Lecture Plan of Mathematics for Engineering Research [700003] for Coursework of Computer Engineering, E&TC, Mechanical Engineering, Civil Engineering Ph.D. Programs (Academic Year 2024-25, Semester II)

Date: 23/06/2025

Unit1 -Linear Algebra

Lecture No.	Date	Time	Name of Faculty	Topic
1	1/7/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Review of matrix algebra, types of systems (consistent/inconsistent), rank
2				
3	8/7/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Gaussian Elimination Method
4				
5	15/7/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Gauss-Jordan Elimination & Row-Reduced Echelon Form (RREF)
6				
7	22/7/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Matrix Inverse Method, Cramer's Rule
8				
9	29/7/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Homogeneous & Non-Homogeneous Systems
10				
11	5/08/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Full vs Sparse Matrices
12				
13	12/08/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Storage Techniques for Sparse Matrices (CSR, CSC formats)
14				
15	19/08/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Operations on Sparse Matrices (add, multiply)
16				
17	26/08/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Overdetermined Systems
18				

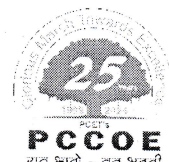| 19	2/09/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Normal Equations & Projection Theorem
20				
21	9/09/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	QR Decomposition for Least Squares
22				
23	16/09/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Definition, Geometric Interpretation
24				
25	23/09/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Characteristic Polynomial, Diagonalization
26				
27	30/09/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Applications: Stability, Differential Equations
28				
29	7/10/2025	3.00-5.00 pm	Mrs. Ashwini Vaze	Power Method, Computational Aspects
30				

Dr. Sandip T. Mali

Ph.D. Research Center Coordinator

Dr. Govind N. Kulkarni

Director

Lecture Plan of **Mathematics for Engineering Research [700003]** for Coursework of Computer Engineering, E&TC, Mechanical Engineering, Civil Engineering Ph.D. Programs (Academic Year 2024-25, Semester II)
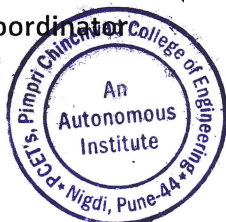
Date: 23/06/2025

Unit No. 10 Soft Computing

Lecture No.	Date	Time	Name of Faculty	Topic
1	2/07/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Introduction to Evolutionary Computation and Genetic Algorithms (GAs)
2		4.00-5.00 pm	Dr. Minakshi Panchal	Working Principle of GAs: Encoding, Selection
3	09/7/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Definition and Basic Concepts
4		4.00-5.00 pm	Dr. Minakshi Panchal	Genetic Operators: Crossover (one-point, two-point, uniform)
5	16/7/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Mutation Techniques and Control Parameters
6		4.00-5.00 pm	Dr. Minakshi Panchal	Fitness Function Design and Scaling
7	23/7/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Applications of GAs in Optimization and Machine Learning
8		4.00-5.00 pm	Dr. Minakshi Panchal	Hands-on/Case Study: Solving TSP or Function Optimization using GA
9	30/7/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Introduction to Fuzzy Sets and Classical vs Fuzzy Logic
10		4.00-5.00 pm	Dr. Minakshi Panchal	Membership Functions and Linguistic Variables
11	6/08/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Fuzzy Set Operations and Properties
12		4.00-5.00 pm	Dr. Minakshi Panchal	Fuzzy Rules and Fuzzy Inference Systems

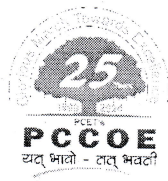| 13	13/08/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Mamdani and Sugeno Models
14		4.00-5.00 pm	Dr. Minakshi Panchal	Fuzzification and Defuzzification Methods
15	20/08/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Applications of Fuzzy Logic in Control Systems, Decision Making
16		4.00-5.00 pm	Dr. Minakshi Panchal	Case Study/Hands-on using Fuzzy Toolboxes in MATLAB
17	27/08/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Introduction to Artificial Neural Networks (ANNs)
18		4.00-5.00 pm	Dr. Minakshi Panchal	Biological Neuron vs Artificial Neuron
19	03/09/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Perceptron and Multilayer Perceptron (MLP)
20		4.00-5.00 pm	Dr. Minakshi Panchal	Activation Functions and Backpropagation Algorithm
21	10/09/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Training and Testing of Neural Networks
22		4.00-5.00 pm	Dr. Minakshi Panchal	Applications of ANN in Classification and Regression
23	17/09/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Hands-on with ANN using Python (Keras/TensorFlow) or R
24		4.00-5.00 pm	Dr. Minakshi Panchal	Introduction to Hyper Heuristics and Need for Metaheuristics
25	24/09/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Types of Hyper Heuristics: Selection and Generation-based
26		4.00-5.00 pm	Dr. Minakshi Panchal	Framework and Components of a Hyper Heuristic System
27	1/10/2025	3.00-4.00 pm	Dr. Minakshi Panchal	Applications of Hyper Heuristics in Real-World Problems
28		4.00-5.00 pm	Dr. Minakshi Panchal	Introduction to Support Vector Machines (SVMs)
29	8/10/2025	3.00-4.00 pm	Dr. Minakshi Panchal	SVM Kernel Trick and Types of Kernels
30		4.00-5.00 pm	Dr. Minakshi Panchal	SVM for Classification and Regression

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Lecture Plan of Mathematics for Engineering Research [700003] for Coursework of Computer Engineering, E&TC, Mechanical Engineering, Civil Engineering Ph.D. Programs (Academic Year 2024-25, Semester II)

Date: 23/06/2025

Unit No: 19 Matrices

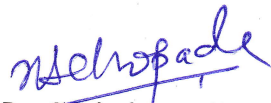| Lecture No.	Date	Time	Name of Faculty	Topic
1	3/07/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Introduction, Brief review of basic matrix operations importance in various fields
2		4.00-5.00 pm	Mrs. Sujata Bhamre	Types of Matrices
3	10/7/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Basic operation on Matrices
4		4.00-5.00 pm	Mrs. Sujata Bhamre	Matrix Transformations: Elementary matrix transformations
5	17/7/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Linear transformations
6		4.00-5.00 pm	Mrs. Sujata Bhamre	Linear transformations
7	24/7/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Orthogonal transformations
8		4.00-5.00 pm	Mrs. Sujata Bhamre	Introduction to Eign values, Vectors and Spectrum
9	31/7/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Eigenvalues and corresponding Eigenvectors
10		4.00-5.00 pm	Mrs. Sujata Bhamre	Eigenvalues and corresponding Eigenvectors

11	7/08/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Markov's Stochastic Process: Introduction to Markov chains
12		4.00-5.00 pm	Mrs. Sujata Bhamre	Transition matrices
13	14/08/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Steady-state probabilities
14		4.00-5.00 pm	Mrs. Sujata Bhamre	Case study
15	21/08/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Numerical Methods for Eigenvalues and Eigenvectors: Power method
16		4.00-5.00 pm	Mrs. Sujata Bhamre	Power method
17	28/08/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Inverse power method
18		4.00-5.00 pm	Mrs. Sujata Bhamre	Inverse power method
19	4/09/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	QR algorithm (brief overview)
20		4.00-5.00 pm	Mrs. Sujata Bhamre	Applications to Mass-Spring Systems: Modeling coupled oscillators with matrices
21	11/09/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Modeling coupled oscillators with matrices
22		4.00-5.00 pm	Mrs. Sujata Bhamre	Natural frequencies and normal modes
23	18/09/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Solving the system using eigenvalues and eigenvectors
24		4.00-5.00 pm	Mrs. Sujata Bhamre	Solving the system using eigenvalues and eigenvectors
25	25/09/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Matrices in Finite Element Methods: Brief introduction to finite element analysis

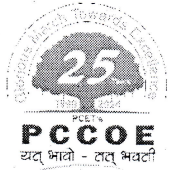| 26		4.00-5.00 pm	Mrs. Sujata Bhamre	finite element analysis
27	9/10/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Role of matrices in discretizing continuous problems
28		4.00-5.00 pm	Mrs. Sujata Bhamre	Role of matrices in discretizing continuous problems
29	16/10/2025	3.00-4.00 pm	Mrs. Sujata Bhamre	Assembly of global stiffness matrices
30		4.00-5.00 pm	Mrs. Sujata Bhamre	Conclusion and Review

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	Pimpri Chinchwad Education Trust's **Pimpri Chinchwad College of Engineering (PCCoE)** (An Autonomous Institute) Affiliated to Savitribai Phule Pune University (SPPU) ISO 21001:2018 Certified by TUV SUD	

Lecture Plan of Research Methodology for Coursework of Computer Engineering, E&TC, Mechanical Engineering, Civil Engineering Ph.D. Programs (Academic Year 2024-25, Semester II)

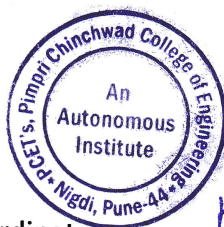Date: 23/06/2025

Unit No. 22 - Graph Theory

Lecture No.	Date	Time	Name of Faculty	Topic
1	4/07/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Introduction, Brief review of Graph Theory & importance in various fields
2		4.00-5.00 pm	Dr. Shaziya Shaikh	Types of Graphs
3	11/7/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Definition and Basic Concepts
4		4.00-5.00 pm	Dr. Shaziya Shaikh	various applications of graphs in modeling real-world problems: Social networks
5	18/7/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	various applications of graphs in modeling real-world problems: Transportation systems
6		4.00-5.00 pm	Dr. Shaziya Shaikh	various applications of graphs in modeling real-world problems: . Molecular structures
7	25/7/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	various applications of graphs in modeling real-world problems: Computer networks
8		4.00-5.00 pm	Dr. Shaziya Shaikh	Planar Graphs
9	1/8/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Introduce Kuratowski's theorem

10		4.00-5.00 pm	Dr. Shaziya Shaikh	Dual Graphs
11	8/08/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	construction a dual graph from a planar graph.
12		4.00-5.00 pm	Dr. Shaziya Shaikh	Vector Spaces of a Graph
13	22/08/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Brief review of vector space axioms
14		4.00-5.00 pm	Dr. Shaziya Shaikh	cycle space and cut space of a graph.
15	29/08/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	properties and relationship of cycle space and cut space
16		4.00-5.00 pm	Dr. Shaziya Shaikh	Matrix Representation of Graphs
17	5/09/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	adjacency matrix and its properties and construction.
18		4.00-5.00 pm	Dr. Shaziya Shaikh	incidence matrix and its properties and construction.
19	12/09/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Graph Coloring, proper vertex coloring
20		4.00-5.00 pm	Dr. Shaziya Shaikh	chromatic number and its significance.
21	19/09/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Graph Covering, vertex cover and edge cover
22		4.00-5.00 pm	Dr. Shaziya Shaikh	minimum cover problem.
23	26/09/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Graph Partitioning
24		4.00-5.00 pm	Dr. Shaziya Shaikh	applications in load balancing and VLSI design
25	3/10/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Directed Graphs: Flow networks Dependency graphs State transition diagrams

26		4.00-5.00 pm	Dr. Shaziya Shaikh	Enumeration of Graphs: Counting Graphs: graph isomorphism. challenges in counting non-isomorphic graphs. Polya's theorem (without proof)
27	10/10/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Depth-First Search (DFS) Breadth-First Search (BFS) Minimum Spanning Tree: algorithms (Kruskal's and Prim's)
28		4.00-5.00 pm	Dr. Shaziya Shaikh	Shortest Path algorithms (Dijkstra's and Floyd-Warshall)
29	17/10/2025	3.00-4.00 pm	Dr. Shaziya Shaikh	Graph representation in programming
30		4.00-5.00 pm	Dr. Shaziya Shaikh	Conclusion and Review

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