Amrutvahini College of Engineering, Sangamner
(An Autonomous Institute)
Department of Computer Engineering

National Education Policy (NEP)-2020 Compliant Curriculum

MTech (Computer Engineering)

(2025 Pattern)

(With effect from Academic Year 2025-26)

First Year MTech (Computer Engineering) (2025 Pattern)

Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks					Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Theory	Tutorial	Practical	Total
Semester I														
R25-MCO-MFCE-501	Major Core Course	Mathematical Foundations for Computer Engineering	4	-	-	50	50	-	-	-	4	-	-	4
R25-MCO-AA-502	Major Core Course	Advanced Algorithms	4	-	-	50	50	-	-	-	4	-	-	4
R25-MCO-AML-503	Major Core Course	Advanced Machine Learning	4	-		50	50	-	-	-	4	-		4
R25-MCO-BA-504	Major Core Course	Business Analytics	4	-		50	50	-	-	-	4	-		4
R25-MCO-LP1-505	Major Core Course	Laboratory Practice-I	-	-	4	-	-	50	-	50	-	-	2	2
R25-MCO-MEC-506(A)	Major Elective Course (Elective –I)	**Elective-I** A. Distributed Computing	4	-	-	50	50	-	-	-	4	-	-	4
R25-MCO-MEC-506(B)		B. Natural Language Processing												
R25-MCO-MEC-506(C)		C. AI in Healthcare												
R25-MCO-CTS-507	CivicTech Skill Course	Human Rights I	-	-	-	-	-	-	-	-	-	-	-	**1**
Total			**20**	**-**	**4**	**250**	**250**	**50**	**--**	**50**	**20**	**--**	**2**	**23**

CCE*: Comprehensive Continuous Evaluation

Approved By:

First Year MTech (Computer Engineering) (2025 Pattern)

Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks					Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Theory	Tutorial	Practical	Total
Semester II														
R25-MCO-QC-508	Major Core Course	Quantum Computing	4	-	-	50	50	-	-	-	4		-	4
R25-MCO-ACN-509	Major Core Course	Advanced Computer Network	4	-	-	50	50	-	-	-	4		-	4
R25-MCO-ASE-510	Major Core Course	Advanced Software Engineering	4	-	-	50	50	-	-	-	4	-	-	4
R25-MCO-LPII-511	Major Core Course	Laboratory Practice-II	-	-	4	-	-	25	-	25	-	-	2	2
R25-MCO-MEC-512(A)	Major Elective Course (Elective –II)	**Elective-II** A. Multi cloud Architecture	3	-	-	50	50	-	-	-	3	-	-	3
R25-MCO-MEC-512(B)		B. Generative Artificial Intelligence												
R25-MCO-MEC-512(C)		C. Deep Learning												
R25-MCO-MEC-513(A)	Major Elective Course (Elective –III)	**Elective-III** A. Computer Vision	3	-	-	50	50	-	-	-	3	-	-	3
R25-MCO-MEC-513(B)		B. Internet of Things												
R25-MCO-MEC-513(C)		C. Speech Processing												
R25-MCO-SEM-514	Seminar	Seminar I	-	-	4	-	-	50	-	-	-	-	2	2
R25-MCO-CTS-515	CivicTech Skill Course	Human Rights II	-	-	-	-	-	-	-	-	-	-	-	1
Total			**18**		**4**	**250**	**250**	**75**	**-**	**25**	**18**	**-**	**4**	**23**

CCE*: Comprehensive Continuous Evaluation

Approved By:

Amrutvahini College of Engineering
First Year of M. Tech (Computer Engineering) (2025 Pattern)
R25-MCO-MFCE-501: Mathematical Foundations for Computer Engineering

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Discrete Mathematics

Companion Course, if any: -- Laboratory Practice I

Preamble: This syllabus outlines the curriculum for a postgraduate-level course titled "Mathematical Foundations for Computer Engineering," designed for M. Tech students in Computer Engineering. This course aims to provide a comprehensive understanding of the essential mathematical concepts and techniques that underpin advanced topics within computer engineering, preparing students for both academic research and industry-oriented challenges. The syllabus details the course objectives, learning outcomes, and a structured unit-wise breakdown of topics to be covered over approximately 40 -42 classes.

Course Objectives:

The primary objectives of this course are:

- To **DEVELOP** a strong understanding of fundamental mathematical structures relevant to computer engineering.
- To **APPLY** linear algebra techniques to solve problems in areas such as data analysis and computer graphics.
- To **PROBABILITY** and statistical methods for modeling and analyzing systems in computer engineering.
- To **ENHANCE** logical reasoning and proof techniques essential for theoretical aspects of computer science and engineering.

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

CO	Course Outcome	Bloom's Level
CO 1:	**APPLY** fundamental concepts of sets, relations, and logic to model and solve problems in computer science.	3
CO 2:	**UTILIZE** advanced combinatorial techniques to analyze algorithms and solve counting problems in various applications.	3
CO 3:	**SOLVE** systems of linear equations and apply matrix algebra in computer engineering domains such as computer graphics.	3
CO 4:	**APPLY** vector space concepts and eigenvalue decomposition to analyze data and understand transformations in areas like machine learning.	3
CO 5:	**MODEL** and analyze random phenomena using probability theory and the concept of random variables.	3

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CO 6:	**APPLY** statistical inference and basic concepts of stochastic processes to analyze the behavior of computer systems and make predictions.	3

Course Contents

Unit I	Foundations of Discrete Mathematics	(08 Hours)

Sets, Relations, and Functions: Basic definitions, types of sets, set operations, properties of relations (reflexive, symmetric, transitive), types of functions (one-to-one, onto, bijective). Logic: Propositional logic, logical connectives, truth tables, tautologies, contradictions, logical equivalence, predicate logic, quantifiers. Proof Techniques: Direct proof, proof by contradiction, proof by induction (mathematical induction, strong induction).

Mapping of Course Outcomes for Unit I	CO1

Unit II	Advanced Combinatorics	(08 Hours)

Basic Counting Principles: Rule of sum, rule of product, permutations, combinations. Advanced Counting Techniques: Combinations with repetition, inclusion-exclusion principle, pigeonhole principle. Generating Functions: Introduction to generating functions and their applications in solving recurrence relations and counting problems.

Mapping of Course Outcomes for Unit II	CO2

Unit III	Linear Algebra: Matrices and Determinants	(08 Hours)

Matrices and Determinants: Basic matrix operations (addition, subtraction, multiplication), types of matrices, determinants, properties of determinants. Systems of Linear Equations: Representation of linear systems using matrices, Gaussian elimination, Gauss-Jordan elimination, types of solutions (unique, no solution, infinitely many solutions). Matrix Inverses: Definition and properties of matrix inverses, methods to find the inverse of a matrix.

Mapping of Course Outcomes for Unit III	CO3

Unit IV	Vector Spaces and Eigenvalue Problems	(08 Hours)

Vector Spaces: Definition of vector spaces, subspaces, linear independence, basis, dimension. Linear Transformations: Introduction to linear transformations and their matrix representations. Eigenvalues and Eigenvectors: Characteristic equation, finding eigenvalues and eigenvectors, diagonalization.

Mapping of Course Outcomes for Unit IV	CO4

Unit V	Probability Theory, Random Variables, Statistical Inference & Stochastic Processes	(10 Hours)

Probability Theory: Sample spaces, events, probability axioms, conditional probability, Bayes' theorem. Random Variables: Discrete and continuous random variables, probability mass functions, probability density functions, cumulative distribution functions. Expectation and Variance: Definition and properties of expectation and variance for discrete and continuous random variables. Common Probability Distributions: Bernoulli, binomial, Poisson, uniform, exponential, normal distributions and their applications. Statistical Inference: Introduction to sampling, point estimation, confidence intervals, hypothesis testing (basic concepts). Introduction to Stochastic Processes: Definition and classification of stochastic processes, Markov chains (basic concepts and examples).1 IIT Madras offers "Applied Stochastic Processes" as an elective.

Mapping of Course Outcomes for Unit V	CO5

Learning Resources

Approved By:

Text Books:

- Discrete Mathematics:
  - C. L. Liu, "Elements of Discrete mathematics," TMH Publication
  - K.H. Rosen,"Discrete Mathematics & Its Applications," McGraw Hill Education.
  - Seymour Lipschutz, Marc Laras Lipson, Varsha H. Patil,"Discrete Mathematics", Schaume Series.
- Advanced Combinatorics:
  - Stasys Jukna," Extrema Combinatorics: With Applications in Computer Science", Springer
  - S. Gill Williamson,"Combinatorics for Computer Science", Rockville, Md. : Computer Science Press
- Linear Algebra:
  - Datta K.B.,"Matrix and Linear Algebra", PHI
  - Ferrante Neri,"Linear Algebra for Computational Sciences and Engineering" Springer.

Reference Books:

- Concrete Mathematics: A Foundation for Computer Science by Ronald L. Graham, Donald E. Knuth, and Oren Patashnik.
  - Discrete and Combinatorial Mathematics by Ralph P. Grimaldi.
- Advanced Combinatorics:
  - Combinatorics: Topics, Techniques, Algorithms by Peter J. Cameron.
  - Combinatorics: The Art of Counting by Bruce E. Sagan.
- Linear Algebra:
  - Linear Algebra and Its Applications by Gilbert Strang.1
  - Advanced Linear Algebra by Steven Roman.
  - Linear Algebra Done Right by Sheldon Axler.
- Probability and Statistics:
  - Probability and Statistics for Computer Science by James L. Johnson.
  - Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross.

Web Links:

- Discrete Mathematics:
  - Codecademy: https://www.codecademy.com/learn/discrete-math.
  - MIT Open Courseware: https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/.
  - Coursera: https://www.coursera.org/specializations/discrete-mathematics.
  - edX: https://www.edx.org/learn/linear-algebra.
  - Khan Academy: https://www.khanacademy.org/math/linear-algebra.
  - MIT Open CourseWare: https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/ and https://ocw.mit.edu/courses/18-06sc-linear-algebra-fall-2011/.
- Probability and Statistics:
  - edX: https://www.edx.org/learn/probability.
  - Coursera: https://www.coursera.org/courses?query=probability.
  - Data Camp: https://www.datacamp.com/category/probability-and-statistics.
  - MIT Open CourseWare: https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/.

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e-Books:

- Discrete Mathematics: An Open Introduction: https://discrete.openmathbooks.org/.

MOOC Courses:

1. **https://onlinecourses.nptel.ac.in/noc22_cs49/preview**
2. **https://nptel.ac.in/courses/106105192**
3. **https://nptel.ac.in/domains/discipline/106?course=106_3**

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Assessment Pattern

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-AA-502: Advanced Algorithm

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Foundation in data structures and algorithms, Proficiency in programming, Understanding of discrete mathematics, probability, and linear algebra

Companion Course, if any: Laboratory Practice I

Course Objectives: The course aims to

- To **UNDERSTAND** different algorithm design techniques.
- To **ANALYZE** performance of different algorithmic strategies in terms of time and space.
- To **APPLY** algorithmic strategies while solving problems.
- To **UNDERSTAND** Multithreaded and Distributed Algorithms.
- To **UNDERSTAND** and apply and implement geometric algorithms and optimization algorithms.

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

CO	Course Outcome	Bloom's Level
CO1:	**EVALUATE** and contrast the efficiency of polynomial time algorithms by examining their performance across the worst, best, and average case scenarios.	**3**
CO2:	**UTILIZE** appropriate algorithmic techniques to address problems involving binomial coefficients, chain matrix multiplication, and longest common subsequence.	**3**
CO3:	**DEVELOP** and apply problem-solving skills to address real-world business challenges and decision-making scenarios.	**3**
CO4:	**EVALUATE** the effectiveness and accuracy of randomized algorithms, considering both their efficiency and correctness.	**3**
CO5:	**APPLY** problem-solving techniques tailored for multi-core, distributed, or concurrent environments to effectively address complex computational challenges.	**3**

Course Contents

Unit I	Introduction to Algorithms and Strategies	(07 Hours)

Introduction: Role of algorithms in computing, Growth functions, Solving Recurrences.
Review of algorithmic strategies: Divide and Conquer, Greedy method, Dynamic Programming, Backtracking, Branch and Bound

Mapping of Course Outcomes for Unit I	CO1

Unit II	Dynamic programming and Linear Programming	(07 Hours)

Dynamic programming: Control abstraction for dynamic programming, elements of dynamic programming, use of dynamic programming method to solve the problems: binomial coefficients, chain matrix multiplication,

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longest common subsequence.
Linear programming: Its use, problem formulation as linear programming model, simplex method, duality.

Mapping of Course Outcomes for Unit II	CO2

Unit III	**Randomized and Distributed Algorithms**	**(08 Hours)**

Randomized Algorithms: Reasons for using randomized algorithms, Examples: Randomized Qsort, min-cut problems, Introduction to approximation algorithms, Examples: TSP, 3-coloring problem,
Parallel and Distributed Algorithms: Parallel loops, Race conditions, Problem Solving using Multithreaded Algorithms, Multithreaded matrix multiplication, Multithreaded merge sort.
Distributed Algorithms: Introduction, Distributed breadth first search, Distributed Minimum Spanning Tree.
String Matching: Introduction, The Naive string-matching algorithm, The Rabin-Karp algorithm.

Mapping of Course Outcomes for Unit III	CO 3

Unit IV	**Complexity Theory**	**(07 Hours)**

Classes of problems: P, NP, NP-complete, and NP-hard. Examples- Travelling salesman problem, post correspondence problem. P vs NP: The implications of solving this problem, its relevance to cryptography, and its connections to real-world applications. Reduction Techniques: Polynomial-time reductions and Cook reductions.

Mapping of Course Outcomes for Unit IV	CO4

Unit V	**Geometric and Optimization Algorithms**	**(07 Hours)**

Geometric algorithms - Introduction, range searching, convex hulls, segment intersections, closest pairs of points. Optimization Algorithms- Introduction, Gradient Descent, Genetic Algorithms, Particle Swarm Optimization.

Mapping of Course Outcomes for Unit V	CO5

Learning Resources

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms,” ISBN: 978-0-262-04630-5, 4th edition MIT press, 2022.
2. Parag Himanshu Dave, Himanshu Bhalchandra Dave, “Design and Analysis of Algorithms,” Pearson Education, ISBN 81-7758-595-92, 2nd edition, 2013.
3. Horowitz and Sahani, “Fundamentals of Computer Algorithms,” University Press, ISBN: 978 817371 6126, 81 7371 61262,

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Reference Books:

1. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms," Cambridge University Press, ISBN: 978-0-521-61390-3, 1st edition, 2004.
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics," PHI, ISBN 978-81-203-1131-2.
3. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples," Wiley, ISBN 978-81-265-0986-7, 1st edition 2006.
4. Dan Gusfield, "Algorithms on Strings, Trees and Sequences," Cambridge University Press, ISBN:0-521-67035-7,1st edition 1997.

MOOC Courses: Design and Analysis of Algorithms, By Prof. Madhavan Mukund, Chennai Mathematical Institute https://onlinecourses.nptel.ac.in/noc19_cs47/preview

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15

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CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-AML-503: Advanced Machine learning

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Machine Learning

Companion Course, if any: Laboratory Practice I

Preamble: This course introduces machine learning concepts and popular machine learning algorithms. It will cover the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbor, an introduction to Bayesian learning and the naive Bayes algorithm, support vector machines and kernels and basic clustering algorithms. Dimensionality reduction methods and some applications to real world problems will also be discussed. It helps the learners to develop application machine learning based solutions for real world applications.

Course Objectives:

- To **UNDERSTAND** the fundamental concepts of machine learning and its applications.
- To **MASTER** the concepts of classification and clustering techniques.
- To **DEVELOP** a deep understanding of convolutional neural networks (CNNs) and their architecture.
- To **APPLY** deep learning techniques to large-scale datasets and real-world problems.
- To **UNDERSTAND** Support Vector Machine and Hidden Markov Model.

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

CO	Course Outcome	Bloom's Level
CO1:	**ANALYZE** the Machine Learning concepts, classifications of Machine Learning algorithms and basic parameter estimation methods. **(Cognitive Knowledge Level: Analyze)**	3
CO2:	**ILLUSTRATE** the concepts of regression and classification techniques **(Cognitive Knowledge Level: Apply)**	3
CO3:	Describe unsupervised learning concepts and dimensionality reduction techniques. (**Cognitive Knowledge Level: Apply**)	3
CO4:	Explain Support Vector Machine concepts and graphical models. **(Cognitive Knowledge Level: Apply)**	3
CO5:	Choose suitable model parameters for different machine learning techniques and to evaluate a model performance. **(Cognitive Knowledge Level: Apply)**	3

Course Contents

Unit I	Parameter Estimation and Regression	(08 Hours)

Approved By:

Overview of machine learning: supervised, semi-supervised, unsupervised learning, reinforcement learning. Basics of parameter estimation: Maximum Likelihood Estimation (MLE), Maximum a Posteriori Estimation (MAP). Gradient Descent Algorithm, Batch Gradient Descent, Stochastic Gradient Descent. Regression algorithms: least squares linear regression, normal equations and closed form solution, Polynomial regression.		
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Regularization techniques and Classification algorithms**	**(08 Hours)**
Overfitting, Regularization techniques - LASSO and RIDGE. Classification algorithms: linear and non-linear algorithms, Perceptron's, Logistic regression, Naive Bayes, Decision trees. Neural networks: Concept of Artificial neuron, Feed-Forward Neural Network, Back propagation algorithm.		
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Unsupervised learning**	**(08 Hours)**
Unsupervised learning: clustering, k-means, Hierarchical clustering, Principal component analysis, Density-based spatial clustering of applications with noise (DBSCAN). Gaussian mixture models: Expectation Maximization (EM) algorithm for Gaussian mixture model.		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Support Vector Machine and Graphical Models**	**(07 Hours)**
Support vector machines and kernels: Max margin classification, Nonlinear SVM and the kernel trick, nonlinear decision boundaries, Kernel functions. Basics of graphical models - Bayesian networks, Hidden Markov model - Inference and estimation.		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Evaluation Metrics and Sampling Methods**	**(08 Hours)**
Classification Performance Evaluation Metrics: Accuracy, Precision, Precision, Recall, Specificity, False Positive Rate (FPR), F1 Score, Receiver Operator Characteristic (ROC) Curve, AUC. Regression Performance Evaluation Metrics: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination. Clustering Performance Evaluation Metrics: Purity, Jaccard index, Normalized Mutual Information, Clustering Accuracy, Silhouette Coefficient, Dunn's Index. Boosting: AdaBoost, gradient boosting machines. Resampling methods: cross-validation, bootstrap. Ensemble methods: bagging, boosting, random forests Practical aspects in machine learning: data preprocessing, overfitting, accuracy estimation, parameter and model selection Bias-Variance tradeoff.		
Mapping of Course Outcomes for Unit V	CO5	
Learning Resources		

Approved By:

Text Books:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that make sense of data, Cambridge University Press, 1st Edition, 2012, ISBN No.: 978-1-316-50611-0.
2. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2nd edition, 2013, 978-0-262-01243-0.
3. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition, Wiley, 2001.
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
5. Geoff Dougherty, "Pattern recognition and classification an Introduction", Springer, 2013.
6. John Shae Taylor and Nello Cristianini, "Kernel methods for pattern analysis" Cambridge university press, 2004.

Reference Books:

1. Christopher Bishop. Neural Networks for Pattern Recognition, Oxford University Press, 1995.
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Second edition Springer 2007.
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
5. C.M. Bishop, Pattern Recognition and Machine learning, Springer, 1st Edition, 2013, ISBN No.: 978-81-322-0906-5.

e-Books:

1.http://www.ru.ac.bd/wpcontent/uploads/sites/25/2019/03/207_05_01_Rajchka_Using-Pythonfor-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:

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/preview

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-BA-504: Business Analytics

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: **Database Management System, Data Science & Big data Analytics, Machine Learning**

Companion Course, if any: **NA**

Course Objectives:

- To **UNDERSTAND** the fundamental concepts, scope, and process of Business Analytics
- To **APPLY** descriptive analytics techniques
- To **DEVELOP** and apply predictive analytics models and machine learning algorithms
- To **UTILISE** prescriptive analytics concepts and optimization techniques
- To **APPLY** Business Analytics concepts, methods, and tools

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

CO	Course Outcome	Bloom's Level
CO1:	**ASSESS** the role and significance of Business Analytics	3
CO2:	**APPLY** descriptive analytics techniques	3
CO3:	**DEVELOP** and apply predictive analytics models and machine learning algorithms,	3
CO4:	**FORMULATE** and solve problems using prescriptive analytics concepts and optimization techniques	3
CO5:	**APPLY** Business Analytics concepts, methods, and tools	3

Course Contents

Unit I	Introduction to Business Analytics and Data	(08 Hours)

Overview of Business Analytics: fundamental concepts of Business Analytics (BA), scope, and the analytical process.
Data Fundamentals: types of data, managing Big Data, data storage, and retrieval. Data Analytics Life Cycle.
Foundational Concepts: statistical notation, descriptive statistical methods, an overview of probability distribution, data modelling, and sampling and estimation methods. role of data science and business analytics. Online Transaction Processing (OLTP) with Online Analytical Processing (OLAP).

Mapping of Course Outcomes for Unit I	CO1

Unit II	Descriptive Analytics and Data Exploration	(08 Hours)

Descriptive Analytics: process of exploring and analyzing data.
Data Visualization: data visualization and analytics. various chart types such as Bars, Pie, Line, Scatter, Map, Bubble, Box & Whisker, Tree map, Heat map, Circle, and Area charts.
Visualization Techniques and Dashboards: creation of worksheets, dashboards, and storyboards. various data types, including Scalar, Vector, Multivariate, Multidimensional, Temporal, Spatial, and Text data. Guidelines for designing effective visualizations and dashboards.

Approved By:

Data Preprocessing and Exploration: Traditional data preprocessing steps like data cleaning, integration, reduction, and transformation. Exploratory Data Analysis (EDA), definition, and steps, including identifying outliers.		
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Predictive Analytics**	**(08 Hours)**
Predictive Analytics Models: modelling relationships and trends in data, simple Linear Regression. business decision-making. Specific models include Linear Regression, Multi-linear Regression, Cluster, CART, and Neural Network models. **Machine Learning Concepts:** Machine Learning concepts and approaches, including Supervised Learning (Bayesian Learning, Naïve Bayes Classifier), Unsupervised Learning (Clustering, including k-Means and semi-supervised clustering), and Reinforcement Learning (Temporal Difference learning, Q-Learning, Deep-Q-Nets) **Techniques and Applications:** Ensemble Learning (Bagging, Random Forest Trees, Boosting, Adaboost, XG boost, Stacking). Forecasting sales of new products.		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Prescriptive Analytics and Decision Making**	**(08 Hours)**
Prescriptive Analytics: Prescriptive Modelling and nonlinear optimization. **Optimization Techniques:** Linear optimization, Integer optimization, Non-linear programming, and Simulation. Optimization of Network models. **Decision Analysis:** formulating decision problems, decision strategies with and without outcome probabilities, Decision Trees, the Value of Information, and Utility and Decision Making. Decision Making under uncertainty, certainty, and risk. **Advanced Prescriptive Concepts:** Monte Carlo Simulation and Risk Analysis.		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Domain-Specific Business Analytics Applications**	**(08 Hours)**
Healthcare Analytics, Retail Analytics, Marketing Analytics, Financial and Accounting Analytics, Risk and Fraud Analytics, Supply Chain and Operations Analytics, HR Analytics, Investment and Banking Analytics, Social Media Analytics. **Business Analytics Tools, Technologies,** Software and Programming: Tableau, R, Excel solver, Python, and SPSS. **Big Data Technologies:** Hadoop architecture, HDFS, MapReduce. **Cloud and Other Technologies**: AWS and GCP.		
Mapping of Course Outcomes for Unit V	CO5	
Learning Resources		

Approved By:

Text Books:

1. Sharda R, Delen D, Turban E, Aronson J, Liang T. P, Business Intelligence and Analytics: Systems for Decision Support, Pearson Education, 10th edition, 2014
2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd Edition, 2020
3. Thomas Davenport et.al, Analytics at Work: Smarter Decisions, Better Results, Harvard Business School Press, 3rd edition, 2010.

Reference Books:

1. **Robert Stine, Dean Foster, "Statistics for Business: Decision Making and Analysis", Pearson Education, 2nd edition, 2013**
2. Mohammed Guller, Big Data Analytics with Spark, Apress, 2015
3. Bart Baesens, Veronique van Vlasselaer, and Wouter Verbeke, Fraud Analytics Using Descriptive, Predictive, and Social Network Techniques: A Guide to Data Science for Fraud Detection, John Wiley and Sons, Hoboken, New Jersey, USA, 2015.

Web Links:

e-Books:

1.https://www.knime.com/sites/default/files/inline-images/KNIME_quickstart.pdf

2.www.cs.ccsu.edu/~markov/weka-tutorial.pdf

3. https://download.e-bookshelf.de/download/0000/5791/06/L-G-0000579106-0002359656.pdf

MOOC Courses:

NPTEL/YouTube video lecture links:

1. Business Analytics for management decision: https://nptel.ac.in/courses/110105089

2. Business analytics and data mining modelling using R: https://nptel.ac.in/courses/110107092

3. Business Analysis for Engineers: https://nptel.ac.in/courses/110106050

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-LPI-505: Laboratory Practice I

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hours/Week	**02**	**Term Work: 50 Marks** **Oral: 50 Marks**

Prerequisite Courses, if any: Applied Algorithms, Mathematical Foundation for Computer Science and Machine Learning

Companion Course, if any: Mathematical Foundation for Computer Engineering, Advanced Algorithms, Advanced Machine Learning, Business Analytics

Course Objectives:

- Use the **FUNDAMENTAL** properties and theorems of probability theory, sample spaces, events and random variables to model real-life phenomena and to compute and interpret probabilities of events.
- **APPLY** statistical methods to estimate parameters of numerical data from a representative sample of a population and interpret the results.
- Perform matrix computations and use eigenvalues and eigenvectors to analyze the structure of a matrix.
- To **APPLY** linear algebra techniques to solve problems in areas such as data analysis and computer graphics.

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

CO	Course Outcome	Bloom's Level
CO:1	**APPLY** matrices, Vectors for solving Linear systems.	3
CO:2	**ANALYE** Eigenvalues and Eigenvectors problems.	3
CO:3	**CREATE** Contingency Tables using Statistics.	3
CO:4	**DEVELOP** and Evaluate Machine Learning Algorithms.	3
CO:5	**USE** suitable model parameters for different machine learning techniques and to evaluate a model performance.	3

List Of Assignments

Part A: Mathematical Foundation for Computer Engineering

1. Exploring Sets, Relations, and Functions using Programming
    1. Define two sets A and B using user input. Perform and display:
        - Union, Intersection, Difference, Cartesian Product.
    2. For a given relation R on a set A, check whether it is:
        - Reflexive, Symmetric, Transitive.
    3. Define a function from A to B and determine if it is:
        - One-to-one (injective), Onto (surjective), or Bijective.

Approved By:

2. Simulating Probability Distributions**:**

1. Write a program to simulate:
    - Tossing a coin 1000 times and plot the frequency of heads/tails.
    - Rolling a dice 1000 times and compute the probability distribution.
2. Generate and plot:
    - Normal distribution and Poisson distribution using given parameters (use NumPy/Matplotlib or Excel).

3. *Weather Prediction using Markov Chains***:**

1. Define a transition probability matrix for a weather model:
    - States: Sunny (S), Rainy (R), Cloudy (C).
    - Example:
    - [S, R, C]
    - S: 0.6, 0.3, 0.1
    - R: 0.2, 0.7, 0.1
    - C: 0.3, 0.3, 0.4
2. Predict the weather after 5 days given initial state = Sunny.

Show state vector updates after each transition.

Part B: Advanced Algorithms

1. Analyze and compare the time complexity (best, average, worst) of Merge Sort vs. Quick Sort using recurrence relations.
2. Case study on how Divide & Conquer was used in real-world applications like image processing or financial modeling.
3. Comparative analysis between Greedy and Dynamic Programming with at least 2 examples (e.g., Knapsack problem).
4. Implement Rabin-Karp and Naïve string-matching algorithms. Compare their execution times on large text data.
5. Case study: Explain how approximation algorithms are used to handle NP-hard problems in logistics or network routing.

Part C: Advanced Machine Learning

1. Support vector machine for multiclass classification using Python: Implement a classification model using Support vector machine algorithm for news article topic classification like science, technology, politics, sports, etc. Use sklearn dataset and/or fetch dataset using APIs.
2. Convolution Neural Network for face recognition using Python: Implement a real-world application like AI Face Recognition Entry Agent using CNN. It detects and recognizes faces in real-time environment. It should grant or denies the entry based on known faces of pre-trained databases.
3. Apply K-Means and DBSCAN on a multidimensional dataset (e.g., Iris or synthetic data) and visualize clusters.

Approved By:

4.Develop a full ML pipeline (data preprocessing, model training, evaluation, deployment) for a domain-specific problem:

- Healthcare (e.g., disease prediction)
- Finance (e.g., fraud detection)
- Agriculture (e.g., crop yield prediction)
- Smart cities (e.g., traffic prediction).

Part D: Business Analytics

1. To apply descriptive analytics techniques and visualize various data types.

2. To develop and apply predictive analytics models and machine learning algorithms.

3. To formulate and solve problems using prescriptive analytics concepts and optimization techniques.

4. To apply Business Analytics concepts, methods, and tools in a specific domain and understand Big Data Technologies.

Learning Resources

Text Books:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that make sense of data, Cambridge University Press, 1st Edition, 2012, ISBN No.: 978-1-316-50611-0.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms," ISBN: 978-0-262-04630-5, 4th edition MIT press, 2022.
3.Parag Himanshu Dave, Himanshu Bhalchandra Dave, "Design and Analysis of Algorithms," Pearson Education, ISBN 81-7758-595-92, 2nd edition, 2013.
4.C. L. Liu, "Elements of Discrete mathematics," TMH Publication.
5.K.H. Rosen," Discrete Mathematics & Its Applications," McGraw Hill Education.

Reference Books:

1.C.M. Bishop, Pattern Recognition and Machine learning, Springer, 1st Edition, 2013, ISBN No.:978-81-322-0906-5.19.
2.Hastie, Tibshirani, Friedman, Introduction to statistical machine learning with applications in R, Springer, 2nd Edition, 2013, ISBN No.: 978-1-4614-7138-7.
3.Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms," Cambridge University Press, ISBN: 978-0-521-61390-3, 1st edition, 2004.
4.Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics," PHI, ISBN 978-81-203-1131-2.

@The CO-PO mapping table

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

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-DC-506 (A): Elective-1: Distributed Computing

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Operating Systems, Computer Networks, Algorithms

Companion Course, if any: NA

Preamble:

- Distributed Computing enables multiple independent systems to work together to achieve a common goal, appearing as a unified system to users.
- It addresses the need for scalable, reliable, and high-performance computing in modern applications such as cloud computing, big data, and IoT.
- The course introduces core concepts including system architectures, inter-process communication, synchronization, and coordination in distributed environments.
- Students will study fault tolerance, replication, and consistency models to understand how distributed systems remain robust and reliable.
- Practical applications such as distributed file systems (HDFS), data processing frameworks (Hadoop, Spark), and emerging technologies (blockchain, microservices) will be explored.
- The course emphasizes both theoretical foundations and practical implementation aspects to prepare students for real-world distributed system design.
- By the end of the course, students will be capable of analyzing, designing, and building distributed applications that are efficient, scalable, and fault-tolerant.

Course Objectives:

- To **UNDERSTAND** the principles and paradigms of distributed computing.
- To **EXPLORE** design and implementation challenges in distributed systems.
- To **STUDY** synchronization, consistency, fault tolerance, and security in distributed environments.
- To **INTRODUCE** current trends such as distributed file systems, cloud computing, and blockchain.

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

CO	Course Outcome	Bloom's Level
CO1:	**EXPLAIN** the core concepts and architectures of distributed systems.	3
CO2:	**APPLY** synchronization and concurrency control mechanisms.	3
CO3:	**ANALYZE** distributed algorithms for mutual exclusion, consensus, and election.	3
CO4:	**EVALUTE** fault tolerance, recovery, and replication techniques.	3
CO5:	**DESIGN** and implement simple distributed applications using appropriate tools and protocols.	3

Course Contents

Unit I	Introduction to Distributed Systems	(8 Hours)

Approved By:

Definition, Goals, Advantages, and Challenges, types of Distributed Systems, Architectural Styles (Client-Server, Peer-to-Peer, Middleware), Communication in Distributed Systems: RPC, RMI, Message Queues		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Processes and Communication**	**(8 Hours)**
Threads and Virtualization, Interprocess Communication, Group Communication, Remote Procedure Call (RPC), Remote Method Invocation (RMI), Sockets and Streams		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Synchronization and Coordination**	**(8 Hours)**
Clocks and Logical Time: Lamport Timestamps, Vector Clocks, Global State and Snapshot Algorithms, Mutual Exclusion Algorithms: Ricart-Agrawala, Maekawa's, Token-based, Election Algorithms: Bully, Ring		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Fault Tolerance and Recovery**	**(8 Hours)**
Failure Models: Crash, Omission, Byzantine, Reliable Communication, Checkpointing and Recovery, Replication and Consistency Models, Consensus Protocols (Paxos, Raft)		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Distributed File Systems and Applications**	**(8 Hours)**
NFS, AFS, HDFS, Naming and Directory Services, Distributed Databases, Case Studies: Google File System, Amazon Dynamo, Hadoop, Spark		
Mapping of Course Outcomes for Unit V	**CO5**	

Learning Resources

Text Books:

1."Distributed Systems: Principles and Paradigms" by Andrew S. Tanenbaum and Maarten van Steen
2."Distributed Systems: Concepts and Design" by George Coulouris, Jean Dollimore, Tim Kindberg

Reference Books:

1."Designing Data-Intensive Applications" by Martin Kleppmann
2."Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl
3.Research papers and case studies on Hadoop, Spark, Kubernetes, etc.

Web Links:

1. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/distributed-systemssurvey.pdf
2. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/DisSysUbiCompReport.html

e-Books:

1. https://www.distributedsystemscourse.com/

MOOC Courses:

***1. NPTEL courses* on SWAYAM—particularly for Hadoop, Dynamo, and Spark.**
2. https://www.mooc-list.com/tags/distributed-systems
3. https://www.mooc-list.com/tags/distributed-computing

Approved By:

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of M. Tech (Computer Engineering) (2025 Pattern)
R25-MCO-NLP-506 (B): Elective-1: Natural Language Processing

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Basics of Probability and Statistics, Programming in Python

Companion Course, if any: - NA

Preamble:
This course introduces students to Natural Language Processing (NLP), focusing on the theoretical foundations, linguistic components, and machine learning approaches used to build language-aware applications. The course progressively covers fundamental to advanced NLP techniques.

Course Objectives:

- To **GAIN** insights into the basics of human language processing.
- To **EXPLORE** foundational techniques in NLP like tokenization, parsing, tagging, and modelling.
- To **APPLY** statistical and deep learning models in solving NLP problems.
- To **EXPOSE** students to recent advancements such as transformer-based models.
- To **DEVELOP** the ability to implement real-world NLP solutions.

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

CO	Course Outcome	Bloom's Level
CO1:	**ACQUIRE** insights into basic concepts and challenges in NLP.	3
CO2:	**APPLY** probabilistic models and classification techniques to language data.	3
CO3:	**IMPLEMENT** parsing algorithms and analyze syntax structures.	3
CO4:	**PERFORM** semantic analysis, named entity recognition, and sentiment classification.	3
CO5:	Use modern deep learning models for advanced NLP tasks.	3

Course Contents

Unit I	Introduction to Natural Language Processing	(08 Hours)

Overview of NLP and its applications, Basics of linguistics: Syntax, Semantics, Morphology, Pragmatics, Text preprocessing: Tokenization, Stemming, Lemmatization, Stopword removal, Normalization, Challenges in NLP: ambiguity, domain sensitivity, multilingual and informal text, Tools and libraries: NLTK, SpaCy, use of text corpora, hands-on in Python.

Case Study: Preprocessing news articles using NLTK and SpaCy for sentiment analysis.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Language Modelling and Text Classification	(08 Hours)

N-gram Language Models, Smoothing Techniques (Laplace, Good-Turing), POS Tagging using Hidden Markov Models, Text Classification using Naïve Bayes, TF-IDF and Vector Space Model, Document Similarity Metrics, Bag-of-Words and N-gram features, Evaluation metrics: Precision, Recall, F1-Score, Handling class imbalance, Introduction to Scikit-learn for text classification.

Case Study: Spam email detection using TF-IDF and Naive Bayes.

Approved By:

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Syntax and Parsing Techniques**	**(08 Hours)**
Context-Free Grammar (CFG), Parsing: CYK, Earley, Shift-Reduce, Constituency and Dependency Parsing, Treebanks: Penn Treebank, Universal Dependencies, Parse tree construction and evaluation, Transition-based vs graph-based parsing, Shallow parsing (chunking). **Case Study:** Dependency parsing of legal documents using SpaCy.		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Semantics and Information Extraction**	**(08 Hours)**
Word Sense Disambiguation, Named Entity Recognition (NER), Sentiment Analysis, Semantic Role Labeling, Topic Modeling: Latent Dirichlet Allocation (LDA), Coreference Resolution, Relation Extraction, Text Summarization, Emotion Detection. **Case Study:** Sentiment and emotion analysis of Twitter data using NER and LDA.		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Deep Learning in NLP and Recent Trends**	**(08 Hours)**
Word Embeddings: Word2Vec, GloVe, FastText, Deep Learning Models: RNN, LSTM, GRU, Transformer-based Architectures: BERT, GPT, Applications: Machine Translation, Summarization, QA Systems, Transfer Learning in NLP, Fine-tuning Pretrained Models, Zero-shot and Few-shot Learning, NLP Ethics and Bias. **Case Study:** Fine-tuning BERT for question answering on the SQuAD dataset.		
Mapping of Course Outcomes for Unit V	CO5	

Learning Resources

Text Books:

1.Jurafsky, D., & Martin, J. H. – Speech and Language Processing, Pearson

2.Steven Bird, Ewan Klein, Edward Loper – Natural Language Processing with Python, O'Reilly

Reference Books:

1.Chris Manning and Hinrich Schütze – Foundations of Statistical Natural Language Processing, MIT Press

2.Yoav Goldberg – Neural Network Methods for Natural Language Processing, Morgan & Claypool Publishers

Web Links:

1.https://www.nltk.org/

2.https://spacy.io/

3.https://huggingface.co/

e-Books:

1.Speech and Language Processing (3rd Edition Draft) – Daniel Jurafsky & James H. Martin
https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf

2.Natural Language Processing with Python – Steven Bird, Ewan Klein, Edward Loper
https://tjzhifei.github.io/resources/NLTK.pdf

3.Neural Network Methods for Natural Language Processing – Yoav Goldberg
https://apeai.com/books/ML/Neural_Network_Methods_for_Natural_Language_Processing_by_Yoav_Goldberg.pdf

Approved By:

MOOC Courses:

1.Coursera: Natural Language Processing by Deep Learning AI.

2.edX: NLP with Python for ML.

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-AIH-506 (C): Elective-1: AI in Healthcare

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any:
Machine Learning, Data Science, Medical Terminology (Basics), Python Programming

Companion Course, if any: NA

Preamble:
Artificial Intelligence (AI) is transforming the healthcare sector by enabling early diagnosis, precision treatment, resource optimization, and personalized patient care. This course introduces AI techniques specifically tailored to healthcare applications, focusing on clinical decision support systems, medical imaging, disease prediction, drug discovery, and patient monitoring. The course integrates theoretical foundations, real-world case studies, and hands-on assignments to equip students with knowledge and skills to innovate in AI-driven healthcare.

Course Objectives:

- To **INTRODUCE** AI concepts and their relevance to healthcare systems.
- To **UNDERSTAND** data types, sources, and preprocessing techniques used in healthcare.
- To **EXPLORE** AI models and their applications in diagnosis, prediction, and treatment.
- To **ANALYZE** ethical, legal, and deployment challenges in AI healthcare systems.
- To **DEVELOP** practical AI solutions for real-world healthcare problems.

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

CO	Course Outcome	Bloom's Level
CO1:	**DESCRIBE** key AI concepts and their relevance in the healthcare domain.	3
CO2:	**APPLY** AI techniques to healthcare data for prediction, classification, and pattern discovery.	3
CO3:	**EVALUATE** AI models in terms of accuracy, interpretability, and clinical relevance.	3
CO4:	**DESIGN** AI-based systems for medical diagnosis, drug recommendation, or remote monitoring.	3
CO5:	**DISCUSS** ethical, legal, and societal implications of AI in healthcare.	3

Course Contents

Unit I	Introduction to AI in Healthcare	(08 Hours)

Overview of AI and ML in healthcare, healthcare data types (EHRs, imaging, signals), typical AI applications (diagnosis, treatment planning, monitoring).

Mapping of Course Outcomes for Unit I	CO1

Unit II	Data Preprocessing and Feature Engineering	(08 Hours)

Handling missing data, imbalanced classes, anonymization; medical ontologies and vocabularies (SNOMED, ICD); Feature extraction from structured/unstructured data.

Mapping of Course Outcomes for Unit II	CO2

Unit III	AI Models for Healthcare Applications	(08 Hours)

Approved By:

Supervised learning (SVM, Decision Trees, Neural Networks), Unsupervised learning (Clustering), Deep Learning (CNNs, LSTMs) for medical imaging, text mining, and bio signal analysis.		
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Use Cases and Applications**	**(08 Hours)**
Case Studies: Disease prediction (e.g., diabetes, cancer, heart disease), Medical image analysis (X-ray, MRI), Drug recommendation systems, Remote patient monitoring using wearable sensors.		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Challenges and Ethical Considerations**	**(08 Hours)**
Model interpretability, bias and fairness in AI, data privacy (HIPAA), legal frameworks, regulatory compliance (e.g., FDA), explainable AI (XAI) in healthcare.		
Mapping of Course Outcomes for Unit V	CO5	

Learning Resources

Text Books:

1.Topol, E. (2019). *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*. New York, NY: Basic Books. **ISBN:** 9781541644632

2.Franks, K. (2020). *Machine Learning and Artificial Intelligence in Healthcare: A Guide to Medical Applications*. New York, NY: Apress. **ISBN:** 9781484261034

3.Bohr, A., & Memarzadeh, K. (Eds.). (2020). *Artificial Intelligence in Healthcare*. Academic Press (Elsevier). **ISBN:** 9780128184387

Reference Books:

1. **Reddy, C. K., & Aggarwal, C. C. (Eds.). (2015).** *Healthcare Data Analytics*. CRC Press, Taylor & Francis Group. **ISBN:** 9781482232111

2. **Ramsundar, B., Zaremba, W., Nair, V., & Adams, R. (2022).** *AI in Healthcare: A Practical Guide for Healthcare Professionals*. O'Reilly Media. **ISBN:** 9781098102974

Web Links:

1. **Journal of Biomedical Informatics**
   Miotto, R., Wang, F., Wang, S., Jiang, X., & Dudley, J. T. (2018). Deep learning for healthcare: review, opportunities and challenges. *Journal of Biomedical Informatics*, 78, 103–111. https://doi.org/10.1016/j.jbi.2018.01.014

2. **Nature Medicine**
   Esteva, A., Robicquet, A., Ramsundar, B., Kuleshov, V., DePristo, M., Chou, K., ... & Dean, J. (2019). A guide to deep learning in healthcare. *Nature Medicine*, 25(1), 24–29. https://doi.org/10.1038/s41591-018-0316-z

3. **IEEE Journal of Biomedical and Health Informatics (IEEE JBHI)**
   Rajkomar, A., Dean, J., & Kohane, I. (2019). Machine learning in medicine. *IEEE Journal of Biomedical and*

Approved By:

Health Informatics, 23(1), 10–19.
https://doi.org/10.1109/JBHI.2018.2888788

e-Books:

1. A Guide to Artificial Intelligence in Healthcare

***Author:* Dr. Bertalan Meskó / The Medical Futurist**

***Link:* [Download PDF](https://ca-hwi.org/public/uploads/pdfs/ArtificialIntelligenceinHealthcare.pdf) ([Leanpub][1])**

2. Artificial Intelligence (AI) in Healthcare and Research

***Publisher:* Nuffield Council on Bioethics**

***Link:* [Download PDF](https://www.nuffieldbioethics.org/wp-content/uploads/Artificial-Intelligence-AI-in-healthcare-and-research-1.pdf) ([Nuffield Council on Bioethics][2], [Nuffield Council on Bioethics][3])**

3. A Short Guide for Medical Professionals in the Era of Artificial Intelligence

***Authors:* Bertalan Meskó & Márton Görög (npj Digital Medicine)**

***Link:* [Download PDF](https://bpb-us-e2.wpmucdn.com/faculty.sites.uci.edu/dist/1/880/files/2021/03/AI-for-MD.pdf) ([BPB][4])**

4. Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes

***Author:* A. Panesar (via PDF archive)**

***Link:* [Download PDF](https://aitskadapa.ac.in/e-books/AI%26DS/MACHINE%20LEARNING/Machine%20Learning%20and%20AI%20for%20Healthcare_%20Big%20Data%20for%20Improved%20Health%20Outcomes%20%28%20PDFDrive%20%29.pdf)**

MOOC Courses:

1.https://onlinecourses.nptel.ac.in/noc25_ch96/preview

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-QC-508: Quantum Computing

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Linear Algebra, Classical Computing, Algorithms

Companion Course, if any: Laboratory Practice II

Preamble:

- Distributed Computing enables multiple independent systems to work together to achieve a common goal, appearing as a unified system to users.
- It addresses the need for scalable, reliable, and high-performance computing in modern applications such as cloud computing, big data, and IoT.
- The course introduces core concepts including system architectures, inter-process communication, synchronization, and coordination in distributed environments.
- Students will study fault tolerance, replication, and consistency models to understand how distributed systems remain robust and reliable.
- Practical applications such as distributed file systems (HDFS), data processing frameworks (Hadoop, Spark), and emerging technologies (blockchain, microservices) will be explored.
- The course emphasizes both theoretical foundations and practical implementation aspects to prepare students for real-world distributed system design.
- By the end of the course, students will be capable of analyzing, designing, and building distributed applications that are efficient, scalable, and fault-tolerant.

Course Objectives:

- To **INTRODCE** the mathematical foundations and principles of quantum mechanics relevant to computing.
- To **UNDERSTAND** quantum gates, quantum circuits, and quantum algorithms.
- To **EXPLORE** quantum programming frameworks and simulators.
- To **EVALUATE** the applications and challenges of quantum computing in cryptography, optimization, and machine learning.

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

CO	Course Outcome	Bloom's Level
CO1:	**UNDERSTAND** the fundamentals of quantum mechanics from a computing perspective.	3
CO2:	**DESIGN** and **SIMULATE** quantum logic circuits using quantum gates.	3
CO3:	**IMPLEMENT** basic quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's algorithms.	3
CO4:	**ANALYZE** the impact of quantum computing in cryptography and complexity theory.	3

Approved By:

CO5:	**APPLY** quantum programming tools such as Qiskit, Cirq, or IBM Quantum Experience.	3

Course Contents

Unit I	Fundamentals of Quantum Mechanics	(08 Hours)
Introduction to quantum computing, Qubits and quantum states, Dirac notation and linear algebra review, Superposition and entanglement, Measurement in quantum systems		
Mapping of Course Outcomes for Unit I	**CO1**	

Unit II	Quantum Gates and Circuits	(08 Hours)
Single and multi-qubit gates (X, Y, Z, H, S, T, CNOT, SWAP, etc.), Quantum circuit representation, Tensor products and unitary operations, Bloch sphere representation, Quantum teleportation, and super dense coding		
Mapping of Course Outcomes for Unit II	**CO2**	

Unit III	Quantum Algorithms – I	(08 Hours)
Deutsch and Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm, Grover's search algorithm, Quantum speedup and complexity analysis		
Mapping of Course Outcomes for Unit III	**CO3**	

Unit IV	Quantum Algorithms – II	(08 Hours)
Shor's algorithm for integer factorization, Quantum Fourier Transform (QFT), Phase estimation algorithm, Quantum error correction: Bit-flip and phase-flip codes		
Mapping of Course Outcomes for Unit IV	**CO4**	

Unit V	Quantum Cryptography and Security	(08 Hours)
Classical vs. quantum cryptography, Quantum key distribution (QKD) – BB84 protocol, Post-quantum cryptography, Quantum random number generation, Security challenges in quantum networks		
Mapping of Course Outcomes for Unit V	**CO5**	

Learning Resources

Text Books:

1.Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press

2.Mermin, N. David, Quantum Computer Science: An Introduction, Cambridge University Press

Reference Books:

1.Quantum Computing: A Gentle Introduction by Eleanor G. Rieffel and Wolfgang H. Polak

2.Quantum Computation by Phillip Kaye, Raymond Laflamme, and Michele Mosca

3.IBM Qiskit documentation and tutorials

4.Research papers from IEEE/ACM Quantum Computing journals

Web Links:

1. https://quantumai.google/

Approved By:

e-Books:
1.http://mmrc.amss.cas.cn/tlb/201702/W020170224608149940643.pdf
2.http://mmrc.amss.cas.cn/tlb/201702/W020170224608150244118.pdf

MOOC Courses:
1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview
2. https://www.coursera.org/learn/introduction-to-quantum-information
3. https://www.coursera.org/learn/quantum-computing-for-everyone-an-introduction
4. https://www.mooc-list.com/course/introduction-quantum-computing-coursera

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05

Approved By:

Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering Sangamner
First Year of MTech in Computer Engineering (2025 Course)
R25-MCO-ACN-509: Advanced Computer Network

Teaching Scheme:	**Credit**	**Examination Scheme:**
Lecture: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Computer Network

Companion Course, if any: Laboratory Practice II

Course Objectives:
The course aims to:

1. To Understand (Remember & Understand) fundamental network design principles, architectures, and their performance characteristics.
2. To Analyze (Analyze) queueing models and traffic management techniques for evaluating network performance.
3. To Apply (Apply) graph-based network modeling, algorithms, and heuristics for designing optimal network topologies.
4. To Evaluate (Evaluate) the impact of various network protocols and architectures using performance analysis techniques.
5. To Create (Create) innovative networking solutions and research methodologies in emerging areas such as cloud computing, AI-driven networking, and quantum networks.

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

CO	**Course Outcome**	**Bloom's Level**
CO1:	**DESCRIBE** the advanced concepts in network design, architectures, and network characteristics.	3
CO2:	**APPLY** queuing models and performance evaluation techniques to analyze network behavior.	3
CO3:	**ANALYZE** real-world networking problems using graph-based modeling and optimization techniques.	3
CO4:	**EVALATE** network performance, QoS parameters, and security issues in modern networks.	3
CO5:	**DESIGN** and **IMPLEMENT** efficient networking solutions using cloud infrastructure, AI, and emerging technologies	3

Course Contents

Unit I	**Introduction to Advanced Networking**	**(08 Hours)**

Introduction: Types of Networks. Network design issues. Network design tools, advanced network architectures. Reliable data delivery, Routing and forwarding, resource allocation, Mobility, Networked applications, Data in support of network design, General Principles of Network Design, network characteristics.

#Exemplar/Case Studies	**Case Study: Google's B4 Network: A Global SDN for Datacenters**

Approved By:

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Delay Models in Data Networks**	**(08 Hours)**
Delay Models in Data Networks: Modeling and Performance evaluation. Multiplexing of Traffic on a Communication Link, Queuing Models- Little's Theorem, Probabilistic Form of Little's Theorem, Application of Little's Theorem, Queuing Systems: M/M/1, M/M/2, M/M/m, M/M/∞, M/M/m/m, M/M/m/q, M/M/1/N, D/D/1, M/G/1 System, M/G/1 Queues with Vacations, Reservations and Polling, Priority Queuing.		
#Exemplar/Case Studies	**Case Study: Netflix Video Streaming Performance & QoS Optimization**	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Network Modeling & Optimization**	**(08 Hours)**
Modeling Networks as Graphs, Problems & algorithms: Multipoint line topology- CMST, Esau-William's Algorithm, Sharma's Algorithm, Bin Packing algorithms. Terminal Assignment- Greedy algorithm and exchange algorithms, Concentrator location- COM, Add, Drop, Relaxation algorithm. Network of queues, Open, closed and semi-open queues, Network node, Kleinrock's Independent approximation.		
#Exemplar/Case Studies	**Case Study: Facebook NetNORAD: AI-driven Network Failure Detection**	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Performance Analysis & Queuing Networks**	**(08 Hours)**
Problem definition : Multipoint line layout heuristics, CMST algorithm, ESAUWilliam's algorithm, Sharma's algorithm, Unified algorithm, Bin packing, Terminal assignments, Concentrator location. Analysis :- Queuing Networks, Closed Queuing Network Example, Nodes in a Packet Switched Network (PSN), Queuing Network Model of Nodes in a PSN, Queuing Network, Analysis of a PSN, performance analysis of Data Link Layer, Network layer, QoS		
#Exemplar/Case Studies	**Case Study: Amazon Web Services (AWS) Network Performance Analysis**	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Cloud Networks & Emerging Trends**	**(08 Hours)**
Cloud Network Infrastructure: AWS, Azure, Google Cloud, Emerging Trends: Quantum Networks, AI-Driven Network Management, Research Methodologies in Network Science, Simulation Tools: NS3, Mininet, OMNeT++, Wireshark, Case Studies: Google B4, Facebook NetNORAD, Netflix Content Distribution, Future Research Challenges in Computer Networks.		
#Exemplar/Case Studies	**Case Study: Microsoft Azure's Quantum Networking Research**	
Mapping of Course Outcomes for Unit V	CO5	
Learning Resources		

Approved By:

Text Books:

1. **Larry L. Peterson, Bruce S. Davie** – *Computer Networks: A Systems Approach*, 6th Edition, Morgan Kaufmann.
2. **Andrew S. Tanenbaum, David J. Wetherall** – *Computer Networks*, 5th Edition, Pearson.
3. **William Stallings** – *Data and Computer Communications*, 10th Edition, Pearson.
4. **Behrouz A. Forouzan** – *Data Communications and Networking*, 5th Edition, McGraw-Hill.
5. **Raj Jain** – *High-Performance TCP/IP Networking: Concepts, Issues, and Solutions*, Pearson

Reference Books:

1. **Dimitri Bertsekas, Robert G. Gallager** – *Data Networks*, 2nd Edition, Prentice Hall.
2. **James F. Kurose, Keith W. Ross** – *Computer Networking: A Top-Down Approach*, 8th Edition, Pearson.
3. **George Kesidis** – *An Introduction to Queueing Systems with Applications to Traffic Engineering*, Springer.
4. **Leonard Kleinrock** – *Queueing Systems: Theory, Vol. 1*, Wiley-Interscience.
5. **Douglas E. Comer** – *Internetworking with TCP/IP*, Vol. 1, Pearson.
6. **Thomas D. Nadeau, Ken Gray** – *SDN: Software Defined Networks*, O'Reilly Media.
7. **Antonios Atlasis** – *SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization*, Kindle Edition.
8. **Russ White, Jeff Tantsura** – *Navigating Network Complexity: Next-Generation Routing with SDN, Service Virtualization, and Service Chaining*, Addison-Wesley.
9. **Natarajan Meghanathan** – *Advanced Topics in Computer Networks*, IntechOpen (Free Open Access).

e-Books:

- **RFCs (Request for Comments)** from IETF – https://www.ietf.org/rfc.html
- **IEEE Communications Surveys & Tutorials** – https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=9739
- **ACM SIGCOMM Conference Papers** – https://conferences.sigcomm.org/
- **Network Simulation Tools** (NS3, Mininet, OMNeT++) Documentation

MOOC Courses:

1. **https://onlinecourses.swayam2.ac.in/ntr25_ed100/preview**
2. **https://onlinecourses.swayam2.ac.in/ntr25_ed138/preview**
3. **https://onlinecourses.nptel.ac.in/noc25_cs126/preview**

CO-PO mapping Table:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-ASE-510: Advanced Software Engineering

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Software Engineering, Software Testing

Companion Course, if any: Laboratory Practice II

Preamble:

The subject Advanced Software Engineering is designed to provide in-depth knowledge and advanced concepts in software development practices, methodologies, and emerging trends. As software systems grow increasingly complex and critical to various domains, there is a growing demand for software engineers equipped with the ability to architect, develop, and manage high-quality software systems effectively.

This course emphasizes both theoretical foundations and practical applications of advanced software engineering principles. It covers contemporary software development methodologies, software reuse; and software project management. It also includes aspects of software quality assurance, validation & verification techniques, and security considerations in software engineering.

Course Objectives:

1.Able to manage a project including planning, scheduling and risk assessment/management.

2. To **PREPARE**, demonstrate an understanding of the proper contents of a software requirements document.

3. To **IDENTIFY** specific components of a software design that can be targeted for reuse.

5. **UNDERSTAND** and able to apply the key software engineering economic fundamentals to real-world software economic issues.

6. **ILLUSTRATE** through example the key software life cycle economics, including product and process life cycles; portfolios; proposals; investment decisions; pricing and costing, and earned value management.

7. To **LEARN** and **UNDERSTAND** software testing techniques in process of SDLC and engineering methods.

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

CO	Course Outcome	Bloom's Level
CO:1	To **SOLVE** social issues and real-life engineering problems.	3
CO:2	To **IDENTIFY contemporary** issues in applying Software Cost Estimation techniques.	3
CO:3	To **DEMONSTRATE** proficiency in software development cost estimation.	3
CO:4	**ABILITY** to apply software testing techniques in process of SDLC and engineering methods.	3
CO:5	**APPLY** the knowledge on testing and creating test reports based on the automation tools.	3

Approved By:

Course Contents		
Unit I	**Secure Software Engineering**	**(08 Hours)**
Security a software Issue: introduction, the problem, Software Assurance and Software Security, Threats to software security, Sources of software insecurity, Benefits of Detecting Software Security **What Makes Software Secure:** Properties of Secure Software, Influencing the security properties of software, Asserting and specifying the desired security properties. **Requirements Engineering for secure software:** Introduction, the SQUARE process Model, Requirements elicitation and prioritization		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Secure Software Architecture and Design**	**(08 Hours)**
Secure Software Architecture and Design: Introduction, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles, security guidelines and attack patterns **Secure coding and Testing:** Code analysis, Software Security testing, Security testing considerations throughput the SDLC		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Software Life Cycle Economics**	**(08 Hours)**
Product, Project, Program, Portfolio, Product Life Cycle, Project Life Cycle, Proposals, Investment , Decisions, Planning Horizon, Price and Pricing, Cost and Costing, Performance Measurement, Earned Value Management, Termination Decisions, Replacement and Retirement Decisions.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Life Cycle Testing and Test Project Management**	**(08 Hours)**
SDLC Testing – Testing in the Requirement Phase - Logical & Physical Design Phase, Test Project Management – Estimating Test Costs and Duration – Staffing - Testing Team, Building a Software Testing Environment – Creating an environment supportive of software testing – Building Software Testing Process – Selecting and Installing Software Testing Tools – Building Software Tester Competency		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Advanced Testing in Software Testing**	**(08 Hours)**
Test Coverage and Test Metrics Management, Improving the Test Processes – Test Process Optimization, Empirical Software Testing and Analysis, **SOA Testing – General Principles and Procedures,** Data Warehouse Testing, Cloud Testing, Big Data Testing, Web Apps Testing		
Mapping of Course Outcomes for Unit V	**CO5**	
Learning Resources		
Text Books: 1.Software Security Engineering: Julia H. Allen, Pearson Education. 2.Karl Popp, Advances in Software Economics: A Reader on Business Models and Partnering, Books on Demand, 2011. 3.Glenford J. Myers, Corey Sandler, Tom Badgett - The Art of Software Testing, 3rd Edition, 2011. 4.Ian Sommeriele, “Software Engineering”, Addison Wesley.		

Approved By:

Reference Books:

1.Developing Secure Software: Jason Grembi, Cengage Learning.
2.Software Security: Richard Sinn, Cengage Learning.
3.Guide to Software Engineering Body of Knowledge Version 3.0 – IEEE Computer Society- chapter 12 Barry W.Boehm, Software Engineering Economics, IEEE transactions on Software Engineering.
4.Donald J. Reifer, Making the Software Business Case: Improvement by the Numbers (SEI Series in Software Engineering), Addison Wesley.
5.Aditya P. Mathur, "Foundations of Software Testing: Fundamental Algorithms and Techniques", Pearson Education India, 2007.
6.Anne Mette Jonassen Hass, "Guide to Advanced Software Testing", Artech House, 2008.
7William E. Perry, "Effective Methods for Software Testing: Includes Complete Guidelines" 3rd Edition, Wiley Publications, 2006.
8.William E. Lewis, "Software Testing and Continuous Quality Improvement", Third Edition, Auerbach Publications, 2008.

Web Links:

1. Purdue ASE: engineering.purdue.edu/online/courses/software-engineering.
2. IBM Testing: ibm.com/think/topics/software-testing.

e-Books:

1. Advanced Software Engineering: Expanding the Frontiers of Software
Author: Dr. Anthony Finkelstein (Editor).
2. Formal Methods: An Advanced Approach to Software Engineering
Author: Jonathan P. Bowen.
3. Software Testing: Principles and Practices
Author: Srinivasan Desikan, Gopalaswamy Ramesh.
4. Lessons Learned in Software Testing
Authors: Cem Kaner, James Bach, Bret Pettichord.

MOOC Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs61/preview.
2. https://onlinecourses.nptel.ac.in/noc20_cs68/preview.

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-LPII-511: Laboratory Practice II

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hours/Week	**02**	**Term Work: 25 Marks** **Oral: 25 Marks**

Prerequisite Courses, if any: Classical Computing, Algorithms, Computer Network and Security, Software Engineering, and Software Testing

Companion Course, if any: Quantum Computing, Advanced Computer Network, Advanced Software Engineering

Course Objectives:

- To **DEVELOP** an understanding of fundamental quantum operations, gates, and protocols through hands-on simulation using Qiskit.
- To **IMPLEMENT** and **ANALYZE** quantum algorithms and cryptographic protocols that demonstrate the advantages of quantum computation.
- To **DEVELOP** and **SIMULATE** efficient, scalable, and real-world network architectures using modern simulation tools.
- To **APPLY** analytical and algorithmic techniques for network performance evaluation and topology optimization.
- To **UNDERSTAND** and **APPLY** practices in software assurance, security, testing, and documentation across the software development lifecycle.
- To **EVALUATE** and **ANALYZE** software projects using financial, technical, and testing metrics, and simulate real-world testing environments including cloud and big data systems.

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

CO	Course Outcome	Bloom's Level
CO1:	**SIMULATE** and **VISULIZE** the behavior of quantum states and gates using Qiskit, enhancing the conceptual clarity of quantum mechanics in computation.	3
CO2:	**APPLY** quantum computing concepts to solve real-world problems such as search, decision problems, teleportation, and secure communication.	3
CO3:	**DESIGN**, **SIMULATE**, and **TROUBLESHOOT** multi-tier and SDN-based networks using tools like Packet Tracer, GNS3, Mininet, and Wireshark.	3
CO4:	**ANALYZE** and **MODEL** network behavior using simulation libraries (SimPy, NS3), and apply graph and queuing theories to evaluate network efficiency and delay.	3
CO5:	**APPLY** software engineering principles to analyze, document, and test real-world software systems, including web services and cloud-based applications.	3

Approved By:

CO6:	**EVALATE** and **COPMPARE** software projects using cost estimation, risk analysis, and earned value management techniques for effective decision-making.	3

List Of Assignments

Part A: Quantum Computing

1. Simulate and analyze the effect of basic single-qubit quantum gates (X, Y, Z, H) on qubit states using Qiskit.
2. Implement the Deutsch-Jozsa algorithm to determine if a given function is constant or balanced using quantum parallelism.
3. Implement Grover's search algorithm to find a target element in an unsorted database.
4. Simulate the quantum teleportation protocol to transfer a qubit state from the sender to the receiver using entanglement and classical communication.
5. Simulate the BB84 quantum key distribution protocol to understand secure quantum communication.

Part B: Advanced Computer Network

1. Design and Simulation of a Scalable Multi-Tier Network Architecture Using Packet Tracer/GNS3
2. Implementation and Analysis of Queuing Delay Models Using SimPy in Python
3. Graph-Based Optimization of Network Topologies Using Esau-Williams and Sharma's Algorithms
4. Performance Evaluation of Packet-Switched Networks Using Queuing Network Models in NS3
5. Traffic Monitoring and Protocol Analysis in Cloud-Based SDN Networks Using Mininet and Wireshark

Part C: Advanced Software Engineering

1. Prepare a brief report on software assurance and software security with real-life case studies (e.g., Heartbleed, Log4j).
2. Preparation of Software Requirement Specification Document, Design Documents and Testing Phase related documents.
3. Analyze and compare the cost and value of two software development projects.

- Select two real-world or case-study-based software projects.
- Prepare a comparative analysis including:
  - Product & Project Life Cycle Phases
  - Investment Decisions
  - Cost & Pricing Strategies
  - Earned Value Management (EVM)
  - Termination or Replacement Decision Criteria.
- Report with financial charts, ROI, and lifecycle diagrams.

MS Excel or any tool-based cost calculation sheet.

Approved By:

4. Perform functional and regression testing of a Web Service.

- Use a public SOAP/REST API (e.g., OpenWeatherMap, Dummy REST API).
- Write test cases to validate:
  - Request-Response Schema
  - Input validation
  - Error handling
- Use Postman or SoapUI to run and report the tests.
- Test execution report (JSON or HTML)

API documentation review and functional checklist.

5. Design a strategy to test a Big Data or Cloud-based application.

- Choose a Big Data platform (e.g., Hadoop or Spark) or Cloud environment (e.g., AWS/Azure).
- Prepare a test strategy document covering:
  - Test environments setup
  - Data volume handling techniques
  - Performance testing plan
  - Security testing elements
- Strategic Test Plan document (PDF/Word)
- Optional: Screenshots or tool setup steps

Learning Resources

Text Books:

1.Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press
2.Andrew S. Tanenbaum, David J. Wetherall – Computer Networks, 5th Edition, Pearson.
3.Glenford J. Myers, Corey Sandler, Tom Badgett - The Art of Software Testing, 3rd Edition, 2011.
4.Ian Sommeriele, "Software Engineering", Addison Wesley.

Reference Books:

1.IBM Qiskit documentation and tutorials
2.Research papers from IEEE/ACM Quantum Computing journals
3.Russ White, Jeff Tantsura – Navigating Network Complexity: Next-Generation Routing with SDN, Service Virtualization, and Service Chaining, Addison-Wesley.
4.Natarajan Meghanathan – Advanced Topics in Computer Networks, IntechOpen (Free Open Access).
5.Guide to Software Engineering Body of Knowledge Version 3.0 – IEEE Computer Society- chapter 12 Barry W.Boehm, Software Engineering Economics, IEEE transactions on Software Engineering.
6.Anne Mette Jonassen Hass, "Guide to Advanced Software Testing", Artech House, 2008.

@The CO-PO mapping table

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

Approved By:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-MEC-512(A): Elective II: Multi-Cloud Architecture

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	CCE: 50 Marks End Sem (Paper): 50 Marks

Companion Course, if any: NA

Course Objectives:

- To **INTRODUCE** the fundamentals and significance of multi-cloud computing.
- To **COMPARE** major cloud platforms and assess service compatibility.
- To **DESIGN** and **DEVELOP** scalable and resilient multi-cloud solutions.
- To **INTEGRATE** security, governance, and compliance into multi-cloud environments.
- To **EQUIP** learners with tools for monitoring, orchestration, and optimization in multi-cloud setups.

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

CO	Course Outcome	Bloom's Level
CO1:	**UNDERSTAND** and **ARTICUTATE** the need and principles of multi-cloud architecture.	3
CO2:	**EVLATE** offerings of major cloud providers and choose appropriate services.	3
CO3:	**ARTICUTATE**, **DESIGN**, and **DEPLOY** multi-cloud applications.	3
CO4:	Implement security, governance, and regulatory compliance in multi-cloud systems.	3
CO5:	Utilize orchestration, monitoring, and optimization tools for managing multi-cloud infrastructures.	3

Course Contents

Unit I	Introduction to Multi-Cloud Architecture	(08 Hours)

Fundamentals of Cloud Computing (IaaS, PaaS, SaaS), Multi-Cloud vs Hybrid Cloud vs Single Cloud Business Drivers for Multi-Cloud Adoption, Key Challenges and Risk Management, Multi-Cloud Design Principles, Architecture Patterns in Multi-Cloud Environments, Multi-Cloud Use Cases (e.g., Failover, Redundancy, Cost Efficiency)

#Exemplar/Case Studies	Netflix's Transition to Multi-Cloud for High Availability and Resilience
Mapping of Course Outcomes for Unit I	CO1

Unit II	Major Cloud Platforms and Services	(08 Hours)

Approved By:

Overview of AWS, Azure, GCP, Compute Services Comparison (EC2, Azure VM, GCE),Storage and Networking Comparisons, Database & Big Data Offerings across Clouds, IAM (Identity and Access Management) Differences, Billing and Pricing Models, Tools for Multi-Cloud Selection & Assessment.		
#Exemplar/Case Studies	Fintech Startup's Comparative Deployment on AWS, Azure, and GCP	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Designing and Building Multi-Cloud Solutions**	**(08 Hours)**
Designing Portable Workloads, Microservices and Containerization (Docker, Kubernetes), Load Balancing and Traffic Distribution, Data Synchronization across Cloud Providers, Service Meshes (Istio, Consul), Case Studies: Architecture Blueprints of Multi-Cloud Applications, Tools for Infrastructure as Code (Terraform, Pulumi).		
#Exemplar/Case Studies	Global E-Commerce Platform Using Kubernetes and Terraform across AWS & Azure	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Security, Compliance, and Governance in Multi-Cloud**	**(08 Hours)**
Security Threats in Multi-Cloud Systems, Encryption and Key Management, IAM & Identity Federation (SSO, OAuth, SAML), Multi-Cloud Governance Frameworks, Regulatory Compliance (GDPR, HIPAA, PCI DSS), Security Monitoring and Event Logging, Best Practices in Policy Enforcement.		
#Exemplar/Case Studies	Healthcare SaaS Provider Implementing HIPAA Compliance in Multi-Cloud Setup	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Monitoring, Orchestration, and Cost Optimization**	**(08 Hours)**
Multi-Cloud Monitoring Tools (Prometheus, Grafana, Cloud-native tools), Centralized Logging & Observability, Orchestration Using Kubernetes in Multi-Cloud, CI/CD Pipelines in Multi-Cloud (Jenkins, GitHub Actions), Cost Management and Billing Tools. Disaster Recovery and High Availability Strategies, SLAs and Performance Tuning in Multi-Cloud		
#Exemplar/Case Studies	Media Streaming Service Using Prometheus, Grafana, and Cloud Billing Tools for Cost Optimization	
Mapping of Course Outcomes for Unit V	CO5	

Learning Resources

Text Books:

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Pearson Education.
2. "Architecting the Cloud" by Michael J. Kavis, Wiley.
3. "Multi-Cloud Architecture and Governance" by Jeroen Mulder, Packt Publishing.

Approved By:

Reference Books:

1. "Designing Multi-Cloud Applications" by Billy Yuen, Andy Domeier, Nathan Taber, O'Reilly Media.
2. "Cloud Computing: Principles and Paradigms" by Rajkumar Buyya et al., Wiley.
3. "Terraform: Up & Running" by Yevgeniy Brikman, O'Reilly Media.

e-Books:

1. https://www.cio.gov/assets/resources/Multi-Cloud%20and%20Hybrid%20Cloud%20Guide_v4_Final.pdf

2.**https://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf**

Online Resources / NPTEL Courses:

1.NPTEL: Cloud Computing by Prof. Rajkumar Buyya / Prof. Soumya Kanti Ghosh - https://nptel.ac.in/courses/106105167

2.NPTEL: Introduction to Cloud Computing by Prof. Sudarshan Iyengar - https://nptel.ac.in/courses/106105183

3.AWS Skill Builder - https://explore.skillbuilder.aws

4.Microsoft Learn: Azure Fundamentals - https://learn.microsoft.com/en-us/training/paths/azure-fundamentals/

5.Google Cloud Skills Boost - https://www.cloudskillsboost.google

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							

Approved By:

L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of M. Tech (Computer Engineering) (2025 Pattern)
R25-MCO-MEC-512 (B): Elective II: Generative Artificial Intelligence

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Introduction to Artificial Intelligence, Probability and Statistics

Companion Course, if any: - NA

Preamble:
Generative Artificial Intelligence (GAI) represents a paradigm shift in how machines can autonomously create data resembling human-created content. From text and images to code and audio, GAI is reshaping industries by enabling intelligent systems to assist or even replace human creativity. This course provides foundational to advanced knowledge on generative models, enabling learners to build, evaluate, and deploy these models responsibly and effectively.

Course Objectives:
- To **INTRODUCE** the fundamental concepts and applications of Generative Artificial Intelligence.
- To **UNDERSTAND** key generative models such as GANs, VAEs, and Transformer-based models.
- To **EXPLORE** domain-specific applications including text, image, code, and multimodal generation.
- To **PROVIDE** hands-on experience in using state-of-the-art generative tools and frameworks.
- To **FOSTER** awareness about ethical, legal, and societal implications of generative technologies.

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

CO	Course Outcome	Bloom's Level
CO1:	Describe the basic principles, capabilities, and ethical concerns of Generative AI.	3
CO2:	**IMPLEMET** foundational models for text generation using transformer-based architectures.	3
CO3:	**ANALYZE** and **APPLY** generative models such as GANs and VAEs for image and multimodal content Creation.	3
CO4:	Use domain-specific generative tools for programming and music applications, with understanding of evaluation criteria.	3
CO5:	Evaluate recent advancements, challenges, and real-world applications of Generative AI systems.	3

Course Contents

Unit I	Introduction to Generative AI and Foundation Models	(08 Hours)

Basics of AI and Machine Learning, Introduction to Generative AI: Definition, Scope, Applications and Overview of Foundation Models (e.g., GPT, BERT, DALL·E), Key Concepts: Pre-training, Fine-tuning, Prompting, Prompt-based Learning, Ethical Concerns and Responsible Use, Generative AI Use Cases.
Case Study: Exploring GPT for Conversational AI

Mapping of Course Outcomes for Unit I	CO1

Unit II	Text Generation Techniques	(08 Hours)

Approved By:

Language Modeling: N-gram, RNNs, LSTMs, Transformer Architecture and Attention Mechanism, Working of Self-Attention, Understanding Positional Encoding, Pretrained Language Models: GPT, BERT, T5, Prompt Engineering, Few-shot and Zero-shot Learning, Text Generation Applications.

Case study: Text Generation using Transformer-Based Models

Mapping of Course Outcomes for Unit II	CO2

Unit III	**Image and Multimodal Generation**	**(08 Hours)**

Generative Adversarial Networks (GANs): Basic Architecture, Types and Applications, Variational Autoencoders (VAEs): Working and Comparison with GANs, Diffusion Models: Overview and Use in Image Generation (DALL·E 2, Stable Diffusion), Image Captioning, Visual Question Answering, Multimodal Models: CLIP, Flamingo.

Case Study: Image Generation using GANs

Mapping of Course Outcomes for Unit III	CO3

Unit IV	**Code and Music Generation with Generative AI**	**(08 Hours)**

Code Generation: Codex, GitHub Copilot, Natural Language to Code, Introduction to Music Generation: MuseNet, Jukebox, Evaluation Metrics for Generative Content: BLEU, ROUGE, FID, Challenges in Generated Media: Quality, Coherency, Legal and Ethical Implications.

Case Study: Code Generation with GitHub Copilot

Mapping of Course Outcomes for Unit IV	CO4

Unit V	**Advanced Topics and Applications**	**(08 Hours)**

Advanced Techniques: Reinforcement Learning with Human Feedback (RLHF), Fine-tuning Large Models for Domain-Specific Applications, Applications in Healthcare, Education, and Entertainment, Open Challenges and Future Directions in Generative AI, Hands-on with Open-source Tools.

Case Study: Implementation of a multimodal AI solution using CLIP and DALL·E to design automated, prompt-driven marketing posters.

Mapping of Course Outcomes for Unit V	CO5

Learning Resources

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press, 2016.
2. Sebastian Raschka, Yuxi Liu, Vahid Mirjalili – Machine Learning with PyTorch and Scikit-Learn, Packt, 2022.

Reference Books:

1. Andriy Burkov – The Hundred-Page Machine Learning Book, 2019.
2. Francois Chollet – Deep Learning with Python, Second Edition, Manning Publications, 2021.
3. Palash Goyal, Sumit Pandey, Karan Jain – Deep Learning for Natural Language Processing, Apress, 2018.

Web Links:

1.https://huggingface.co
2.https://openai.com/research
3.https://keras.io/guides/
4.https://pytorch.org/tutorials/
5.https://deepai.org/

Approved By:

e-Books:

1.The Illustrated Transformer by Jay Alammar – https://jalammar.github.io/illustrated-transformer/

2.Dive into Deep Learning – https://d2l.ai

3.GANs in Action by Jakub Langr and Vladimir Bok – Available on Manning & GitHub.

MOOC Courses:

1. https://www.coursera.org/learn/generative-ai-with-llms

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-MEC-512 (C): Elective II: Deep Learning

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Linear Algebra, Statistics and Probability, Advanced Machine Learning

Companion Course, if any: NA

Course Objectives:

- **UNDERSTAND** fundamental concepts of deep learning.
- **APPLY** deep learning algorithms to solve real-world problems.
- **DEVELOP** and **EVALUATE** deep learning models.
- Critically **ANALYZE** deep learning methodologies.

Course Outcomes:

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

CO1: **FUNDAMENTALS**: Demonstrate mastery of fundamental deep learning concepts.

CO2: **APPLICATION**: Apply deep learning algorithms to solve practical engineering problems.

CO3: Model Development: Design, implement, and evaluate deep learning models.

CO4: **CRITICAL ANALYSIS**: Critically evaluate deep learning methodologies and their limitations.

CO5: **PROBLEM SOLVING**: Develop and implement solutions using deep learning techniques appropriate to given contexts

Course Contents

Unit I	Foundations of Deep Learning-	(08 Hours)

Introduction to Artificial Neural Networks (ANNs), Perceptrons and Multilayer Perceptrons (MLPs), Activation Functions (Sigmoid, Tanh, ReLU, Leaky ReLU), Backpropagation Algorithm, Optimization Algorithms (Gradient Descent, Stochastic Gradient Descent, Adam), Regularization Techniques (Dropout, L1/L2 Regularization), Introduction to Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) – basic concepts only.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Deep Learning Architectures and Applications	(08 Hours)

Convolutional Neural Networks (CNNs): Architectures (LeNet, AlexNet, ResNet, Inception), Applications (Image Classification, Object Detection, Image Segmentation), Recurrent Neural Networks (RNNs): Architectures (Vanilla RNN, LSTM, GRU), Applications (Natural Language Processing, Time Series Analysis), Long Short-Term Memory (LSTM) Networks and Gated Recurrent Units (GRUs), Generative Adversarial Networks (GANs)

Mapping of Course Outcomes for Unit II	CO2

Unit III	Deep Learning Model Development	(08 Hours)

Approved By:

Data Preprocessing for Deep Learning, Model Selection, Training Strategies, and Hyperparameter Tuning, Evaluation Metrics for Deep Learning Models (Accuracy, Precision, Recall, F1-Score, AUCROC), Model Deployment and Monitoring, Techniques for handling imbalanced datasets in deep learning, Introduction to transfer learning

Mapping of Course Outcomes for Unit III	CO3

Unit IV	**Advanced Deep Learning Techniques**	**(08 Hours)**

Autoencoders: Undercomplete Autoencoders, Regulraized Autoencoders-Sparse Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders. Ensemble Methods in Deep Learning, Autoencoders and Variational Autoencoders (VAEs), Deep Reinforcement Learning (basics), Explainable AI (XAI) and its role in DL, Ethical considerations in deep learning,

Mapping of Course Outcomes for Unit IV	CO4

Unit V	**Deep Learning Applications in Computer Engineering**	**(08 Hours)**

Deep Learning applications in Computer Vision, Natural Language Processing, and other relevant fields, Image Classification, Social N/w/ analysis, Speech Recognition, Recommender system, Case studies on the application of Deep Learning in areas such as robotics, signal processing, and healthcare

Mapping of Course Outcomes for Unit V	CO5

Learning Resources

Text Books:

1. **"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville**
2. "Deep Learning" By Josh Patterson & Adam Gibson
3. "Neural Networks and deep learning" By Charu Agarwal

Reference Books:

1. **"Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow" by Aurélien Géron**
2. **"Neural Networks and Deep Learning" by Michael Nielsen**
3. **"Deep Learning with Python" by Francois Chollet**

Web Links:

1.**https://www.deeplearningbook.org/**

e-Books:

1.http://csis.pace.edu/ctappert/cs855-18fall/DeepLearningPractitionersApproach.pdf2

2.https://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf

MOOC Courses:

1. https://www.my-mooc.com/en/categorie/deep-learning

@The CO-PO mapping table

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

Approved By:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025Pattern)
R25-MCO-MEC-513 (A): Elective III: Computer Vision

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: **Calculus, Linear algebra, Probability, Programming Knowledge**

Companion Course, if any: NA

Preamble: In this course students will learn basic principles of image formation. This course emphasizes the core vision task of scene understanding and recognition. Application to object recognition, image analysis, image retrieval and object tracking will be discussed.

Course Objectives:

- Students will learn basic principles of image formation, image processing algorithms.
- Students will learn various algorithms and methods involved for computer vision.
- Students will learn Motion technique
- This course also focused on the core vision tasks of scene understanding.
- Students will learn basic recognition with Applications

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

CO	Course Outcome	Bloom's Level
CO1:	To **IMPLEMENT** fundamental image processing techniques required for computer vision	3
CO2:	**UNDERSTAND** Image formation process	3
CO3:	To **PERFORM** various analysis on image to extract features form Images	3
CO4:	To **DEVELOP** applications using computer vision techniques	3
CO5:	Students should be able to suggest a design for a computer vision system for a specific problem	3

Course Contents

Unit I	INTRODUCTION TO COMPUTER VISION	(08 Hours)

Image Processing, Computer Vision and Computer Graphics, Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

Mapping of Course Outcomes for Unit I **CO1**

Unit II	IMAGE REPRESENTATION AND ANALYSIS	(08 Hours)

Image representation, Image processing techniques like color and geometric transforms, Edge-detection Techniques, Filtering, Mathematical operations on image and its applications like convolution, filtering.

Mapping of Course Outcomes for Unit II **CO2**

Unit III	MOTION ESTIMATION	(08 Hours)

Approved By:

Introduction to motion, Regularization theory, Optical computation, StereoVision, Motion estimation, Structure from motion and models.

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

Unit IV	**OBJECT RECOGNITION**	**(08 Hours)**

Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition

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

Unit V	**APPLICATIONS**	**(08 Hours)**

APPLICATIONS

Photo album, Face detection, Face recognition, Eigen faces, Active appearance and 3D shape models of faces Application: Surveillance, foreground- background separation, particle filters, Chamfer matching, tracking, and occlusion, combining views from multiple cameras, human gait analysis Application: In vehicle vision system: locating roadway, road markings, identifying road signs, locating pedestrians

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

Learning Resources

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010 6. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.

Reference Books:

1. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
3. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

Web Links:

1.**https://www.udacity.com/course/computer-vision-nanodegree--nd891,**

2.**https://opencv.org/university/?srsltid=AfmBOor20EXH0g8kLYCVpYYss**

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e-Books:

1. Computer Vision: Algorithms and Applications (R. Szeliski)
2. Computer Vision: Models, Learning, and Inference (S.J.D. Prince)

MOOC Courses:

1. "Introduction to Computer Vision" on Coursera and "Deep Learning for Computer Vision" on NPTEL/Swayam

Approved By:

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-MEC-513 (B): Elective III: Internet of Things

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Course Objectives:

- To **UNDERSTAND** the concept of IoT.
- To **BUILD** IoT based Applications.
- To **ANALYZE** the performance of IoT based Systems.

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

CO	Course Outcome	Bloom's Level
CO1:	**SUMMARIZE** the concepts of network connected embedded devices.	3
CO2:	**DESIGN** suitable network architecture and use appropriate protocols for a given IOT application.	3
CO3:	**IDENTIFY** and **SUMMARIZE** different components required for IOT applications.	3
CO4:	**ANALYZE** the system through Data Analytics tools.	3
CO5:	**ANALYZE** the system through Data Analytics tools.	3

Course Contents

Unit I	Introduction & Basic of IoT	(08 Hours)

Definition, Characteristics, Physical and Logical Designs, challenges, Technological trends in IOT, IoT Examples, M2M

Mapping of Course Outcomes for Unit I	CO1

Unit II	Components, Communication and Networking	(08 Hours)

Introduction to Sensing and Networking: Sensing & actuation, Wireless Senor network, Senor nodes, Communication Protocols, M2M Communication, Networking Hardware, Networking Protocols.

Mapping of Course Outcomes for Unit II	CO2

Unit III	IoT System Management	(08 Hours)

Network Operator Requirements, IoT Platform Design Specification — Requirements, Process, Do- main Model, Service, IoT Level, Function, Operational view, Device and Component Integration, Application development.

Mapping of Course Outcomes for Unit III	CO3

Unit IV	Networking and Computing	(08 Hours)

File Handling, Python Packages for IoT, IoT Physical Servers — Cloud Storage Models, Communication APIs.

Approved By:

Mapping of Course Outcomes for Unit IV	CO4

Unit V	**IoT Clouds and Data Analytics and Applications**	**(08 Hours)**

RESTful Web API, Amazon Web Services for IoT, Apache Hadoop, Batch Data Analysis, Chef, Chef Case Studies, Puppet, NETCONF-YANG. Case studies: smart cities, smart home, connected vehicles, Industrial IOT

Mapping of Course Outcomes for Unit V	CO5

Learning Resources

Text Books:

1. Kamal, R.,"Internet of Things — Architecture and Design Principles," 1st Edition, Mcgraw Hill,2017.
2. Simone Cirani," Internet of Things- Architectures, Protocols and Standards", WILEY,2018.
3. Alessandro Bassi," Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model", Springer,20l3.

Reference Books:

1. D. Patranabis, "Sensor & Transducers", Murthy Prentice Hall India Learning Private Limited, 2nd edition, 2009.
2. Jacob Fraden," Handbook of Modern Sensors", Physics, Designs, and Applications, Fifth Edition, Spinger,2016.

Web Links:

1. **https://onlinecourses.nptel.ac.in**
2. **https://www.netacad.com**
3. **https://www.edx.org**

e-Books:

1. Internet of Things: A Hands-On Approach by Arshdeep Bahga & Vijay Madisetti
2. The Internet of Things in the Cloud: A Middleware Perspective by Honbo Zhou
3. Springer Handbook of Internet of Things

MOOC Courses:

1. "Introduction to the Internet of Things" — offered via Coursera (in collaboration with Indian Institutes)
2. "Introduction to Internet of Things and Digital Transformation" via Cisco Networking Academy
3. MOOCs listed via edX for deeper or self-paced learning.

@The CO-PO mapping table

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Approved By:

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Open Book Test	Assignment	Seminar / Case Study	Quiz / presentation etc.	
L1	✓	✓	✓	✓	✓		✓
L2	✓	✓	✓	✓	✓		✓
L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

Unit wise Weightage:

Exam	Unit1	Unit2	Unit3	Unit4	Unit5	Total
CT1	8	7				15
CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO-MEC-513 (C): Elective III: Speech Processing

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End Sem (Paper): 50 Marks**

Prerequisite Courses, if any: Linear algebra and Probability, Digital Signal processing

Course Objectives:

- To **UNDERSTAND** the concept of speech processing.
- To **BUILD** speech-based systems.
- To **ANALYZE** the performance of speech processing systems.

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

CO	Course Outcome	Bloom's Level
CO1:	Explain the mechanism of human speech production and perception.	3
CO2:	Explain each component of speech recognition systems.	3
CO3:	Understand the importance of probabilistic modeling in speech recognition.	3
CO4:	Build a speech recognition system.	3
CO5:	Build Speech Synthesis system	3

Course Contents

Unit I	Speech Analysis	(08 Hours)

Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures — mathematical and perceptual — Log Spectral Distance, Cepstral Distances, Weighted Cep- stral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization — Dynamic Time Warping, Multiple Time — Alignment Paths.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Speech Modeling	(08 Hours)

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs — Evaluation, Optimal State Sequence — Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

Mapping of Course Outcomes for Unit II	CO2

Unit III	IoT System Management	(08 Hours)

Network Operator Requirements, IoT Platform Design Specification — Requirements, Process, Do- main Model, Service, IoT Level, Function, Operational view, Device and Component Integration, Application development.

Mapping of Course Outcomes for Unit III	CO3

Unit IV	Speech Recognition	(08 Hours)

Approved By:

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vo- cabulary continuous speech recognition system — acoustics and language models — ngrams, context dependent sub-word units; Applications and present status		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Speech Synthesis**	**(08 Hours)**
Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub- word units for TTS, intelligibility and naturalness — role of prosody, Applications and present status.		
Mapping of Course Outcomes for Unit V	CO5	

Learning Resources

Text Books:

1. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing — An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.

Reference Books:

1. Jacob Benesty, M. Mohan Sondhi, Yiteng Huang, Springer Handbook of Speech Processing, Springer-Verlag Berlin, **2008,** ISBN: **978-3-540-49125-5**
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing — Principles and Practice", Pearson Education.
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
5. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press.

Web Links:

1. https://www.speech.cs.cmu.edu
2.https://ocw.mit.edu/courses/6-341-discrete-time-signal-processing
3. https://signalprocessingsociety.org

e-Books:

1. "Speech and Language Processing" –by Jurafsky & Martin
2. "Digital Processing of Speech Signals" by Rabiner & Schafer
3. "Pattern Recognition and Machine Learning" by Christopher Bishop
4. "Fundamentals of Speech Recognition" by Rabiner & Juang

Approved By:

MOOC Courses:

1. NPTEL – Speech Signal Processing
2. Speech Processing – EPFL
3. Audio Signal Processing for Music Applications – UPF Barcelona
4. TensorFlow Speech Recognition Challenge Course

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

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Assessment Pattern

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L3	✓	✓	✓	✓	✓		✓
L4							
L5							
L6							

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CT2			8	7		15
Open Book Test					10	10
Assignments	5					05
Seminar	5					05
ESE	10	10	10	10	10	50
						100

Approved By:

Amrutvahini College of Engineering
First Year of MTech (Computer Engineering) (2025 Pattern)
R25-MCO -SEM-514: Seminar

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hours/Week	**02**	**Term-work: 50 Marks**

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.
- To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms and services.

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

CO	Course Outcome	Bloom's Level
CO1:	To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression.	3
CO2:	To acquire, articulate, create and convey intended meaning using verbal and non- verbal method of communication.	3
CO3:	To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across	3

Course Contents

The student shall have to deliver the seminar I in semester II on a topic approved by guide and authorities. It is recommended to allot guide to the student since the commencement of semester I. The guide allotment preferably needs to be carried out in synchronization with mutual domains of interest. It is recommended that seminar shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected or domain of interest.

It is appreciated and strongly recommended that the student will select the domain of his/her dissertation and identify the literature confined to the domain. Thorough literature study based on the broad identified topic has to be carried out. This practice will eventually lead to convergence of the efforts for the dissertation in Semester III and IV.

The relevant literature then be explored as state-of-the-art, exotic, recent technological advancement, future trend, application and research & innovation. Multidisciplinary topics are encouraged. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in seminar logbook approved by Board of Studies.

Approved By:

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

Approved By: