Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology

Vidyanagari, Baramati, Dist. – Pune 413133
An Autonomous Institute Approved by AICTE and affiliated to SPPU,Pune

Department of Computer Engineering

VPKBIET

Curriculum Structure and Syllabus of S. Y. BTech Computer Engineering (Course 2024)

With effective from Academic Year 2025-26

INSTITUTE VISION AND MISSION

VISION

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

MISSION

1. To ensure holistic development of students as lifelong learners and problem solvers through value based quality education.

2. To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards co- creation of knowledge

3. To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.

4. To partner with industry for mutually beneficial relations to generate employable and deployable workforce.

5. To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent.

DEPARTMENT VISION AND MISSION

VISION

To achieve excellence in the field of Computer Engineering with consistent and collaborative efforts of every individual

MISSION

1. To develop students with fundamental advanced tools and technologies to work as skilled Computer professionals with ethical values.

2. To promote faculty for higher education and expose them to current trends to enrich educational quality.

3. To provide appropriate environment with required resources to achieve academic excellence.

4. To develop hand-in-hand relations with industries for catering institute-industry needs.

5. To apply collaborative efforts to make students competent to provide solutions to social problems.

Program Specific Outcomes (PSO)

PSO1: Professional Skills

- The ability to understand, analyse and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying.

PSO2: Problem-Solving Skills

- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: Successful Career and Entrepreneurship

- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Program Educational Objectives (PEO)

1. Students will be able to apply the fundamentals, domain knowledge and modern technology of computer engineering to a provide effective and innovative solutions to engineering problems

2. Students will be able to solve societal challenging and multidisciplinary problems applying suitable resources

3. Students will be able to work as competent professional as an individual and a team member

Program Outcomes (POs)

Learners are expected to know and be able to		
PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies : Computer Engineering

Syllabus: Second Year (S.Y. B. Tech.) Computer Engineering
w.e.f. AY:2025-2026 (2024 Pattern)

SEMESTER-III

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits				
		TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	OR	TUT	Total
CO24201	Discrete Mathematics	3	-	-	10	30	60	-	-	-	100	3	-	-	-	3
CO24202	Data Structures and Algorithms	3	2	-	10	30	60	-	30	-	130	3	1	-	-	4
CO24203	Digital Electronics and Computer Organization	3	2	-	10	30	60	-	-	30	130	3	1	-	-	4
MD240XX	Multi-disciplinary minor	3	2	-	10	30	60	30	-	-	130	3	1	-	-	4
OE240XX	Open Elective	2	-	-	10	-	60	-	-	-	70	2	-	-	-	2
HS24201	Public Speaking and Aptitude	1	2	-	10	-	-	30	-	30	70	1	1	-	-	2
CO24204	Data Analytics and Visualization using Python	1	2	-	10	-	-	30	30	-	70	1	1	-	-	2
Total		16	10	0	70	120	300	90	60	60	700	16	5	0	0	21

SEMESTER-IV

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits				
		TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	OR	TUT	Total
BS24201	Advanced Mathematics for Computer Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	-	3
CO24211	Machine Learning	3	2	-	10	30	60	-	30	-	130	3	1	-	-	4
CO24212	Microprocessor	3	2	-	10	30	60	-	-	30	130	3	1	-	-	4
CO24213	Operating System	3	2	-	10	30	60	-	-	30	130	3	1	-	-	4
MD240XX	Multi-disciplinary minor	2	2	-	10	-	60	30	-	-	100	2	1	-	-	3
CO24214	Community Engineering. Project/Field Project	-	4	-	10	-	-	30	-	30	70	-	2	-	-	2
HS24311	Environmental Studies	2	-	-	10	-	60	-	-	-	70	2	-	-	-	2
Total		16	12	-	70	120	360	60	30	90	730	16	6	-	-	22

TH: Theory PR : Practical TUT : Tutorial CAA : Continuous Activity Assessment , ISE : In Semester Examination , ESE : End Semester Examination TW : Term-Work , OR : Oral

Dept. Autonomy Coordinator
Mr. M. D. Shelar

Academic Coordinator
Dr. P. M. Paithane

Head of Department
Dr. G. J. Chhajed

Dean Autonomy
Dr. C. B. Nayak

Dean Academic
Dr. S. M. Bhosle

Principal
Dr. S. B. Lande

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Vidyanagari, Baramati-413133

Semester I

CO24201: Discrete Mathematics		
Teaching Scheme: TH: 03 Hrs/Week	**Credit: 03**	**Examination Scheme:** CAA: 10 Mark In Semester: 30 Mark End Semester: 60 Mark

Prerequisite: Basic Mathematics

Course Objective:

- To introduce students to understand, explain, and apply the foundational mathematical concepts at the core of computer science.
- To apply appropriate set, function, and relation models to analyze practical examples.
- To acquire skills in logic and proof techniques to enhance mathematical maturity.
- To acquire a comprehensive understanding of set theory, graph theory, and algebraic structures.
- To formulate problems precisely, solve the problems, apply formal proof techniques and explain the reasoning clearly

Course Outcomes:

1. To **Acquire** Knowledge of sets and logics for solving the real world problems
2. To **Recognize** and **Analyze** Relations, Functions, and their Characteristics
3. To **apply** advanced counting techniques such as the Inclusion-Exclusion principle and generating functions to solve complex counting problems and optimize problem-solving strategies.
4. To **explore** the concepts of group theory and their applications for solving the advance technological problems.
5. Illustrate the principles & concepts of graph theory for solving problems related to computer science.
6. Utilize tree structures as a modeling tool for solving algorithmic problems, demonstrating the ability to convert real-world problems into tree representations.

Guideline for Couse Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Mini Projects
2. Industry Visit
3. Seminar
4. Research Paper
5. Group Discussion

Course Contents

Mapping of Course Outcomes for Unit I	CO1

UNIT I	Set Theory and Logics	07 Hours

Introduction and Significance of Discrete Mathematics in Computer Engineering, Application areas in Computer Engineering. **Set Theory**: Introduction to Set, Set Representation, Types of Sets, Power set, Set Operations, Principle of Inclusion and Exclusion. **Logics and Proofs:** Propositions, Conditional Propositions, Truth Tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference. Predicate Logic: First order predicate, well-formed formula of predicate, Universal and Existential Quantifiers, Translating English Statements into Propositions, Mathematical Induction.

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Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Relation & Function**	**07 Hours**

Relation: Definition of Relation, Properties of Binary Relations, Closure of Relations, Warshall"s Algorithm,Equivalence Relations and Equivalence Classes, Partitions, Partial Ordering Relations (POSET), Hasse Diagrams and Lattices, Properties of lattices – Bounded, Complemented, Distributed, Modular and Complete lattice. **Function**: Function Definition, Composition of Functions, Injective, Surjective and Bijective Function, Inverse of a Function, Growth of Functions.

Mapping of Course Outcomes for Unit III	CO3	
UNIT III	**Counting Principles**	**07 Hours**

Introduction to Counting- rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Advanced Counting Techniques: Inclusion-Exclusion principle, Pigeonhole principle. Recurrence Relations: Basics of recurrence relations Solving linear recurrence relations.

Mapping of Course Outcomes for Unit IV	CO4	
UNIT IV	**Group Theory**	**07Hours**

Definition, Basic Properties, Groups, Semi-group & Monoid, Abelian group, Subgroup, Normal subgroup, Groups and Coding, Group Homomorphism's, Rings, Integral Domain and Field. **Case Study:** Application of Group Theory in Computer Engineering.

Mapping of Course Outcomes for Unit V	CO5	
UNIT V	**Graph Theory**	**07 Hours**

Graph : Basic Terminology and Special Types of Graphs, Representation of graphs using adjacency matrix and adjacency list, , Paths and Circuits, Hamiltonian and Euler Paths and Circuits, Isomorphic Graphs, Planer Graph,Single source shortest path- Dijkstra's Algorithm, Graph coloring. **Case Study:** Applications of Graph Theory in Computer Engineering.

Mapping of Course Outcomes for Unit VI	CO6	
UNIT VI	**Trees**	**07 Hours**

Introduction, properties of trees, Rooted Trees, Binary search tree, tree traversal, Prefix Codes, Huffman Algorithm for Optimal Tree, Spanning Trees, Minimum Spanning Trees, Kruskal"s and Prim's Algorithm for Minimum Spanning Tree. **Case Study:** Applications of Trees in Computer Engineering.

Books and Other Resources

Text Books:

1. "C. L. Liu, "Elements of Discrete Mathematics"l, TMH, ISBN 10:0-07-066913-9.
2. "N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications"l, Tata McGraw-Hill, ISBN 978- 0-07-288008-3
4. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4
5. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81- 265-2758-8

E Books & Videos:

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

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4. https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
5. http://home.iitk.ac.in/~arlal/book/mth202.pdf

MOOC/ Video Lectures available at:

1. https://www.nptel.ac.in/courses/106/106/106106094/
2. https://nptel.ac.in/courses/106/106/106106183/
3. https://nptel.ac.in/courses/106/103/106103205/
4. https://nptel.ac.in/courses/106/105/106105192/
5. https://nptel.ac.in/courses/111/106/111106050/
6. https://nptel.ac.in/courses/111/106/111106102/



CO23202: Data Structure & Algorithms		
Teaching Scheme: TH: 03 Hrs/Week PR: 02 Hrs/Week	**Credit: 03**	**Examination Scheme:** CA A: 10 Mark In Semester: 30 Marks End Semester: 60 Marks Practical: 30 Marks

Prerequisite: C, C++ Programming

Course Objective:

1. To study data structures, their implementations and applications
2. To study different searching and sorting techniques
3. To develop a logic for graphical modelling of the real life problems
4. To build the logic to use appropriate data structure in logical and computational solutions
5. To choose the appropriate data structure and algorithm design method for a specified application

Course Outcomes:

1. To design and apply hashing and multi way trees structures in the application development
2. To understand fundamentals of data structures and their applications in various domains
3. To implement searching and sorting algorithms and calculate their complexity
4. To develop applications by using stack and queue
5. To design non-linear data structures and use them in the application development
6. To apply non-linear data structures for solving real time problems in various domain
7. To design and apply advanced data structures in the application development

Course Activity :

For the assessment of course activity must complete at least one activities out of following

1. Course mini project design using java
2. Implementation of Data Structure assignments using java

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Introduction**	**06 Hours**

Introduction to Data Structures -: Concept of data, Data object, Data structure, Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures, Definition of ADT. **Analysis of algorithm:** Frequency count and its importance in analysis of an algorithm, Time Complexity & Space complexity of an algorithm Big 'O', 'Ω' and 'Θ' notations. **Sequential Organization:** Single and multidimensional array and address calculation

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Searching and Sorting**	**06 Hours**

Searching and sorting: Need of searching and sorting, Concept of internal and external sorting, sort Stability, Searching methods: Linear and binary search algorithms, Fibonacci Search.
Sorting methods: Bubble sort, selection sort, insertion sort, Quick sort, Merge sort, shell sort, Bucket sort and comparison of all sorting methods

Mapping of Course Outcomes for Unit III	CO3	
UNIT III	**Stack &Queue**	**08 Hours**

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Stack: Concept of stack, stack as an ADT using sequential and linked organization, Applications of stack: recursion, converting expressions from infix to postfix or prefix form, evaluating postfix or prefix form

Queue: Concept of queues as ADT, Implementation of queue using array and linked organization, Concept of circular queue, double ended queue, priority queue, Applications of queue.

Mapping of Course Outcomes for Unit IV	CO4

UNIT IV	Linked List	08 Hours

Types of linked list- Linear and circular linked lists, Doubly Linked List and operations, Circular Linked List, singly circular linked list, doubly circular linked list, Polynomial Manipulations - Polynomial addition, Multiplication of two polynomials using linked list. Generalized Linked List (GLL)

Mapping of Course Outcomes for Unit V	CO5

UNIT V	Tree and Graph	08 Hours

Tree: Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, Binary search tree, Recursive and Non recursive algorithms for binary tree traversals, Binary search tree as ADT (Insert Search Delete, level wise Display), Concept of threaded binary tree. **Height Balanced Tree:** AVL tree, Trie Tree, Splay Tree, Red-Black Tree

Graph : Concept and terminologies, Graph as an ADT, Representation of graphs using adjacency matrix and adjacency list, Breadth First Search traversal, Depth First Search traversal, Prim's and Kruskal' algorithms for minimum spanning tree, Shortest path using Dijkstra's algorithm.

Mapping of Course Outcomes for Unit VI	CO6

UNIT VI	Hashing and Multiway trees	06 Hours

Hash Table: Hash Table- Concepts-hash table, hash function, bucket, collision, overflow, open hashing, closed hashing, perfect hash function, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining without replacement, open addressing and chaining with replacement. **Multiway Trees:** B-Tree, B+ Tree.

Books and Other Resources

Text Books:

1. "Fundamentals of Data Structures in C", E. Horowitz, S. Sahni, S. Anderson-freed, Second Edition, 2008, University Press, ISBN 978-81-7371-605-8

2. "The C Programming Language", B. Kernighan, D. Ritchie, Second Edition, 2015, Pearson Education India; ISBN 81-203-0596-5

Reference Books:

1. "Data Structures using C", Y. Langsam, M. Augenstin and A. Tannenbaum, First Edition, 2002, Pearson Education Asia, ISBN 978-81-317-0229-1
   "Computer organization" , Hamacher and Zaky, Fifth Edition
2. "Fundamentals of Data Structures in C++", Ellis Horowitz, S. Sahni, D. Mehta, 2nd Edition, 2008, University Press, ISBN-10: 8173716064
3. "An introduction to data structures with Applications", Jean-Paul Tremblay, Paul. G. Soresan, 2nd

Edition, 1984, Tata Mc-Graw Hill International Editions, ISBN-0-07-462471-7

Guidelines for Practical Examination:
Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student 's understanding of the fundamentals, effective and efficient implementation.

Guidelines for Laboratory Conduction:
Assignments should be implemented in C++/JAVA programming language. Use of open source software is encouraged. Based on the concepts learned. Operating System recommended: - 64-bit Open source Linux or its derivative Programming Programming tools recommended: Open source programming tool like G++/GCC, Jupyter Notebook, Pycharm, Spyder etc.

Guidelines for Term Work Assessment:
Term work assessment will be based on overall performance of Laboratory assignments performed by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Practical Assignments

1. Implement a program to store marks of N students in Fundamental of Data Structures and calculate: avg. score of the class, highest and lowest score, count absent students, display marks with highest frequency

2. Implementation of following matrix operations: addition of two matrices, subtraction of two matrices, multiplication of two matrices, transpose of a matrix

3. Implement a program to store roll numbers of student in array who attended training program in random order. Write function for- a) Searching whether particular student attended training program or not using linear search b) Searching whether particular student attended training program or not using binary search

4. Implement a program to store percentage of students using an array. Write function for sorting array of in ascending order using a) Selection Sort b) Bubble sort

5. Implement a program for expression conversion as infix to postfix

6. Implement a program for postfix/prefix expression evaluation

7. Implement a program to simulate the system using circular queue using array.

8. Implement a program for manipulation of a singly link list(insert at front, insert at middle , Insert at end, delete at front, delete at middle delete at end,display,reverse)

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9. Starting with an Empty Binary Search Tree(BST),create a BST by reading the values in the given
   i. Order and perform following operations on it: 1. Insert a new node 2. Perform Inorder, Preorder
   ii. And Postorder Traversals 3. Search 4. Delete 5. Height 6. Mirror Image 7. Find Smallest and
   iii. Largest Element

10. Implement a program to represent a graph using adjacency matrix and adjacency list, compute DFS and BFS of the same



CO24203: Digital Electronics and Computer Organization

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week	TH Credit :03	CAA: 10 Mark
PR: 02 Hrs/Week	PR Credit : 01	In-Semester : 30 Mark
		End-Semester: 60 Mark
		Oral : 30 Mark

Prerequisite:

Basis Electronics Engineering

Course Objective:

- To understand the Boolean Logic and its simplification
- To learn the implementation of basic combinational and sequential circuits
- To understand the fundamentals of Computer Organization
- To understand the Processor and Instructions
- To learn the basics of memory system in Computer

Course Outcomes:

1. Perform basic binary arithmetic & simplify logic expressions.
2. Implementation of Combinational Logic Functions
3. Use of Flip-flop for implementation of Counters and Registers
4. Understand the organization of Computer and its structure
5. Perform Computer Arithmetic and production of microinstructions
6. Describe an assortment of memory types and I/O devices

Guideline for Couse Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Mini Projects
2. Industry Visit
3. Seminar
4. Research Paper
5. Group Discussion

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Number System, Logic Gate and Boolean Algebra**	**08 Hours**

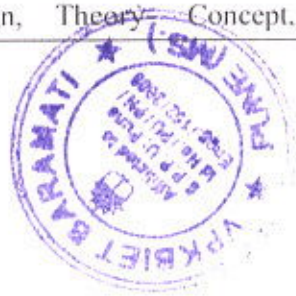
Number system: Number Conversion, Representation of Binary Numbers: Sign Magnitude, 1's complement, 2's Complement, Binary Codes. **Logic Gates**: Positive and Negative Logic, Truth table, Logic Gates **Boolean Algebra**: Theorems, Simplification Techniques: Sum of Product, Product of Sum, K-Map, Quine–McCluskey Tabular Method

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Combinational Circuits**	**06 Hours**

Introduction, Clock Signal, Combinational Circuit Implementation: Half Adder-Subtractor, Full Adder-

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Subtractor, BCD Adder, Parity Generator and Checker, Comparator, Multiplexures and Demultiplexures		
Mapping of Course Outcomes for Unit III	**CO3**	
UNIT III	**Sequential Circuits**	**06 Hours**
Introduction to Flip-Flop, Types of Flip-Flop, Flip-Flop Conversion: JK to SR, JK to D, JK to T, SR to JK. **Registers**: Types, Shift Registers Counters: Synchronous and Asynchronous		
Mapping of Course Outcomes for Unit IV	**CO4**	
UNIT IV	**Basic Structure of Computer and Computer Arithmetic**	**08 Hours**
Von Neumann Architecture, Functional units of Computer, Basic Operational Concept – Address, Data, Control Bus structure, Memory location and Address, Memory operations **Arithmetic**: Addition and Subtraction of Signed Numbers, Design of Fast Adder, Multiplication of Unsigned Numbers, Multiplication of signed Numbers -- Booth Multiplication, Integer Division, Floating-Point Numbers and Operations.		
Mapping of Course Outcomes for Unit V	**CO5**	
UNIT V	**Control Processing Unit**	**08 Hours**
Processor: Registers and Its types **Instructions**: Elements, Format and representation Addressing modes **Basic Processing Unit**: Execution of a Complete Instruction, Hardware Components, Instruction cycle, Instruction Pipelining, Pipelining Hazards, Control Signals, Hardwired Control and Micro-program Control, **Single Bus Organization and Micro Instructions**		
Mapping of Course Outcomes for Unit VI	**CO6**	
UNIT VI	**Memory and I/O System**	**08 Hours**
Memory Systems: Characteristics of Memory Systems, Memory Hierarchy, Memory read & write cycle, Semiconductor RAM Memories, Read-only Memories **Cache Memory** – Principle of Locality, Organization, Mapping functions, write policies, Replacement policies, Multilevel Caches, Cache Coherence **Input / Output Systems**: Accessing I/O devices, I/O Module-Programmed I/O, Interrupt Driven I/O, Direct Memory Access (DMA).		
Books and Other Resources		
Text Books: 1. "Modern Digital Electronics", R.P. Jain, Tata McGraw-Hill, Third Edition 2. "Computer organization and architecture, designing for performance" by William Stallings , Prentice Hall ,Eighth edition **Reference Books:** 1. "Digital Design", M Morris Mano, Prentice Hall, Third Edition 2. "Computer organization" , Hamacher and Zaky, Fifth Edition		
Guidelines for Students Journal : The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration,		



conclusion/analysis). 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.

Guidelines for Laboratory /TW Assessment :

- Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of student.
- Each Laboratory assignment assessment should assign 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, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

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

Practical Assignments

1. Design and Implement Full Adder using IC74138
2. Design and implement Code Converters-Binary to Gray.
3. Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4. Design & Implement Parity Generator and checker using EX-OR.
5. Design of Synchronous 3 bit Up and Down Counter using MSJK Flip Flop / D Flip Flop
6. Design and Realization: Flip Flop conversion
7. Write a C++/Python/Java Program to implement booth algorithm.
8. Case Study: Single Bus Organization and Microinstructions



HS24201: Public Speaking and Aptitude

Teaching Scheme		Credit: 02	Examination Scheme	
TH	01 Hrs/Week		CAA	:10 Marks
PR	02 Hrs/Week	TH Credit :01 PR Credit: 01	Termwork	:30 Marks
			Oral	:30 Marks

Course Objectives:

1. To develop fluency in spoken English by improving vocabulary, pronunciation, intonation, and conversational skills for effective communication.
2. To enhance presentation skills by focusing on body language, voice modulation, strategic pauses, and empathetic communication for impactful public speaking.
3. To strengthen quantitative aptitude through problem-solving techniques in data interpretation, numerical computation, and statistics.
4. To develop logical and spatial reasoning skills for better analytical thinking and problem-solving in competitive exams.

Course Outcomes:

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

1. Communicate effectively in various spoken interactions, including telephone conversations and discussions.
2. Deliver structured and engaging presentations with appropriate body language, voice modulation, and confident speech techniques.
3. Solve quantitative problems efficiently using data interpretation, numerical computation, and statistical analysis techniques.
4. Apply logical reasoning and spatial aptitude skills to analyze complex problems.

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Spoken English**	**04 Hours**

Pre-Assessment, Vocabulary made easy, the Power of Words, Introduction to Word Accent, Introduction to Rhythm: Intonation, Rising Intonation, Falling Intonation, Introduction & Specific scenarios: Telephone Skills: Taking & Making Calls, Voice, Intonation, and Language, Conversations: The Role of Questions

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Impactful Presentations**	**07 Hours**

Voice Modulation: Voice Projection, replacing Fillers, and Emphasis Power of Pause: Pause to engage audience in Conversation, Combine Pause & Repetition Techniques, Demonstrate Confidence & Control, establish Presence Empathy: Essential Human Quality, Practice Heartful Communication, Impact of Communication, How to deliver memorable speech.

Mapping of Course Outcomes for Unit III	CO3	
UNIT III	**General Aptitude for all Competitive Exams**	**07 Hours**

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Quantitative Aptitude :Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.

Analytical Aptitude Logic: deduction and induction, Analogy, Numerical relations and reasoning

Spatial Aptitude Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping paper folding, cutting, and patterns in 2 and 3 dimensions

Books and Other Resources

Text Books:

1. "A Course in Phonetics and Spoken English" – T. Balasubramanian
2. "Effective Technical Communication" – M. Ashraf Rizvi
3. "Quantitative Aptitude for Competitive Examinations" – R.S. Aggarwal

Reference Books:

1. "High School English Grammar & Composition" – Wren & Martin
2. "How to Speak, How to Listen" – Mortimer J. Adler
3. "Logical and Analytical Reasoning" – A.K. Gupta

NPTEL Course:

- Mastering Speaking and Presentations: A case Based Approach by Prof. Seema Singh, IIT Kharagpur **https://onlinecourses.nptel.ac.in/noc25_hs96/preview**

Practicals

- Session 1: Vocabulary & Word Accent Mastery Pre-Assessment: Conduct a quick spoken test to evaluate pronunciation and fluency. Vocabulary exercises using flashcards & interactive word-building games.
- Session 2: Intonation & Rhythm in Speech Introduction to rising and falling intonation with examples. Role play exercises for practicing intonation in different scenarios (expressing surprise, asking questions, etc.). Rhythm practice: Reading passages with proper pauses and stress patterns.
- Session 3: Telephone Skills & Professional Conversations Practicing making and taking calls with simulated dialogues. Focus on voice modulation, clarity, and polite expressions.
- Session 4: Body Language & Stage Presence Mirror exercises to improve facial expressions and gestures. Practicing posture, movement, and eye contact while speaking.
- Session 5: Voice Modulation & Power of Pause Exercises on voice projection and eliminating fillers. Practicing pauses strategically to enhance speech impact. Repetition and emphasis techniques using speech excerpts.
- Session 6: Empathy & Heartfelt Communication Interactive storytelling to practice emotional connection. Exercises on active listening and empathetic responses. Speech practice: delivering a short talk with an emotional appeal.
- Session 7: Quantitative Aptitude – Data Interpretation & Computation Solving numerical problems based on bar graphs, pie charts, and tables. Quick estimation exercises using ratios, percentages, and logarithms. Group challenges on permutations and combinations.
- Session 8: Analytical Aptitude – Logical & Numerical Reasoning Deduction and induction puzzles. Solving analogy-based reasoning questions. Speed tests for numerical relations and reasoning.

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- Session 09: Spatial Aptitude – Shape & Pattern Recognition Hands-on paper folding and cutting exercises.
- Visualization tasks for rotation, scaling, and mirroring of shapes. Solving pattern-based problems in 2D and 3D space.
- Session 10 : Mock test from online test series of companies like TCS, Infosys employability tests like CoCubes, AMCAT etc.

Dr. A. B. Patil
Course Coordinator

Prof R. K. Shastri
BOS Chairman HSS

Dr. C. B. Nayak
Dean Autonomy

Dr. S. M. Bhosle
Dean Academic

Dr. S. B. Lande
Principal

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Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

CO24204 : Data Analytics and Visualization using Python

Teaching Scheme:	Credit: 02	Examination Scheme:
TH: 01 Hrs/Week	TH Credit :01	CAA: 10 Mark
PR: 02 Hrs/Week	PR Credit :01	Term Work : 30 Mark
		Practical: 30 Mark

Prerequisite: Students are expected to have a good understanding of Programming and Problem Solving(PPS) Python Programming.

Course Objective:

- To understand principles of Data Analytics and Visualization for the analysis of real time problems
- To develop in depth understanding and implementation of the key technologies in Data Science and data analytics to understand the Processor and Instructions
- To develop ability to analyze and demonstrate knowledge of statistical data analysis techniques for decision-making
- To gain practical, hands-on experience with statistics programming languages.

Course Outcomes:

1. Understand and apply basic Python programming concepts for data handling and analysis
2. Perform exploratory data analysis (EDA) and visualize data using Matplotlib and Seaborn.
3. Interpret data insights from visualizations and summarize data effectively.
4. Apply principles of Data Science for the analysis of real time problems

Course Activity :

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Data Analytics Mini Project
2. Collection of Dataset on different domains and analyze that data.
3. Industry Visit
4. Seminar
5. Research Paper in data analytics and visualization domain

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Introduction to Data Analysis and Basics of Python**	**04 Hours**

Introduction to Data Analytics : Data Analytics, Importance and Real-life Applications, Types of Data: Structured vs. Unstructured, **Python Basics for Data Handling** :Data Types (Numbers, Strings, Lists, Tuples, Dictionaries),Conditional Statements and Loops, Functions and Modules in Python, **Data Handling with Pandas** :Introduction to Pandas, Creating and Manipulating DataFrames, Reading and Writing CSV Files.

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Exploratory Data Analysis (EDA) & Basic Visualization**	**04 Hours**

Understanding Data : Data Cleaning (Handling Missing Values), Removing Duplicates, Basic Summary Statistics (Mean, Median, Mode), Outliers, Data Normalization , Data Transformation , **Basic Data Visualization with Matplotlib** :Line Plot, Bar Chart, Histogram, **Basic Data Visualization with Seaborn** : Scatter Plot, Box Plot, Pair Plot.

Mapping of Course Outcomes for Unit III	CO3



UNIT III	Data Interpretation & Simple Plotting	04 Hours

Interpreting Data from Plots :Identifying Trends and Patterns, Understanding Data Distributions, Comparing Data using Graphs, **Plot Customization in Matplotlib** :Adding Titles and Labels, Adjusting Colors and Styles, Displaying Multiple Plots, **Simple Data Aggregation**: Grouping Data with Pandas, Calculating Averages and Totals, Sorting and Filtering Data.

Books and Other Resources

Text Books:

- "Python for Data Analysis" – *Wes McKinney*
- "Matplotlib and Seaborn for Data Visualization" – *Allen Yu, Claire Chung*

Reference Books:

- "Data Science from Scratch" – *Joel Grus*
- "Python Data Science Handbook" – *Jake VanderPlas*
- "Think Stats: Exploratory Data Analysis in Python" – *Allen B. Downey*
- Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press,(2020), ISBN : ISBN 978-1-108-47244-9. 2. Wes McKinney,
- "Python for Data Analysis", O' Reilly media, ISBN : 978-1-449-31979-3. 3. "Scikit-learn Cookbook", Trent hauk,Packt Publishing, ISBN: 9781787286382 4. R Kent Dybvig,
- "The Scheme Programming Language", MIT Press, ISBN 978-0-262-51298-5. 5. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", OReilly Media, Inc.

Guidelines for Term Work Assessment :

Term work assessment will be based on overall performance of Laboratory assignments performed by a students. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Practical Examination :

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation..

Guidelines for Laboratory Conduction :

Use of open source software is encouraged. Based on the concepts learned.
Operating System recommended: - 64-bit Open source Linux or its derivative Programming, Windows.
Tools recommended: - Latest version of Python, Anaconda (Jupyter Notebook), Visual Studio, PyCharm.

Practical Assignments

1. Data Wrangling I
   Perform the following operations using Python on any open source dataset (e.g., data.csv)
   - Import all the required Python Libraries.
   - Locate an open source data from the web (e.g., https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site).
   - Load the Dataset into pandas dataframe.
   - Data Preprocessing: check for missing values in the data using pandas isnull(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc.Check the dimensions of the data frame.

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- Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions.
- Turn categorical variables into quantitative variables in Python.

2. Data Wrangling II

Create an "Academic performance" dataset of students and perform the following operations using Python.

- Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them.
- Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them.

3. Data Wrangling III

Perform the following statistic operations on any open source dataset (e.g., data.csv)

- Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. For example, if your categorical variable is age groups and quantitative variable is income, then provide summary statistics of income grouped by the age groups. Create a list that contains a numeric value for each response to the categorical variable.
- Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of 'Iris-setosa', 'Iris-versicolor' and 'Iris-versicolor'of iris.csv dataset. Provide the codes with outputs and explain everything that you do in this step.

Use dataset https://www.kaggle.com/c/boston-housing for 4-6 assignments

4. Write a Python program to demonstrate how to draw a Bar Plot using Matplotlib/Seaborn and analyze the data patterns if any.

5. Write a Python program to demonstrate how to draw a Scatter Plot using Matplotlib/Seaboarn and analyze the data patterns if any.

6. Write a Python program to demonstrate how to draw a Histogram Plot using Matplotlib/Seaboarn and analyze the data patterns if any.

7. Write a Python program to demonstrate how to draw a Pie Chart using Matplotlib/Seaboarn Using iris.csv dataset and analyze the data patterns if any.

8. Use the dataset 'titanic',
   1. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names : 'sex' and 'age')
   2. Write observations on the inference from the above statistics.



Semester II

GS24201: Advanced Mathematics for Computer Engineering		
Teaching Scheme: Theory : 3 Hours/Week	**Credit: 03**	**Examination Scheme:** CAA: 10 Mark In-Semester : 30 Marks End-Semester : 60 Marks

Prerequisite: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification & Representation of data.

Course Objective:

To provide the students with concepts and techniques in Linear differential equations, Fourier transform, Statistical methods, and Probability theory. The aim is to equip them with the techniques to understand advanced-level mathematics and its applications that would be useful in their discipline and enhance their thinking power.

Course Outcomes:

1. Solve higher-order linear differential equations using appropriate techniques useful for modeling in their field.
2. Understand the concepts of Fourier transform
3. Understand and apply the various concepts of statistical methods of correlation, and regression and Apply them in their field.
4. Apply the concepts of appropriate Probability and Probability distribution for data analysis and predictions in multiple data sets.
5. Solve Algebraic, Transcendental equations and System of linear equations using numerical techniques.
6. Compute Interpolating polynomials, numerical differentiation, and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Linear Differential Equations (LDE) and Applications**	**07 Hours**

Introduction, Solution of LDE, General method, short-cut method, Method of variation of parameters, Cauchy's, Legendre's DE, Simultaneous DE.

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Fourier Transform and Statistics**	**07 Hours**

Fourier Transform: General Fourier, Fourier Sine, Cosine, and inverse transforms.

Statistics: Measures of dispersion, Moments, Skewness and Kurtosis, Correlation and Regression analysis.

Mapping of Course Outcomes for Unit III	CO3	
UNIT III	**Regression Models**	**07 Hours**

Importance of Regression in Data Mining, Simple Linear Regression, Model: $Y = \beta0 + \beta1X + \varepsilon$ Assumptions. Estimation of $\beta0$ and $\beta1$ by the method of least squares, Multiple linear regression model $Y = \beta0 + \beta1X1 + ... + \beta pXp + \varepsilon$, residuals, Least-Squares Estimation of the Regression Coefficients, obtaining normal equations, Solutions of normal equations, Generalized linear models, and applications.

Mapping of Course Outcomes for Unit IV	CO4

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UNIT IV	Probability and Probability Distributions	07Hours

Theorems on probability, Random variables, Probability Mass function, Probability Density function, Mathematical Expectation. Binomial, Poisson, and Normal distribution and applications.

Mapping of Course Outcomes for Unit V	CO5

UNIT V	Numerical Methods	07 Hours

Numerical Solution of Algebraic and Transcendental Equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods.

Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods

Mapping of Course Outcomes for Unit VI	CO6

UNIT VI	Numerical Methods	07 Hours

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formula, Numerical Differentiation.

Numerical Integration: Trapezoidal and Simpson's rules.

Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order.

Books and Other Resources

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

E Books & Videos:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10ed, Wiley India
2. M. D. Greenberg, "Advanced Engineering Mathematics", 2nd e Pearson Education
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7ed, Cengage Learning
4. S. L. Ross, "Differential Equations", 3e, Wiley India
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press
6. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, "Numerical Methods for Scientific and Engineering Computation", 5e, (New Age International Publication).
7. Draper, N. R. and Smith, H. "Applied Regression analysis", (1998) (John Wiley) Third Edition.
8. S.P. Gupta, Sultan Chand and Sons, "Statistical Methods", New Delhi, 2009.

Guidelines for Term Work Assessment :

1. Tutorials for the subject shall be engaged in a minimum of three batches (batch size of 22 students) per division.
2. Term work shall consist of six assignments on each unit and is based on performance and continuous internal assessment.

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CO24211 : Machine Learning

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week	TH Credit :03	CAA : 10 Mark
PR: 02 Hrs/Week	PR Credit :01	In Semester: 30 Mark
		End Semester: 60 Mark
		Practical: 30 Mark

Prerequisite: Programming and Problem Solving (CO23101)
Data Analytics and Visualization Lab (CO23205)

Course Objective:

- To understand the need for Machine learning
- To understand computational statistics in Data Science
- To study and understand regression and classification methods
- To understand the need for multi-class classifiers.
- To learn the working of clustering algorithms
- To learn fundamental neural network algorithms.

Course Outcomes:

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

1. Understand the fundamentals of machine learning and data science.
2. Apply data preprocessing and feature selection techniques.
3. Apply regression techniques and evaluation metrics to build and optimize predictive models.
4. Apply classification algorithms and evaluation metrics to develop and assess predictive models.
5. Apply clustering techniques and association rule mining to analyze patterns and relationships in data.
6. Design a neural network for solving engineering problems.

Course Activity:

The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

6. Mini Project based on Machine learning
7. Quiz
8. Industry Visit
9. Seminar
10. Research paper

Course Contents

Mapping of Course Outcomes for Unit I		CO1
UNIT I	**Introduction Machine Learning**	**07 Hours**

Introduction to Machine learning and data science, Life cycle of machine learning, ML vs AI vs Data Science. Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, **Types of Data** in statistics and machine learning, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models. Important Elements of Machine Learning: Data formats, Learnability

Mapping of Course Outcomes for Unit II		CO2
UNIT II	**Feature Engineering and Statistical Measures**	**07 Hours**

Concept of Feature, preprocessing of data: Normalization and Scaling, Standardization, Managing missing values, Statistical Measures: Measures of Central Tendency: length, count-based, Mean, Median, Mode, Mid-range, Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA), Feature Extraction: Kernel PCA, Local Binary Pattern. Introduction to various Feature Selection Techniques: Sequential Forward Selection, Sequential Backward Selection, Basics and need of hypothesis and hypothesis testing.

Mapping of Course Outcomes for Unit III	**CO3**

UNIT III	**Supervised Regression**	**07 Hours**

Introduction to Regression, Regression Assumptions and Conditions, Bias, Variance, Trade-off, Generalization, Under fitting, Over fitting, Linear Regression, Regularization Techniques : Ridge and Lasso Regression, Logistic Regression, Evaluation Metrics for Regression Models: MSE, RMSE, MAE, R^2 Score, Gradient Descent in Regression, Regression with Categorical Variables (One-Hot Encoding, Dummy Variables), Implementation Using Python.

Mapping of Course Outcomes for Unit IV	**CO4**

UNIT IV	**Supervised Classification**	**07 Hours**

Introduction classification, K-nearest neighbor, Naïve Bayes, Support vector machine, Decision Tree, Random Forest, Ensemble Learning: Bagging, Boosting : XGBoost, Adaboost and Stacking, Binary-vs-Multiclass Classification, Balanced and Imbalanced Multiclass Classification Problems, Variants of Multiclass Classification: One-vs-One and One-vs-All, Evaluation Metrics and Score: Confusion Matrix, Accuracy, Precision, Recall, F1-score, Cross-validation.

Mapping of Course Outcomes for Unit V	**CO5**

UNIT V	**Unsupervised Learning**	**07 Hours**

Introduction, **Clustering** : K-Means, K-medoids, Hierarchical, and Density-based Clustering, Spectral Clustering, **Association Rules**: Apriori Algorithm, FP growth, Evaluation metrics and score: elbow method, extrinsic and intrinsic methods.

Mapping of Course Outcomes for Unit VI	**CO6**

UNIT VI	**Introduction To Neural Networks**	**07 Hours**

Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Functional Link Artificial Neural Network, and Radial Basis Function Network, Activation functions, Introduction to Recurrent Neural Networks and Convolutional Neural Networks.

Books and Other Resources

Text Books:

1. Bishop, Christopher M., and Nasser M. Nasrabadi, —Pattern recognition and machine learning,Vol. 4.No. 4. New York: springer, 2006.
2. Ethem Alpaydin, — Introduction to Machine Learningǁ, PHI 2nd Edition-2013

Reference Books:

1. David Dietrich, Barry Hiller, Data Science and Big Data Analytics, EMC education services, Wiley publication, 2012, ISBN0-07-120413-X
2. Tom Mitchell, — Machine learningl, McGraw-Hill series in Computer Science, 1997
3. Shalev-Shwartz, Shai, and Shai Ben-David, —Understanding machine learning: From theory to

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algorithms, Cambridge university press, 2014.

4. Jiawei Han, Micheline Kamber, and Jian Pie, —Data Mining: Concepts and Techniquesl, Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
5. Hastie, Trevor, et al., —The elements of statistical learning: data mining, inference, and prediction, Vol. 2. New York: springer, 2009.
6. McKinney, —Python for Data Analysis —,O' Reilly media, ISBN : 978-1-449-31979-3
7. Trent hauk, —Scikit-learnl, Cookbook, Packt Publishing, ISBN: 9781787286382
8. Goodfellow I.,Bengio Y. and Courville, — A Deep Learningl, MIT Press, 2016

e-Books :

1. Python Machine Learning : http://www.ru.ac.bd/wpcontent/uploads/sites/25/2019/03/207_05_01_Rajchka_Using-Python-for-machinelearning-2015.pdf
2. Foundation of Machine Learning: https://cs.nyu.edu/~mohri/mlbook/
3. Dive into Deep Learning: http://d2l.ai/
4. A brief introduction to machine learning for Engineers: https://arxiv.org/pdf/1709.02840.pdf
5. Feature selection: https://dl.acm.org/doi/pdf/10.5555/944919.944968
6. Introductory Machine Learning Nodes : http://lcsl.mit.edu/courses/ml/1718/MLNotes.pdf

MOOC Courses Links:

1. Introduction to Machine Learning : https://nptel.ac.in/courses/106105152
2. Introduction to Machine Learning (IIT Madras): https://onlinecourses.nptel.ac.in/noc22_cs29/prevew
3. Deep learning: https://nptel.ac.in/courses/106106184

Guidelines for Term Work Assessment:

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

Guidelines for Practical Examination:

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student 's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence 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 student's academics.

Guidelines for Laboratory Conduction:

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source

software is encouraged. Based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to each branch beyond the scope of the syllabus.
Operating System recommended:- 64-bit Open source Linux or its derivative
Programming tools recommended: - C++, Java, Python, Solidity, etc.

Practical Assignments

1. Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks:
   1. Pre-process the dataset.
   2. Identify outliers.
   3. Check the correlation.
   4. Implement linear regression and random forest regression models.
   5. Evaluate the models and compare their respective scores like R2, RMSE, etc.

   Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset
2. Classify the email using the binary classification method.
   Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam.
   Use K-Nearest Neighbors, Support Vector Machine and Logistic Regression for classification. Analyze their performance and compare the performance.
   Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv
3. Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset.
   Dataset link : https://www.kaggle.com/datasets/abdallamahgoub/diabetes
4. Use ensemble learning to predict whether a customer will default on a loan based on financial history and demographic data. Compare Bagging, Boosting, and Stacking techniques.
   Use following dataset link :- https://www.kaggle.com/datasets/nikhil1e9/loan-default?resource=download
5. Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method.
   Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data
6. Implement machine learning model to predict future stock price returns based on Indian Market data from 2000 to 2020 using dataset to analyze ups and downs in the market
   Dataset Link: https://www.kaggle.com/datasets/sagara9595/stock-data
7. Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.). Dataset Link: https://www.kaggle.com/competitions/titanic/data
8. Develop application for signature identification by creating your own dataset of your college student

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CO24212: Microprocessor		
Teaching Scheme: TH: 03 Hrs/Week PR: 02 Hrs/Week	**Credit: 04** TH Credit :03 PR Credit : 01	**Examination Scheme:** CAA :10 Marks In Semester :30 Marks End Semester :60 Marks Oral :30 Marks

Prerequisite:
Digital Electronics and Logic Design

Course Objectives:
The course is intended to provide practical exposure to the students on microprocessors, design and coding knowledge on 8086 and 80836 and introduction to microcontrollers.

- To learn and distinguish the architecture and programmer's model of advanced processor.
- To acquire the logic to build assembly language programs.
- To identify the memory management features and processes of advanced processors.
- To study processor modes and protection methods.
- To demonstrate the use of virtual mode.
- To differentiate Microprocessor and microcontroller.

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

1. **Exhibit** skill of assembly language programming for the application.
2. **Classify** Processor architectures and bus cycles.
3. **Illustrate** advanced features of 80386 Microprocessor.
4. **Compare** and **contrast** different processor modes and protection methods.
5. **Use** virtual mode mechanism in applications.
6. **Differentiate** between Microprocessors and Microcontrollers.

Guideline for Couse Activity:
The course coordinator should identify relative and innovative activities for course activity. Below are some suggested course activity for course coordinator

1. Active participation in Hackthon related to Microprocessor Assembly Language
2. Survey on uses of Microprocessor with emerging technology
3. Industry Visit
4. Seminar
5. Research Paper
6. Intellectual Property Rights

Mapping of Course Outcomes for Unit I		CO1
UNIT I	**Introduction to Microprocessor and Assembly Language**	**08 Hours**

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Introduction: Brief History of Intel Processors, Basics of 8086, Need of microprocessors, Applications of microprocessor, Addressing modes and data types.

Instruction Set: 80386 Instruction Set, types of instructions of 80386

Introduction to assembly language programming- Basic Arithmetic and Loop Instructions, Basic Syntax, Procedures and Parameters, Macro, String Representations and Array Representations and Processing.

Mapping of Course Outcomes for Unit II	CO1, CO2

UNIT II	System Architecture	08 Hours

Systems Architecture- 80386 Architecture, Programmers Model, Operating modes, Systems Registers (Systems flags, Memory Management registers, Control registers, Debug registers, Test registers), System Instructions. Functional pin Diagram, functionality of various pins, I/O Organization, Memory Organization (Memory banks), Basic memory read and writes cycles with timing diagram, Processor State after Reset.

Mapping of Course Outcomes for Unit III	CO3

UNIT III	Memory Management	06Hours

Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, GDTR, LDTR, IDTR. Formats of Descriptors and Selector, Segment Translation, Page Translation, Combining Segment and Page Translation.

Mapping of Course Outcomes for Unit IV	CO4

UNIT IV	Protection	08 Hours

Need of Protection, Overview of 80386DX Protection Mechanisms: Protection rings and levels. Privileged Instructions, Concept of DPL, CPL, RPL, EPL.Inter privilege level transfers using Call gates, Conforming code segment, Privilege levels and stacks. Page Level Protection, Combining Segment and Page Level Protection.

Mapping of Course Outcomes for Unit V	CO5

UNIT V	Multitasking and Virtual 8086 Mode	08 Hours

Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space.

Interrupts, Exceptions: Error handling in microprocessor

Virtual Mode – Features, Memory management in Virtual Mode, Entering and leaving Virtual mode.

Mapping of Course Outcomes for Unit VI	CO6

UNIT VI	Introduction to Microcontrollers	06 Hours

Introduction to Microcontrollers: Architecture of typical Microcontroller, In diagram of microcontroller, Difference between Microprocessor and Microcontroller, Characteristics of microcontrollers, Types of microcontroller, Applications of Microcontrollers.

Books and Other Resources

Textbooks:

1. A.Ray, K.Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing", Tata McGraw Hill,2004 ISBN 0-07-463841-6
2. Douglas Hall, "Microprocessors & Interfacing", McGraw Hill, Revised 2 Edition, 2006 ISBN 0- 07-

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Reference Books:

1. Walter A. Triebel, "The 80386Dx Microprocessor: Hardware", Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
2. Brey, Barry B, "8086/8088, 80286, 80386 and 80486 Assembly Language Programming", Prentice Hall, ISBN: 13: 9780023142475.
3. Mohammad Rafiquzzaman, "Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
4. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012.Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.

Virtual Laboratory:

http://209.211.220.205/vlabiitece/mi/MI3.php

MOOC/ Video Lectures available at:

https://nptel.ac.in/courses/106/108/106108100/

https://nptel.ac.in/courses/108/107/108107029/

Guideline for Practical Conduction:

Continuous assessment of laboratory work is based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign 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.

Operating System: 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM/TASM/NASM/FASM.

Guidelines for Term Work Assessment :

Term work assessment will be based on overall performance of Laboratory assignments performed by a students.

Guidelines for Practical Examination :

Problem statements will be formed based on assignments and performance will be evaluated by Internal and External Examiner. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation

Practical Assignments

1. Write an X86/64 ALP to accept a string and to display its length.
2. Write an X86/64 ALP to find the largest of given Byte/Word/Dword/64-bit numbers
3. Write an X86/64 ALP to count the number of positive and negative numbers from the array.
4. Write an X86/64 ALP to multiply two 8 and 16 bit signed and unsigned numbers.
5. Write an X86/64 ALP to compare two strings using string instructions.
6. Write x86 ALP to find the factorial of a given integer number on a command line by using recursion.
7. Write x86 ALP using macro for a) Addition b) Subtraction c) Multiplication

d) Division

8. Write an X86 ALP to accept five Hexadecimal numbers from user and store them in an array and display them.
9. Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number and 5- digit BCD number into its equivalent HEX number.
10. Write X86 ALP to find, a) Number of Blank spaces b) Number of lines c) Occurrence of a particular character. Accept the data from the text file.



CO24213: Operating Systems

Teaching Scheme:	Credit: 04	Examination Scheme:
TH: 03 Hrs/Week PR: 02 Hrs/Week	TH Credit :03 PR Credit :01	CAA: 10 Mark In-Semester: 30 Mark End-Semester: 60 Mark Oral: 30 Mark

Prerequisite: Digital Electronics and Computer Organization, Programming Languages

Course Objective:

- To learn the basic concepts operating system
- To learn processes life cycle, process states and scheduling algorithms
- To learn Inter Process synchronization, and communication between processes
- To explore memory management, and virtual memory management policies..
- To understand the organization and management of file systems,
- To understand device management

Course Outcomes:

1. To Build the basic knowledge of Operating System
2. To identify process management strategies and processor scheduling algorithms
3. To apply concepts of Inter Process synchronization, and communication
4. To apply memory management, and virtual memory management strategies
5. To make use of concepts of File management and free space management
6. To make use of concepts of device management

Course Activity:

Course teacher will plan the course activity

Course Contents

Mapping of Course Outcomes for Unit I		CO1
UNIT I	**Operating System Structures**	**06 Hours**

Introduction to Operating System: Evolution of OS, Functions of OS, Operating System Components, O.S. Services, Types of OS, Kernel and types of Kernel, System Calls, Virtual Machines, Boot Sequence. Case study of UNIX operating System

Mapping of Course Outcomes for Unit II		CO2
UNIT II	**Processes Management**	**08 Hours**

Process concept: Creation, Termination of process, Process states, Context Switching, Process Control Block, **Thread:** Concept of a Thread, Thread libraries, Multithreading, Comparison of thread **Process Scheduling**, Scheduling criterion, Scheduling algorithms: FCFS, SJF, RR, Priority ,Process System calls. Case Study of Unix Process Management

Mapping of Course Outcomes for Unit III	CO3

UNIT III	Inter process Communication & Synchronization	08 Hours
Synchronization: Critical section problem, Hardware support for mutual exclusion, Semaphores, Monitors, Classical Problems in Synchronization: Producer-consumer, Reader-writer, **Deadlock:** Deadlock-principle, Deadlock prevention Deadlock avoidance, Deadlock detection and recovery, Case Study of Unix IPC		
Mapping of Course Outcomes for Unit IV	**CO4**	
UNIT IV	**Memory management**	**08 Hours**
Memory Management: Continuous and Non Contiguous memory management, Swapping, Paging, Segmentation. **Virtual Memory Management**: Demand Paging, Page replacement algorithms- FIFO, LRU, Optimal, Thrashing, Allocation method, Case Study of Unix Memory management		
Mapping of Course Outcomes for Unit V	**CO5**	
UNIT V	**File Management**	**06 Hours**
File Organization: Concept of files, File Attributes, File operations, File types, Directories and types of directories, Free space management. **File System Implementation:** Data structures like Inode and super block, data block and boot block. Case study of Unix file system		
Mapping of Course Outcomes for Unit VI	**CO6**	
UNIT VI	**I/O System**	**08 Hours**
I/O Management: I/O devices, Organization of I/O functions, Design issues related to I/O devices, I/O Buffering. **Disk Scheduling**- FCFS, SCAN, SSTF, LOOK		

Books and Other Resources

Text Books:

1. " Abranhan Silberschatz, Peter B Galvin, Greg Gagne; Operating System Concepts, Wiley India Students Edition, 8th Edition, ISBN: 978-81-265-2051-0
2. Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 3rd Edition. ISBN: 978-81-203-3904-0

Reference Books:

1. Milan Milenkovic; Operating Systems; Tata McGraw Hill; Second Edition. ISBN: 0-07-044700-4
2. Maurice J. Bach; The Design of the Unix Opearating System; Prentice Hall of India; ISBN: 978-81-203-0516-8
3. Uresh Vahalia; Unix Internals, The New Frontiers; Prentice Hall; ISBN: 0-13-101908-2

Guidelines for Term Work Assessment:

Term work assessment will be based on overall performance of Laboratory assignments performed by students.

Guidelines for Practical Examination :

- Internal and External Examine will take jointly oral examination of not more than 2 students at a time.

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- Understanding of the fundamentals, effective and efficient implementation.

Guidelines for Laboratory Conduction :

- Operating System recommended :- 64-bit Open source Linux or its derivative
- Programming tools recommended: - C++/ Java/ Python

Practical Assignments

1. Demonstration of Installation of Linux Operating System and Exploration of Unix/Linux Commands (File, Directory and Process commands).
2. Write a program to implement operations on processes using fork and join system calls.
3. Simulation of the scheduling algorithms. For example: First Come First Serve (FCFS), Shortest Remaining Time Next (SRTN).
4. Simulation of scheduling algorithms. For example: Round-Robin (RR), Pre-emptive Priority scheduling.
5. Write a program to implement Reader-Writer problem using semaphores
6. Write a program to implement Producer-Consumer problem
7. Write a program to implement Banker's Algorithm for deadlock handling
8. Simulation of Page replacement algorithms. For example: First-In-First-Out, Least Recently Used, optimal page replacement.
9. Simulation of memory allocation strategies. For example: First Fit, Best Fit and Worst Fit.



CO24214: Community Engagement Project

Teaching Scheme:	Credit: 02	Examination Scheme:
PR:04 Hrs/Week		**CAA : 10 Mark** Termwork:30 Marks Oral : 30 Marks

Prerequisite: Students should have prior knowledge of

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

Companion Course :

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

Course Objective:

1. To understand social and technological problems in local communities.
2. To develop awareness about the application of computer engineering in society.
3. To provide practical exposure through community interaction and fieldwork.
4. To develop solutions using appropriate computer engineering technologies.
5. To promote teamwork, leadership, and social responsibility.

Course Outcomes:

On completion of this course students will be able to

1. Identify community issues and formulate appropriate project objectives.
2. Conduct community surveys and analyze the requirements of beneficiaries.
3. Design suitable technology-based solutions for identified problems.
4. Implement and demonstrate solutions using appropriate computer engineering technologies.
5. Evaluate the effectiveness and social impact of implemented solutions.

Course Contents

Preamble:

Community Engagement Project (CEP) is an experiential learning approach designed to provide students with opportunities to develop technical knowledge, practical skills, social responsibility, and problem-solving abilities through active engagement with local communities. It enables students to identify, understand, and address authentic social, technological, and environmental challenges faced by communities by applying the concepts and technologies of computer engineering.

The Community Engagement Project goes beyond conventional classroom learning by encouraging students to interact with community members, identify real-life problems, analyze community needs and develop

appropriate technology-based solutions or conduct socially beneficial activities. It emphasizes learning by doing through meaningful participation, collaboration and practical implementation.

Community Engagement Project (CEP) requires regular mentoring and guidance by faculty throughout the semester for the successful completion of activities and project tasks undertaken by students. Students shall work in batches, with each batch divided into sub-groups of 3 to 4 students. Each group shall identify a relevant community problem and surveys, interact with beneficiaries, and undertake suitable activities such as digital literacy, cybersecurity awareness, technology-based solutions, social awareness programmers or community-oriented applications.

The selected community engagement activities and project work shall be carried out throughout the semester under the supervision of assigned faculty mentors. Faculty members involved in CEP shall provide regular guidance, monitor student progress and evaluate project outcomes. Credits for Community Engagement Project shall be awarded based on continuous internal assessment, active community participation, project implementation, documentation, presentation and evaluation at the end of the semester.

Group Structure:
Working in supervisor/mentor monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.

1. There should be a team/group of 3-4 students
2. A supervisor/mentor teacher assigned to individual groups

Selection of Community Engagement Project / Problem:
The community-based project-oriented learning model is recommended for the Community Engagement Project (CEP). The process begins with identifying real-life problems or challenges faced by local communities, villages, schools, NGOs or other social organizations. Students shall interact with community members, conduct surveys and identify problems that can be addressed through the application of Computer engineering knowledge and technologies.

The identified problems may be social, educational, environmental, technical, agricultural or healthcare-related. Students shall analyse the selected problem and propose suitable solutions using Computer engineering concepts such as programming, web development, mobile applications, database management, Artificial intelligence, IoT and cybersecurity.

The selected project should address a genuine community need and provide practical social benefits. An interdisciplinary approach may be adopted wherever required for analysing and solving the identified problems.

Students are encouraged to use appropriate technologies to investigate community issues, collaborate with stakeholders, analyse collected data, develop solutions and present their outcomes. Activities may include solving real-life community problems, conducting digital literacy and cybersecurity awareness programmes, developing community-oriented software applications, field visits, surveys, case studies and preparation of project reports.

Suggestive list of topics under Community Engagement Project

Community Engagement Projects should focus on specific local issues in the students' nearby areas, and students are expected to carry them out with involvement, commitment, responsibility and accountability.

Mentors may assign a student or a group of students any of the following or any **Community problems**

Health and Wellness

- Health and hygiene of school students, homemakers and the elderly
- Health interventions and awareness programmes
- Healthcare awareness programmes and their impact
- Traditional and modern healthcare methods
- Incidence of diabetes and other chronic diseases
- Blood groups and blood levels
- Yoga awareness and practice

Food and Nutrition

- Food habits
- Herbal remedies and nutrition
- Food adulteration
- Chemicals in daily life

Environment and Agriculture

- Water facilities and drinking water availability
- Air, noise and water pollution
- Plantation and soil conservation
- Horticulture
- Organic farming
- Renewable energy and solar systems

Youth and Society

- Use and misuse of mobile phones
- Career orientation of youth
- Women's education and empowerment
- Music and dance

Guidelines for TW Assessment (40 Marks)

1. Problem Identification and Research (7 Marks)

- 4 Marks: Clear, relevant problem statement supported by surveys and literature.
- 3 Marks: Effective research, including community input and background information.

2. Design and Concept Development (7 Marks)

- 4 Marks: Use of UML/ER/DFD design tools for concept visualization.
- 3 Marks: Practicality in terms of cost effective feasibility and sustainability.

3. Prototyping and Testing (7 Marks)

- 4 Marks: Testing methods, results, and prototype improvements.
- 3 Marks: Documentation of prototyping process (photos, notes).

4. Implementation and Community Engagement (7 Marks)

- 4 Marks: Successful deployment with community interaction, training, and feedback.
- 3 Marks: Modifications based on community feedback.

5. Documentation , Report Writing and IPR/Publication (7 Marks)

- 4 Marks: Clear, organized, and accurate project report with proper citations
- 3 Mark: IPR/Publications.

6. Presentation and Communication (5 Marks)

- 3 Marks: Clear and engaging presentation to stakeholders

Guidelines for OR Assessment (30 Marks)

1. Presentation Structure (10 Marks)

- Clarity & Organization (5 Marks): Clear structure, logical flow from problem to solution.
- Logical Flow (5 Marks): Well-organized content, smooth progression through key points.

2. Technical Understanding (8 Marks)

- Engineering Concepts (4 Marks): Demonstrates deep understanding of applied technology and engineering principles.
- Problem-Solving (4 Marks): Clear explanation of solution and engineering approach.

3. Design & Prototyping (6 Marks)

- Design Explanation (3 Marks): Clear explanation of software design process.
- Prototype/Model Explanation (3 Marks): Functionality and testing outcomes of the prototype.

4. Community Engagement (4 Marks)

- Community Involvement (2 Marks): Explains community feedback and participation.
- Impact (2 Marks): Describes the solution's impact on the community.

5. Response to Questions (2 Marks)

- Confidence & Accuracy (2 Marks): Clear, confident, and accurate answers

Prof. Dr. M. D. Shelar

Dr. G. I. Chhajed

HOD-Comp. Dr. A. M. Jagtap

HS24211 Environmental Studies

Teaching Scheme		Credit: 02	Examination Scheme	
			CAA:	:10 Marks
			End Semester:	:60 Marks
TH	02 Hrs/Week	TH Credit :02	Total	:70 Marks

Course Objective:

The primary objectives of this course are to:

- Understand the fundamental concepts of environmental science and its relevance to engineering.
- Analyze the environmental impact of various engineering industries.
- Learn about sustainable engineering practices, pollution control, and waste management.
- Study environmental laws in India and global initiatives for environmental conservation.
- Explore corrective measures and preventive technologies for mitigating environmental damage

Course Outcomes:

At the end of the course, students will be able

CO1: Understand the components of the environment and types of energy resources.

CO2: Analyze the impact of engineering industries on the environment.

CO3: Learn sustainable engineering solutions for mitigating environmental damage.

CO4: Aware of Indian and global initiatives for environmental protection.

Course Contents

Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Introduction to Environmental Studies**	**06 Hours**

Importance of Environmental Studies, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere, Ecosystems and Biodiversity: Types, Importance, and Conservation, Sustainable Development Goals (SDGs) and Role of Engineers in Sustainability, Renewable and Non-Renewable Resources, Water Resources: Overuse, Pollution, and Engineering Solutions, Energy Resources: Fossil Fuels, Nuclear Power, and Renewable Energy Alternatives, Land Resources: Soil Degradation, Deforestation, and Urbanization

Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Impact of Engineering Industries on Environment**	**07 Hours**

Manufacturing & Automobile Industry: Air pollution, Carbon emissions, Waste disposal, Chemical & Pharmaceutical Industry: Water and soil contamination, Hazardous waste, Construction & Infrastructure: Land degradation, Dust pollution, Waste generation, Electronics & IT Industry: E-waste, Energy consumption, Semiconductor waste, Power Generation (Thermal. Hydropower, Nuclear): Pollution, Waste heat, Radiation hazards, Causes and Effects of Climate Change, Global Warming and Greenhouse Effect.

Mapping of Course Outcomes for Unit III	CO3	
UNIT III	**Engineering Solutions for Environmental Mitigation and Sustainable Practices**	**07 Hours**

Carbon Capture and Storage (CCS), Eco-friendly Materials, Sustainable Design & Life Cycle Assessment (LCA), Energy-efficient Technologies & Smart Grids, Case Studies on Successful Pollution Reduction Waste Management Strategies: Solid Waste and Biomedical Waste Management, E-Waste: Sources, Impact, and Recycling, Hazardous Waste Handling and Treatment, Circular Economy and Zero-Waste

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Technologies Sustainable Engineering Practices: Renewable Energy Technologies (Solar, Wind, Biomass, Hydropower) Green Buildings and Sustainable Architecture, Electric Vehicles and Smart Transportation Systems, Sustainable Agriculture and Water Conservation Technologies

Mapping of Course Outcomes for Unit IV	CO4 CO5

UNIT III	Environmental Initiatives in India and Worldwide	06 Hours

National Initiatives: Swachh Bharat Abhiyan, Namami Gange, National Green Tribunal (NGT), Corporate Social Responsibility (CSR) & Environmental Compliance, Environmental Activism and the Role of NGOs, Environmental Laws and Policies in India, The Environmental Protection Act, 1986, Role of Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB), International Environmental Agreements (Kyoto Protocol, Paris Agreement, COP Summits), Global Initiatives: UNEP, IPCC, World Bank Environmental Policies

Books and Other Resources

Text Books:

1. Benny Joseph, Environmental Studies, McGraw Hill Education, 3rd Edition, 2021.
2. Anubha Kaushik & C.P. Kaushik, Environmental Studies, New Age International Publishers, 5th Edition, 2022.

Reference Books:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 3rd Edition, 2021.
2. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Press, 3rd Edition, 2021.
3. Suresh K. Dhameja, Environmental Science and Engineering, S.K. Kataria & Sons, 2nd Edition, 2020

Additional Reports and Resources:

- Government of India - Ministry of Environment, Forest & Climate Change (MoEFCC) Reports (Website)
- United Nations Environment Programme (UNEP) Reports (Website)
- IPCC Climate Change Reports (Website)
- Central Pollution Control Board (CPCB) Reports (Website)

Activity

Perform any two activities of the following.

1. **Ecosystem Study Report –** Visit a local park, water body, or forested area and document its ecosystem components (flora, fauna, food chains).
2. **Sustainability Case Study** – Choose one of the Sustainable Development Goals (SDGs) and prepare a report on its implementation in India.
3. **Renewable vs. Non-Renewable Resources** – Prepare a comparative chart listing sources, usage, and sustainability factors.
4. **Water Conservation Survey** – Conduct a survey in your neighborhood or campus to assess water consumption and suggest conservation strategies.

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5. **Industrial Impact Assessment** – Select an engineering industry (automobile, chemical, IT, etc.) and analyze its environmental impact.
6. **Carbon Footprint Calculation** – Calculate the carbon footprint of your daily activities (electricity, transportation, food, etc.) and suggest ways to reduce it.
7. **Climate Change Awareness Video** – Create a short video (2–3 min) explaining global warming and its impact.
8. **Case Study on Pollution Control Failures** – Research a real-world incident of industrial pollution (e.g., Bhopal Gas Tragedy, Minamata Disease) and analyze the causes and consequences.
9. **Waste Management Audit** – Conduct a waste audit in your college or home, classify the waste generated, and propose a waste management plan.
10. **E-Waste Collection Drive** – Organize a drive to collect and safely dispose of e-waste in your locality. Submit a report on the amount collected and its disposal method.
11. **Renewable Energy Model** – Create a working or conceptual model of a solar panel, wind turbine, or biomass plant.
12. **Green Building Analysis** – Identify a green building in your city (or college) and analyze its energy-efficient features.
13. **Report on National Environmental Policies** – Summarize key environmental laws in India and their effectiveness.
14. **International Climate Agreements Presentation** – Prepare a presentation on major agreements like the Paris Agreement, Kyoto Protocol, and their impact on India.
15. **NGO/CSR Initiative Study** – Research an NGO or corporate social responsibility (CSR) initiative focused on environmental protection and prepare a report.
16. **Swachh Bharat Implementation Review** – Visit a local area, document cleanliness conditions, and suggest improvements under Swachh Bharat Abhiyan.

Evaluation Criteria

- Depth of Analysis (3 Marks)
- Presentation & Clarity (3 Marks)
- Creativity & Practical Application (2 Marks)
- Timely Submission (2 Mark)

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Course Coordinator

Prof R. K. Shastri
BOS Chairman HSS

Dr. C. B. Nayak
Dean Autonomy

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