOT/Career Anchors/RIASEC) and prepare a reflective career domain analysis identifying interests, values, strengths, and suitable professional pathways.	Analyze (4)
2	**Industry and Organization Analysis** Select an industry, identify three organizations, and analyze roles, skills required, and prospects using LinkedIn. Based on the analysis set SMART goals for a targeted job role.	Analyze (4)
3	**Professional Introduction and Elevator Pitch** Prepare and deliver a structured self-introduction and a 30–60 second elevator pitch for professional contexts.	Apply (3)
4	**Time and Self-Management for Professionals** Conduct a personal time audit and design a structured weekly schedule based on productivity analysis. Use time management principles and techniques like Pareto principle and Eisenhower matrix.	Apply (3)
5	**Aptitude and Language Readiness for MNCs** Attempt Aptitude and English tests based on MNC recruitment patterns and analyze performance.	Analyze (4)
6	**Group Discussion and Team Interaction** Conduct a structured group discussion demonstrating listening, logical reasoning, and collaboration.	Apply (3)
7	**Team Work and Collaboration** Facilitator shall conduct an activity and students shall work in teams to achieve a common objective, give peer feedback, and reflect on individual contributions.	Apply (3)
8	**Resume and Cover Letter** Prepare a role-specific ATS friendly resume and draft a cover letter or application email for the same.	Create (6)
9	**Interview Skills and Mock Interviews** Participate in mock interviews simulating real recruitment scenarios. Give feedback and discuss common interview mistakes.	Apply (3)
10	**Professionalism and Workplace Conduct** Analyze workplace behavior and ethical case scenarios through case studies or role play. Prepare structured responses recommending appropriate professional actions.	Analyze (4)

International Institute of Information Technology (I²IT) * Pune *

Learning Resources

Textbooks

T1. Personality Development and Soft Skills – Barun K Mitra, Oxford University Press
T2. Technical Communication: Principles and Practice - Meenakshi Raman & Sangeeta Sharma, Oxford University Press.

Reference Books

R1. The Ace of Soft Skills – Ramesh Gopalaswamy, Pearson Education
R2. Soft Skills: An Integrated Approach to Maximise Personality – Gajendra Singh Chauhan, Sangeeta Sharma, Wiley India Pvt Ltd.

Web Resources

1. How to Prepare for a Job Interview https://in.indeed.com/career-advice/interviewing/interview-preparation
2. How to give an elevator pitch https://in.indeed.com/career-advice/interviewing/how-to-give-an-elevator-pitch-examples

Massive Open Online Courses (MOOCs)

1. Complete guide for campus interviews: Step by step preparation for internships and full-time jobs – Prof Vinod Aravindakshan, Prof Vibin Aravindaksha https://nptel.ac.in/courses/109106602
2. Soft Skills – Prof Binod Mishra -IIT Roorkee https://nptel.ac.in/courses/109107121

CO PO Mapping

CO\ PO	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
CO1	-	2	-	-	2		-	-	-	-	3	-	-	3
CO2	-	3	-	-	-	-	-	-	-	1	3	-	1	3
CO3	-	-	-	-	-	-	-	-	3	3	2	1	-	3
CO4	-	2	-	-	-	-	-	-	3	3	2	-	2	3
CO5	-	-	-	-	-	-	-	3	2	2	3	2	-	3

International Institute of Information Technology (I²IT) * Pune *

S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Project Management (CE-EEM-S19)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial: 02 Hrs/ Week	**TUT:** 2	**Term Work:** 25 Marks **Oral:** 25 Marks **Total Marks:** 50 Marks

Course Introduction:

This course introduces the fundamental principles and practices of software engineering required for systematic software development. It covers software process models, requirements analysis, project estimation, design, and testing. The course emphasizes applying engineering approaches to develop high-quality and maintainable software systems.

Prerequisites:

- Fundamentals of Programming Languages

Course Objectives: The objective of this course is:

1. To learn and understand the principles of Software Engineering.
2. To familiarize with methods of capturing, specifying, and modeling software requirements.
3. To apply project estimation and scheduling techniques for effective software project planning.
4. To understand basic software design, architectural modeling, risk management, and configuration management practices in software projects.

Course Outcomes: After successful completion of the course, the learner will be able to:

- EEM-CO-S19.1: Apply software engineering principles to develop software.
- EEM-CO-S19.2: Analyze and document software requirements and develop UML models for a given software system.
- EEM-CO-S19.3: Perform software project estimation and prepare project schedules using suitable project management tools.
- EEM-CO-S19.4: Develop basic software design and architectural models and prepare a simple risk management and configuration management plan for a software project.

Course Contents

Unit I	Software Processes and Agile Project Management	06 Hours

Software Engineering Fundamentals: Nature of software, software engineering practice, **Overview of Software Processes:** Generic process model, Waterfall vs Agile (conceptual comparison), Agile principles and workflow, Introduction to Agile project management and sprint-based development.
Suggested Tool: JIRA
Assignment:

Create a project in JIRA.
Define Epics, User Stories, and Tasks.
Create product backlog and plan one sprint.
Demonstrate Agile workflow using the tool.

Unit II	Requirements Engineering and System Modeling	06 Hours

Requirements Engineering overview and tasks, Requirement Elicitation techniques (overview),**Types of requirements:** Functional and Non-functional, Characteristics and quality of good requirements, Software Requirements Specification (SRS), System scope and feasibility (basic concepts), **UML Modeling:** Use Case Diagram, Class Diagram (Sequence Diagram – optional).
Suggested Tools: StarUML / Modelio / SmartDraw
Assignment:
Prepare SRS for the selected mini-project.
Draw Use Case and Class Diagrams using UML tool.
Define system scope and basic feasibility note.

Unit III	Project Estimation and Scheduling	06 Hours

Project planning basics and scope definition, Resource identification and task breakdown (WBS), Software estimation concepts, Use Case Point–based estimation (application level), Overview of COCOMO II (conceptual), Requirement Traceability Matrix (RTM), Project scheduling concepts and Gantt chart.
Suggested Tools: GanttProject
Assignment:
Create project schedule and Gantt chart using tool.

Unit IV	Software Design, Risk and Configuration Management	06 Hours

Software design concepts and quality attributes, **Design concepts:** Abstraction, Modularity, Information Hiding (overview), Software Architecture: Definition and importance, **Common architectural styles:** Layered, Client-Server, MVC (overview), **Design models:** Component and Deployment diagrams.
Risk Management: Risk identification, analysis, mitigation, Risk Register and RMMM Plan.
Software Configuration Management: SCM concepts, repository, basic process (overview).

Suggested Tool: SmartDraw
Assignment:
Draw software architecture diagram.
Draw Component and Deployment diagrams.
Identify project risks and prepare Risk Register + RMMM plan.
Prepare a brief note on SCM process for the project.

Learning Resources

Textbooks

T1. Roger Pressman, —Software Engineering: A Practitioner's Approach‖, McGraw Hill, ISBN 007–337597–7

T2. Ian Sommerville, —Software Engineering‖, Addison and Wesley, ISBN 0-13-703515-2

Reference Books

R1. Carlo Ghezzi, —Fundamentals of Software Engineering", Prentice Hall India, ISBN-10:0133056996

R2. Rajib Mall, —Fundamentals of Software Engineering‖, Prentice Hall India, ISBN-13: 9788120348981

R3. Pankaj Jalote, —An Integrated Approach to Software Engineering‖, Springer, ISBN 13: 9788173192715.

R4. S K Chang, —Handbook of Software Engineering and Knowledge Engineering‖, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1

R5. Tom Halt, —Handbook of Software Engineering‖, Clanye International ISBN- 10:1632402939

Web Resources

1. https://www.geeksforgeeks.org/software-engineering/software-engineering

Massive Open Online Courses (MOOCs)

1. https://nptel.ac.in/courses/106105182

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	2	1	1
CO2	2	1	-	-	-	-	-	-	-	-	1	2	1	1
CO3	2	-	-	-	1	-	-	1	-	1	-	1	1	1
CO4	2	1	-	-	2	-	-	-	-	-	1	2	2	2

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S.Y. B.Tech. Computer Engineering Curriculum
With effect from A.Y. 2026-27
Semester II

Environmental Studies (CE-VEC-S20)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02 Hrs/Week	**TH:** 2	**Term Work:** 50 Marks **Total Marks:** 50 Marks

Course Introduction:

This course provides a comprehensive overview of the environment, emphasizing the delicate balance of ecosystems and the impact of human activity on natural resources. It aims to bridge the gap between technological advancement and ecological conservation by exploring sustainable development, pollution control, and environmental ethics. Students will gain the multidisciplinary knowledge required to address global challenges like climate change and waste management while understanding the legal and ethical frameworks governing environmental protection.

Prerequisites:

- Basic understanding of secondary-level Biology and Geography.
- General awareness of current global environmental issues and climate trends.

Course Objectives: The objective of this course is:

1. Introduce students to fundamental concepts of environment, ecology, and ecosystems.
2. Develop understanding of natural resources and principles of sustainable development.
3. Create awareness about environmental pollution, its impacts, and control measures.
4. Familiarize students with climate change, biodiversity, and major environmental issues.
5. Instill environmental ethics, legal awareness, and responsibility towards a sustainable society.

Course Outcomes: After successful completion of the course, the learner will be able to:

- VEC-CO-S20.1: Explain basic ecological principles and ecosystem functioning.
- VEC-CO-S20.2: Analyze the importance of conservation and sustainable utilization of natural resources.
- VEC-CO-S20.3: Identify different types of environmental pollution and suggest suitable control measures.
- VEC-CO-S20.4: Assess environmental challenges such as climate change, biodiversity loss, and waste management.
- VEC-CO-S20.5: Apply environmental ethics, laws, and sustainability concepts in professional and societal contexts.

Course Contents

Unit I	**Introduction to Environment and Ecology**	**05 Hours**

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Definition, scope, and importance of Environmental Studies, Components of environment: lithosphere, hydrosphere, atmosphere, biosphere, Concept of ecology and ecosystem ,Structure and functions of ecosystem, Energy flow, food chains, food webs, and ecological pyramids.

Unit II	Natural Resources and Sustainable Development	05 Hours

Renewable and non-renewable natural resources, Forest, water, mineral, food, land, and energy resources, Resource conservation and management, Sustainable development: concept, objectives, and challenges, Role of technology and computer engineering in sustainability.

Unit III	Environmental Pollution and Control	05 Hours

Air, water, soil, noise, thermal, and radioactive pollution. Sources, effects, and control measures of Pollution, Solid waste management: sources, classification, and disposal, E-waste: generation, impacts, and management, Case studies on environmental pollution.

Unit IV	Climate Change, Biodiversity, and Environmental Issues	05 Hours

Climate change: causes, impacts, and mitigation, Global warming and greenhouse effect, Biodiversity: levels, values, and conservation • Threats to biodiversity • Environmental issues at national and global levels.

Unit V	Environmental Policies, Ethics, and Sustainable Society	06 Hours

Environmental ethics and human values, Environmental laws and policies in India, Environmental Impact Assessment (EIA), Role of individuals, industries, and IT sector in environmental protection, Sustainable lifestyle and green computing conccpts.

Learning Resources

Textbooks

T1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, Univer sities Press.
T2. Benny Joseph, Environmental Studies, Tata McGraw-Hill.

Reference Books

R1. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press.
R2. Anubha Kaushik and C. P. Kaushik, Environmental Studies, New Age International.

Web Resources

1. Ministry of Environment, Forest and Climate Change (MoEFCC): https://moef. gov.in
2. United Nations Environment Programme (UNEP): https://www.unep.org
3. NationalGeographic–Environment: https://www.nationalgeographic.com/ environment

Massive Open Online Courses (MOOCs)

1. NPTEL/SWAYAM:Environmental Studies.
2. Coursera: Introduction to Sustainability
3. edX: Environmental Management and Sustainability.

CO PO Mapping

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	1	3	-	-	-	-	-	-	1
CO2	2	-	-	-	-	2	3	-	-	-	-	-	-	1
CO3	2	2	2	-	-	2	3	-	-	-	-	-	-	2
CO4	2	2	-	2	-	2	3	-	-	-	-	-	-	2
CO5	-	-	-	-	-	3	3	3	1	1	-	-	-	2

International Institute of Information Technology (I²IT) Pune

EXIT PROGRAM

List of Exit Courses after completion of 2nd Year

1. Exit option is available for students those who have earned the total 88 credits at the End of fourth Semester.
2. Student who wants to avail the exit option after second year has to earn additional 8 credits from the list of courses shown below.
3. Student has to complete these courses within summer vacation after 2nd Year.
4. After fulfillment as mentioned in 1 to 3 above, Students can earn UG-Diploma/ Diploma-Engg and same will be issued by the Institute.

Sr. No.	Course code	Name	Credits
1	CE-EXT-S01	Online Swayam or NPTEL Certification Course on C++ Programming. By Prof. Partha Pratim Das, IIT Kharagpur, Programming in Modern C++ - Course	2
2	CE-EXT-S02	Online Swayam or NPTEL Certification Course on Advanced Java Programming. By Prof. Madhavan Mukund, Chennai Mathematical Institute, Programming Concepts using Java - Course	2
3	CE-EXT-S03	Online Swayam or NPTEL Certification Course on Full Stack Development. By Prof. Aamod Sane, Prof. Abhijat Vichare, Prof. Madhavan Mukund | Persistent Computing Institute, Persistent Computing Institute, Chennai Mathematical Institute, Modern Application Development - Course	2
4	CE-EXT-S04	Online Swayam or NPTEL Certification Course on Database Management System. By Prof. Partha Pratim Das & Prof. Samiran Chattopadhyay, IIT Kharagpur, Database Management System - Course	4
5	CE-EXT-S05	Internship at Industry	4

International Institute of Information Technology (I²IT) * Pune *

DEPARTMENT OF COMPUTER ENGINEERING

Honors Course for Data Science & Analytics

Curriculum Structure (w.e.f. Academic Year 2026-27)

Semester - III			Teaching Scheme (Hours/Week)			Credits				Examination / Evaluation Scheme and Marks						
Course Type	Course Code	Course Title	L	T	P	L	T	P	Total	CCE [40]		ESE [60]	TW	PR	OR	Total
										CCE1 [16]	CCE2 [24]					
Honors Course	CE-HNR-S01	Foundations of Data Science	2			2			2	16	24	60				100

Semester - IV			Teaching Scheme (Hours/Week)			Credits				Examination / Evaluation Scheme and Marks						
Course Type	Course Code	Course Title	L	T	P	L	T	P	Total	CCE [40]		ESE [60]	TW	PR	OR	Total
										CCE1 [16]	CCE2 [24]					
Honors Course	CE-HNR-S02	Data Science using Python	3			3			3	16	24	60				100
Honors Course	CE-HNR-S03	Data Science using Python Laboratory			2			1	1				25			25

# **L** = Lecture **P** = Practical **T** = Tutorial
CCE = Comprehensive Continuous Evaluation **ESE** = End Semester Examination **TW** = Term work **PR/OR** = Practical/Oral

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SEMESTER - I

S.Y. B.Tech. Honors Course for Data Science & Analytics Curriculum
With effect from A.Y. 2026-27
Semester – I

Foundations of Data Science (CE-HNR-S01)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02 Hrs/Week	**TH:** 2	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This course introduces the fundamental concepts of Data Science and Big Data Analytics. It focuses on understanding data types, data preprocessing, statistical techniques, and the Big Data analytics lifecycle. The course also provides an overview of predictive analytics, data visualization, and the Hadoop ecosystem, forming a foundation for advanced data analysis using programming tools.

Prerequisites:

- Basic knowledge of Mathematics and Statistics
- Logical and analytical thinking

Course Objectives: The objective of this course is:

1. To understand the fundamentals and importance of Data Science and Big Data
2. To learn basic statistical techniques used in data analysis
3. To study the lifecycle of Data Analytics
4. To understand concepts of predictive analytics and machine learning basics
5. To introduce data visualization techniques and Big Data ecosystem

Course Outcomes: After successful completion of the course, the learner will be able to:

- HNR-CO-SO1.1: Analyze the need and applications of Data Science and Big Data.
- HNR-CO-SO1.2: Apply basic statistical methods for data analysis.
- HNR-CO-SO1.3: Understand and apply the Data Analytics lifecycle.
- HNR-CO-SO1.4: Understand concepts of predictive analytics and machine learning techniques.
- HNR-CO-SO1.5: Understand data visualization techniques and Big Data ecosystem.

Course Contents

Unit I	**Introduction to Data Science and Big Data**	**06 Hours**

Basics and need of Data Science and Big Data, applications in real-world domains, data explosion, 5 V's of Big Data, Data Science vs Business Intelligence, overview of Data Science lifecycle, types of data (structured, semi-structured, unstructured), data collection methods, introduction to data wrangling, data cleaning, basic transformation and discretization.

Unit II	Statistical Inference	06 Hours

Role of statistics in Data Science, measures of central tendency: mean, median, mode, measures of dispersion: range, variance, standard deviation, basics of probability and Bayes theorem, introduction to hypothesis testing, correlation using Pearson method, overview of chi-square test and t-test, interpretation of results

Unit III	Big Data Analytics Life Cycle	06 Hours

Introduction to Big Data and its sources, overview of analytics lifecycle, discovery and data preparation phases, model planning and model building concepts, communication of results, operationalization, simple case study understanding.

Unit IV	Introduction to Predictive Analytics	06 Hours

Types of analytics (descriptive, predictive, prescriptive), introduction to predictive modeling, basics of association rules, overview of regression (linear, logistic), overview of classification methods (naïve Bayes, decision trees), understanding use cases.

Unit V	Visualization and Big Data Ecosystem	06 Hours

Basics and importance of data visualization, challenges and types of visualization, introduction to visualization tools, overview of Hadoop ecosystem, HDFS and MapReduce, introduction to Pig and Hive, role of Hadoop in Big Data.

Learning Resources

Textbooks

T1. David Dietrich, Barry Heller, "Data Science and Big Data Analytics", Wiley Publication
T2. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Elsevier
T3. Shivganga V. Gavhane, Pallavi S. Yevale, Ketaki S. Chinchane, Priyadarshani N. Doke, "Python Programming for Beginners", SIP International Publishers Pvt. Ltd.

Reference Books

R1. EMC Education Services, "Data Science and Big Data Analytics"
R2. DT Editorial Services, "Big Data Black Book"
R3. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press
R4. Wes McKinney, "Python for Data Analysis", O'Reilly Media
R5. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley

Web Resources

1. https://www.kaggle.com

2. https://archive.ics.uci.edu/ml
3. https://hadoop.apache.org
4. https://scikit-learn.org

Massive Open Online Courses (MOOCs)

1. NPTEL – Data Science for Engineers: https://onlinecourses-archive.nptel.ac.in/noc19_cs13/course
2. NPTEL – Big Data Computing: https://onlinecourses-archive.nptel.ac.in/noc19_cs33/course
3. Coursera – Introduction to Data Science: https://www.coursera.org/learn/what-is-datascience
4. edX – Data Science Essentials: https://www.edx.org/learn/data-science

CO PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	3	2	1	-	-	-	-	1	-	-	1	1	-
CO2	1	2	1	2	-	-	-	-	1	-	-	1	1	-
CO3	2	1	2	1	-	-	-	-	1	-	-	1	1	-
CO4	1	2	2	2	1	-	-	-	1	-	-	1	1	-
CO5	1	2	2	1	1	-	-	-	1	-	-	1	1	-

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SEMESTER - II

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Hope Foundation's
INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY (I²IT)
An Autonomous Institute affiliated to Savitribai Phule Pune University
AICTE Permanent ID : 1-448945341 | DTE Code : EN6754 | AISHE Code : C-41681
Accredited by NAAC with "A" Grade in Cycle 2 | NBA Accredited - CE and E&TC (A.Y. 2023-24 to A.Y. 2025-26)

S.Y. B.Tech. Honors Course for Data Science & Analytics Curriculum
With effect from A.Y. 2026-27
Semester – II

Data Science using Python (CE-HNR-S02)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 Hrs/Week	**TH:** 3	**Comprehensive Continuous Evaluation (CCE):** 40 Marks **End Semester:** 60 Marks **Total Marks:** 100 Marks

Course Introduction:

This laboratory course provides hands-on experience in applying Data Science concepts using Python. It focuses on data preprocessing, statistical analysis, machine learning implementation, text analytics, data visualization, and Big Data tools. The course enables students to work on real-world datasets and develop practical analytical solutions.

Prerequisites:

- Programming and Problem solving
- Foundations of Data Science

Course Objectives: The objective of this course is:

1. To implement data analysis and preprocessing techniques using Python
2. To apply machine learning algorithms for real-world problems
3. To perform clustering and text analytics
4. To evaluate and optimize machine learning models
5. To visualize data using Python libraries

Course Outcomes: After successful completion of the course, the learner will be able to:

- HNR-CO-SO2.1:Apply Python libraries for data handling and preprocessing
- HNR-CO-SO2.2: Implement data preprocessing and feature engineering techniques
- HNR-CO-SO2.3: Apply machine learning algorithms for regression and classification
- HNR-CO-SO2.4: Perform clustering and text analytics
- HNR-CO-SO2.5: Evaluate models and visualize data effectively.

Course Contents

Unit I	Python for Data Science	08 Hours

Introduction to Python environment, NumPy arrays and operations, Pandas Series and DataFrames, data loading from files, data inspection using basic functions, indexing and slicing, handling datasets.

Unit II	Data Preprocessing using Python	08 Hours

Handling missing values, removing duplicates, data transformation and normalization, encoding categorical variables, outlier detection and treatment, data consistency checks, basic feature engineering.

Unit III	Machine Learning – Regression and Classification	08 Hours

Linear regression implementation, logistic regression for classification, use of scikit-learn library, dataset splitting, naïve Bayes classifier, decision trees, model training and prediction.

Unit IV	Clustering and Text Analytics	08 Hours

K-means clustering, elbow method, hierarchical clustering, text preprocessing: tokenization, stop words, stemming, lemmatization, feature extraction using bag of words and TF-IDF, basic NLP tasks.

Unit V	Model Evaluation and Visualization	08 Hours

Evaluation metrics, confusion matrix, ROC and AUC, validation methods, parameter tuning basics, visualization using Matplotlib and Seaborn, plots such as line, scatter, histogram and box plot.

Learning Resources

Textbooks:

T1. Python for Data Analysis, Wes McKinney, Publisher: O'Reilly Media
T2. Python Data Science Handbook, Jake VanderPlas, Publisher: O'Reilly Media
T3. Python Programming for Beginners, Shivganga V. Gavhane, Pallavi S. Yevale, Ketaki S. Chinchane, Priyadarshani N. Doke, SIP International Publishers Pvt. Ltd.

Reference Books:

R1. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press
R2. Trent Hauk, "Scikit-learn Cookbook", Packt Publishing
R3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly
R4. Andreas Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly

Web Resources:

1. https://www.kaggle.com
2. https://scikit-learn.org/stable/
3. https://pandas.pydata.org
4. https://numpy.org
5. https://matplotlib.org

Massive Open Online Courses (MOOCs)

1. NPTEL – Python for Data Science: https://onlinecourses.nptel.ac.in/noc23_cs99/preview
2. NPTEL – Machine Learning: https://onlinecourses.nptel.ac.in/noc23_cs85/preview
3. Coursera – Applied Data Science with Python: https://www.coursera.org/specializations/data-science-python
4. edX – Python for Data Science: https://www.edx.org/learn/python

CO PO Mapping

CO\ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
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CO3	2	3	3	2	2	-	-	-	1	-	-	2	2	-
CO4	2	2	2	2	2	-	-	-	1	-	-	2	2	-
CO5	2	2	2	2	3	-	-	-	1	-	-	2	2	-

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S.Y. B.Tech. Honors Course for Data Science & Analytics Curriculum
With effect from A.Y. 2026-27
Semester – II

Data Science using Python Laboratory (CE-HNR-S03)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 Hrs/ Week	**PR:** 1	**Term work:** 25 Marks

Course Introduction:

This laboratory course provides hands-on experience in applying Data Science concepts using Python. It focuses on data preprocessing, statistical analysis, machine learning implementation, text analytics, data visualization, and Big Data tools. The course enables students to work on real-world datasets and develop practical analytical solutions.

Prerequisites:

- Programming and Problem solving
- Foundations of Data Science

Guidelines for Student's Laboratory Journal

- Journal should include Certificate, Table of Contents, and detailed write-up of each assignment
- Each assignment must include Title, Objective, Problem Statement, Theory, Algorithm, Code, Output, and Conclusion
- Proper dataset description and interpretation of results must be included.
- Soft copy of programs should be maintained and submitted.
- Avoid unnecessary printouts; follow Green IT practices.

Guidelines for Laboratory/Term Work Assessment

- Continuous assessment based on performance in assignments.
- Evaluation parameters: timely completion, correctness, coding efficiency, understanding of concepts, and innovation.
- Internal assessment should include practical performance and viva.

Guidelines for Laboratory Conduction

- Instructor should design assignments based on prerequisites and current trends
- Use of open-source tools and datasets is encouraged
- Assignments should cover both basic and advanced levels
- Mini-project should be included to enhance practical understanding.

Guidelines for Practical/Oral Examination

- Problem statements should be jointly set by internal and external examiners
- Evaluation based on implementation, correctness, and understanding
- Students should be able to explain logic, concepts, and outputs
- Viva questions should test conceptual clarity and practical knowledge.

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Course Objectives: The objective of this course is:

1. To apply Data Science concepts using Python on real-world datasets
2. To perform data preprocessing and statistical analysis
3. To implement machine learning and text analytics techniques
4. To visualize data and interpret analytical results
5. To gain hands-on experience with Big Data tools

Course Outcomes: After successful completion of the course, the learner will be able to:

- HNR-CO-S03.1: Apply Data Science principles for real-world data analysis.
- HNR-CO-S03.2: Implement data preprocessing and statistical techniques.
- HNR-CO-S03.3: Apply machine learning algorithms for prediction and classification.
- HNR-CO-S03.4: Perform text analytics and data visualization.
- HNR-CO-S03.5: Use Big Data tools for data processing.

List of Assignments

1. **Data Wrangling I – Dataset Understanding:** Select the **E-commerce Dataset** ((https://www.kaggle.com/datasets/carrie1/ecommerce-data), import required Python libraries, load the dataset into a Pandas DataFrame, display structure and summary, identify missing values and data types, perform basic inspection, and convert categorical variables into numerical form. Document each step.
2. **Data Wrangling II – Data Cleaning and Transformation:** Use the **Students Performance Dataset** (https://www.kaggle.com/datasets/spscientist/students-performance-in-exams), identify missing values and inconsistencies, apply suitable techniques for handling missing data, detect outliers in marks, perform normalization or scaling, and justify preprocessing methods.
3. **Descriptive Statistics and Analysis:** Using the **Medical Cost Personal Dataset** (https://www.kaggle.com/datasets/mirichoi0218/insurance), compute mean, median, variance and standard deviation, perform grouped analysis based on attributes such as gender or smoker status, calculate percentiles, and interpret statistical results.
4. **Correlation and Hypothesis Testing:** Using the **Superstore Sales Dataset** (https://www.kaggle.com/datasets/vivek468/superstore-dataset-final), analyze correlation between sales, profit and discount, visualize correlation matrix, perform hypothesis testing (t-test or chi-square), and interpret significance.
5. **Data Analytics I – Linear Regression:** Build a Linear Regression model in Python or R to estimate house prices using the **Boston Housing dataset** (https://www.kaggle.com/c/boston-housing). This dataset includes 506 observations with 14 different features describing various aspects of homes in Boston. The aim is to develop a model that can accurately predict housing prices based on these input variables.
6. **Data Analytics II – Logistic Regression and Evaluation:** Using the **Loan Prediction Dataset** (https://www.kaggle.com/datasets/altruistdelhite04/loan-prediction-problem-dataset), apply logistic regression to classify loan approval status, compute confusion matrix, calculate accuracy, precision, recall, and interpret model results.
7. **Text Analytics:** Using the **Amazon Product Reviews Dataset** (https://www.kaggle.com/datasets/snap/amazon-fine-food-reviews), perform text preprocessing including tokenization, stop word removal, stemming and lemmatization, generate bag of words and

TF-IDF features, and analyze frequent terms.

8. **Data Visualization:** Using the **Salary Dataset** (https://www.kaggle.com/datasets/abhishek14398/salary-dataset-simple-linear-regression), identify features and types of salary distribution, create histograms and box plots salary distribution, analyze distributions, detect outliers, and summarize findings.
9. Write a code in JAVA for a simple Word Count application that counts the number of occurrences of each word in a given input set using the Hadoop Map-Reduce framework on local-standalone set-up.
10. Mini Project: Design and implement a complete Data Science solution using Python by performing the following steps:
    a. Select an application domain such as:
        - Sentiment analysis of social media data
        - Product or movie recommendation system
        - Retail or sales data analysis
        - Healthcare or COVID-19 data analytics
        - Big Data processing using Hadoop ecosystem
        - Or any other domain

    b. Collect dataset from open-source platforms (e.g., Kaggle).
    c. Perform data preprocessing including cleaning, transformation and handling missing values.
    d. Apply suitable statistical analysis and data visualization techniques.
    e. Implement appropriate machine learning or analytical models.
    f. Evaluate the model using performance metrics such as accuracy, precision, recall, etc.
    g. Visualize results using suitable plots and graphs.
    h. Interpret results and provide meaningful insights for decision making.

Learning Resources

Textbooks:

T1. Python for Data Analysis, Author: Wes McKinney, Publisher: O'Reilly Media
T2. Python Data Science Handbook, Author: Jake VanderPlas, Publisher: O'Reilly Media
T3. Python Programming for Beginners, Authors: Dr. Shivganga V. Gavhane, Pallavi S. Yevale, Ketaki S. Chinchane, Priyadarshani N. Doke, SIP International Publishers Pvt. Ltd.

Reference Books:

R1. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press
R2. Wes McKinney, "Python for Data Analysis", O'Reilly Media
R3. Trent Hauk, "Scikit-learn Cookbook", Packt Publishing
R4. Jake VanderPlas, "Python Data Science Handbook"

Web Resources:

1. https://www.kaggle.com
2. https://scikit-learn.org
3. https://pandas.pydata.org

4. https://numpy.org
5. https://matplotlib.org

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2. NPTEL – Big Data Computing: https://onlinecourses-archive.nptel.ac.in/noc19_cs33/course
3. Coursera – Applied Data Science with Python: https://www.coursera.org/specializations/data-science-python
4. edX – Data Science Essentials: https://www.edx.org/learn/data-science

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