Scheme of Teaching and Evaluation for

M.Tech– I, II, III, IV Semester

Computer Science & Engg.

(2024 Scheme)

M.Tech in Computer Science & Engineering Scheme of Teaching and Examinations – 2024. Outcome Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2024-25)

Structure of M.Tech Scheme

I SEMESTER

Sl. No.	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours per Week			Examination				Credits
					Theory	Practical/Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	P	S					
1	BSC	24MCS11	Advanced Mathematical Techniques for Computer Science	H & S	03	00	00	03	50	50	100	3
2	IPCC	24MCS12	Principles of Data Science and Visualization	CSE	03	02	00	03	50	50	100	4
3	PCC	24MCS13	Artificial Intelligence	CSE	03	00	02	03	50	50	100	4
4	PCC	24MCS14	Advanced Design and Analysis of Algorithms	CSE	03	00	02	03	50	50	100	4
5	PCC	24MCS15	Distributed and Cloud Computing	CSE	02	00	02	03	50	50	100	3
6	PCC	24MCSL16	Advanced Design and Analysis Algorithms Lab	CSE	00	04	00	03	50	50	100	2
TOTAL					**14**	**06**	**06**	**18**	**300**	**300**	**600**	**20**

Note: BSC: Basic Science Course. **PCC:** Professional Core Course. **IPCC**-Integrated Professional Core Course. **L**-Lecture. **P**-Practical **S**-Skill Development Activity

Note:
Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE).However, questions from the practical part of IPCC shall be included in the SEE question paper.

Skill Development Activities: Under skill development activities in a concerned course, students should:

1. Interact with industry (small, medium, and large).
2. Involve in research, testing, or projects to understand industry problems and help develop creative and innovative methods to solve them.
3. Participate in case studies and field visits/fieldwork.
4. Acclimate to the use of standards and codes to narrow the gap between academia and industry.
5. Handle advanced framework to enhance technical skills.
6. Gain confidence in modeling systems and algorithms for transient and steady-state operations.
7. Work on different software/tools to simulate, analyze, authenticate output, and interpret conclusions.

All activities should enhance students' abilities to seek employment and/or self-employment opportunities, management skills, statistical analysis, fiscal expertise, etc. Students and the course instructor(s), either individually or in groups, should interact to enhance learning and application skills in their area of study. With the help of the course teacher, students can take up relevant technical activities that will improve their skills. The prepared report shall be evaluated for Continuous Internal Evaluation (CIE) marks.

II SEMESTER

Sl. No.	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board(PSB)	Teaching Hours per Week			Examination				Credits
					Theory	Practical/Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	P	S					
1	PCC	24MCS21	Machine Learning	CSE	03	00	02	03	50	50	100	4
2	IPCC	24MCS22	Advanced Computer Networks	CSE	03	02	00	03	50	50	100	4
3	PEC	24MCS23X	Professional Elective-1	CSE	02	00	02	03	50	50	100	3
4	PEC	24MCS24X	Professional Elective-2	CSE	02	00	02	03	50	50	100	3
5	MPS	24MCS25	Mini Project-1 with Seminar	CSE	00	06	00	--	100	--	100	4
6	PCCL	24MCSL26	Machine Learning Laboratory	CSE	00	04	00	03	50	50	100	2
TOTAL					**10**	**12**	**06**	**15**	**350**	**250**	**600**	**20**

Note: PCC: Professional core courses, **PEC**: Professional Elective Courses**, IPCC**-Integrated Professional Core Courses.
MPS-Mini Project With Seminar
L-Lecture. **P**-Practical **S**-Skill Development Activity

Professional Elective -1		Professional Elective- 2	
Course Code under 24MCS23X	**Course title**	**Course Code under 24MCS24X**	**Course title**
24MCS231	Wireless Networks & Mobile Computing	24MCS241	Pattern Recognition
24MCS232	Big Data Analytics	24MCS242	Learning from Data
24MCS233	Data Warehouse & Data Mining.	24MCS243	Distributed Database System
24MCS234	Image Processing and Machine Vision	24MCS244	Internet of Things

III SEMESTER

Sl. No.	Course	Course Code	Course Title	TeachingDepartment (TD)and QuestionPaper SettingBoard(PSB)	Teaching Hours per Week			Examination				
					Theory Lecture	Practical/Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
					L	P	S					
1	PCC	24MCS31	Deep Learning	CSE	03	00	02	04	50	50	100	4
2	PEC	24MCS32X	Professional Elective-3	CSE	02	00	02	03	50	50	100	3
3	PEC	24MCS33X	Professional Elective-4	CSE	02	00	02	03	50	50	100	3
4	PROJ	24MCS34	Project Work Phase-1	CSE	--	02	--	--	100	--	100	1
5	MPS	24MCS35	Mini Project-2 with Seminar	CSE	--	06	--	--	100	--	100	3
6	INTR	24MCS36	Internship	CSE	(6 weeks Internship Completed during the intervening vacation of II And III semesters.)			03	50	50	100	6
					07	**08**	**06**	**13**	**400**	**200**	**600**	**20**

Note: **PCC:** Professional Core Courses, **PEC:** Professional Elective Courses, **IPCC**-Integrated Professional Core Courses. **MPS**-Mini Project With Seminar; **INTR:** Internship
L-Lecture. **P**-Practical **S**-Skill Development Activity

Note:

1. **Mini Project-1 with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analyzing and authenticating, case studies, etc. CIE marks shall be awarded by a committee comprising of Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory. The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course.

2. **Internship:** All the students shall have to undergo a mandatory internship of 06 weeks during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Professional Elective-3		**Professional Elective-4**	
Course Code under 24MCS32X	**Course Title**	**Course Code under 24MCS33X**	**Course Title**
24MCS321	Natural Language Processing	24MCS331	Modern Cryptography
24MCS322	Speech Processing	24MCS332	Software defined Networks
24MCS323	Virtual Reality	24MCS333	Block Chain Technology
24MCS324	DevOps	24MCS334	Generative AI

Note: **Project Work Phase-1**:
The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted. Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar. CIE marks shall be awarded by a committee comprising of Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.
Mini Project-2 with Seminar:
Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems. CIE marks shall be awarded by a committee comprising of Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE (University examination) for this course.
Internship:
Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms. CIE marks shall be awarded by a committee comprising of Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

IV SEMESTER

Sl. No.	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper Setting Board (PSB)	Teaching Hours per Week				Examination			
					Theory Lecture	Practical/ Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
					L	P	S					
1	Project	24MCS401	Project Work Phase-2	CSE	Entire semester to completing a project and present dissertation			03	100	100	200	20

Note:

Project Work Phase-2:

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar. CIE marks shall be awarded by a committee comprising of Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

I SEMESTER

Advanced Mathematical Techniques for Computer Science			
Course Code	**24MCS11**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course Objectives:

1. Explain the concepts of vector spaces, linear independence, basis, and linear transformations.
2. Apply orthogonality, Gram-Schmidt, and least squares methods to solve problems.
3. Analyse the applications of diagonalization, quadratic forms, Singular Value Decomposition (SVD), and Principal Component Analysis (PCA).
4. Apply correlation, regression, and curve fitting techniques to develop statistical models.
5. Understand and apply probability distributions, sampling theory, and hypothesis testing methods.

Module-1

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices.

Module-2

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).

Module-3

Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis.

Module-4

Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non-linear)

Module-5

Probability Theory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by ***t***-test, χ^2- test.

Course Outcomes:

On completion of this course, students are able to:

1. Use numerical methods to solve equations and find their roots in given examples.
2. Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
3. Apply vector space concepts to understand and analyze magnification and rotation of images.
4. Utilize the statistical tools in multi variable distributions.
5. Use probability formulations for new predictions with discrete and continuous RV's.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Linear Algebra and its Applications	David C. Lay, Steven R. Lay and J. J. McDonald	Pearson Education Ltd	5th Edition 2015.
2	Numerical methods for Scientific and Engg. Computation	M K Jain, S.R.K Iyengar, R K. Jain	New Age International	6th Ed., 2014
3	Probability, Statistics and Random Process	T. Veerarajan	Tata Mc-Graw Hill Co	3rd Edition 2016

Reference Books:

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Optimization: Theory & Applications Techniques	Rao. S.S	Wiley Eastern Ltd New Delhi.	
2	Signals, Systems, and Inference	Alan V. Oppenheim and George C. Verghese	Spring	2010.
3	Foundation Mathematics for Computer Science	John Vince	Springer International	
4	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Ed.,2017

Principles of Data Science and Visualization			
Course Code	**24MCS12**	CIE Marks	50
Teaching Hours/Week(L:P:S)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

1. Understand core Data Science concepts and decision-making roles.
2. Learn effective data visualization techniques.
3. Create and customize visualizations using Matplotlib and Seaborn.
4. Learn data cleaning, transformation, and feature engineering.
5. Explore advanced techniques like PCA and anomaly detection.

Module-1

Introduction to Data Science: Definition of Data Science and its applications, Historical evolution and significance of Data Science, Key concepts: Big Data, Data Analytics, Ethical considerations in Data Science, Role ofData Scientists in decision-making processes.

Module-2

Introduction Data visualization: Introduction to data visualization, Importance of data visualization, types of data visualization, tools for data visualization. Area plots, Histograms, Bar charts, Pie chart, Box plots, Scatter plots, bubble plots.

Module-3

Visualization using Matplotlib and Seaborn: Introduction to matplotlib; creating basic plots with matplotlib, customizing plots with matplotlib, advanced matplotlib features, Waffle charts, Word clouds. Introduction to Seaborn; creating statistical plots with seaborn, Customizing plots with seaborn, advanced seaborn features, and regression.

Module-4

Data Management and Preprocessing: Data preprocessing: Techniques for cleaning and transforming raw data, Strategies for handling outliers and anomalies. Feature engineering and transformation to meet analysis requirements, Handling missing data in datasets.

Module-5

Advanced Topics in Data Science: Dimensionality reduction techniques: Overview of techniques such as PCA (Principal Component Analysis), Anomaly detection and outlier analysis, Text mining, and Time series analysis.

Lab components:

1. Write a Python program to calculate mean, median, mode, and variance for a dataset.
2. Create area plots and histograms using Matplotlib for a given dataset.
3. Visualize categorical data with bar charts and pie charts using Matplotlib.
4. Generate box plots and scatter plots to analyze data distribution and relationships.
5. Customize Matplotlib plots by adding titles, labels, legends, and modifying colors.

6. Create waffle charts and word clouds for visualizing data in innovative ways.
7. Generate regression and distribution plots using Seaborn.
8. Clean a dataset by handling missing values and detecting outliers.
9. Perform feature engineering and apply scaling or normalization to a dataset.
10. Implement Principal Component Analysis (PCA) for dimensionality reduction and visualize results

Course Outcomes:

At the end of the course the student shall be able to

1. Articulate Data Science concepts and assess ethical issues.
2. Apply appropriate visualization tools for data insights.
3. Create and customize visualizations using Matplotlib and Seaborn.
4. Implement pre-processing and handle missing data and outliers.
5. Apply advanced techniques to solve complex data problems.

Text Books:

1. An Introduction to StatisticalLearning **by** Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani Springer, 1st Edition
2. Data Visualization with Matplotliband Seaborn, Hasnain Raz, Hasnain Raz, 1st Edition

References:

1. Data Science from Scratch ,Joel Grus, O'ReillyMedia, 2nd Edition.
2. Python for Data Analysis, Wes McKinney, O'ReillyMedia, 3rd Edition.
3. Data Science with Python, Wade Briggs, Pearson, 1st Edition.

Artificial Intelligence

Course Code	**24MCS13**	CIE Marks	50
Teaching Hours/Week(L:P:S)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	03

Course Objectives:

1. Provide an introduction to Machine Intelligence, Problem Solving, Heuristic Search.
2. Provide an introduction to Game Playing.
3. Provide an introduction to various knowledge representation techniques,Reasoning, and expert systems.
4. Provide an introduction to planning and learning in AI.
5. Understanding, Natural Language Processing, and Robotics – Perception and Action.

Module-1

Introduction: Introduction to AI. The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environment, And The Structure of Agents.

Module-2

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments.

Module-3

Adversarial Search :

Games,Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games .Partially Observable Games, State-of-the-Art Game Programs, Alternative Approaches .Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs , The Structure of Problems.

Module-4

Knowledge and reasoning

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, And Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First Order Inference, Unification and Lifting , Forward Chaining Backward Chaining , Resolution.

Module- 5

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State Space Search, Planning Graphs, Other Classical Planning Approaches, and Analysis of Planning Approaches.
Planning and Acting in the Real World :
Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains , Multi agent Planning.

Course Outcomes:

At the end of the course, the student will be able to:

1. Apply various search techniques for solving problems in AI.
2. Write programs to play games.
3. Apply knowledge representation techniques and build algorithms for reasoning with knowledge.
4. Apply planning and learning algorithms to enhance AI problem solving.
5. Identify the AI research and problem areas and choose appropriate problem solving methods.

Text Books:

1. "Artificial Intelligence – A Modern Approach", Stuart Russell and Peter Norvig, Pearson, 3rd Edition (Paperback), 2016.

Reference Book(s):

1. "A First Course in Artificial Intelligence", Deepak Khemani, McGraw Hill, 1st Edition, 2013.

2. "Artificial Intelligence", E Rich and K Knight and Shivashankar Nair, Tata McGraw Hill, 3rd Edition, 2009.

Advanced Design and Analysis of Algorithms

Course Code	**24MCS14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

1. Explore advanced topics in algorithms and complexity theory.
2. Engage in analysis and design of complex algorithms for real-world problems in current application domains.
3. Study advanced/novel algorithm design strategies and techniques.
4. Interpret sturdy/open problems in algorithms or complexity the or by analyzing known approaches and their limitations.

Module-1

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

Module-2

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.

Module-3

Number-Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA crypto system; Primality testing; Integer factorization.

Module-4

String-Matching Algorithms: Naïve string Matching; Rabin- Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer–Moore algorithms.

Module-5

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

Course Outcomes:

1. Analyze Algorithm Efficiency.
2. Implement and Apply Advanced Graph Algorithms.
3. Develop Number-Theoretic Solutions.
4. Apply String-Matching Algorithms.
5. Utilize Probabilistic and Randomized Algorithms.

Text Books:

1. T.H Cormen, C E Leiserson, RL Rivestand C Stein. Introduction to Algorithms. PHI, 3rd Edition,2010.
2. Kenneth A.Berman .Algorithms.CengageLearning.2002.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan .Fundamentals of Computer Algorithms. Universities press.2nd Edition, 2007.

Distributed and Cloud Computing

Course Code	**24MCS15**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	03

Course Objectives:

1. Understand the fundamental concepts and models of distributed and cloud computing.
2. Explore the design and architecture of computer clusters for scalable parallel computing.
3. Analyze various levels of virtualization, including CPU, memory, and I/O devices, and their role in resource management.
4. Study cloud platform architectures and public cloud services, focusing on service models and security.
5. Gain insight into service-oriented architectures and middleware for distributed computing, including workflows, discovery, and database management.

Module-1

Distributed System Models and Enabling Technologies: Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security, and Energy Efficiency.

Module-2

Computer Clusters for Scalable Parallel Computing: Clustering for Massive Parallelism, Computer Clusters and MPP Architectures, Design Principles of Computer Clusters, Cluster Job Management Systems, Case Studies of Top Supercomputer Systems.

Module-3

Implementation Levels of Virtualization: Levels of Virtualization Implementation, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

Module-4

Cloud Platform Architecture over Virtualized Data Centers: Cloud Computing and Service Models, Data-Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS, and Azure,Inter-cloud Resource Management. Cloud Security and Trust Management.

Module-5

Service-Oriented Architectures for Distributed Computing: Message-Oriented Middleware. Portals and Science Gateways. Discovery, Registries, Metadata, and Databases. .Workflow in Service-Oriented Architectures.

Course Outcomes:

1. Ability to apply distributed and cloud computing models in real-world scenarios.
2. Proficiency in designing and managing scalable computer clusters for parallel computing tasks.
3. Expertise in implementing virtualization technologies for efficient resource management in data centers.
4. Understanding of cloud platform architectures and the capability to evaluate and utilize public cloud platforms like AWS, Azure, and GAE.
5. Enhanced skills in developing service-oriented architectures and using middleware for distributed computing applications.

Text Books: Distributed and Cloud Computing From Parallel Processing to the Internet of Things Kai Hwang Geoffrey C. Fox Jack J. Dongarra

Reference: Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescu Elsevier (MK), 2013.
2. Computing Principles and aradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinsk, Willey, 2014.
3. Cloud Computing Implementation, Management and Security John W Rittinghouse, James F Ransome, CRC Press, 2013.

Advanced Design and Analysis of Algorithms Lab

Course Code	**24MCSL16**	CIE Marks	50
Teaching Hours/Week(L:P:S)	0:4:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	02	Exam Hours	03

Course objectives:

1. Apply various asymptotic notations to analyze the efficiency of algorithms.
2. Solve recurrence relations using different methods (substitution, recurrence tree, master method) to determine the time complexity of recursive algorithms.
3. Design and implement efficient graph algorithms for tasks such as shortest path, minimum spanning trees, and maximum flow.
4. Apply number-theoretic algorithms to solve problems related to modular arithmetic, cryptography, and primality testing.
5. Develop and analyze string-matching algorithms for efficient pattern searching in text.

Lab Experiments:

1. Implement functions with different time complexities (e.g., linear, quadratic, logarithmic) and analyze their performance using asymptotic notations.
2. Solve recurrence relations using different methods (substitution, recurrence tree, master method) and analyze their time complexities.
3. Implement the Bellman-Ford, Dijkstra, and Johnson's algorithms for finding shortest paths in graphs.
4. Implement the Ford-Fulkerson algorithm for maximum flow in a network and the Hopcroft-Karp algorithm for maximum bipartite matching.
5. Implement modular arithmetic operations and the RSA cryptosystem.
6. Implement algorithms for primality testing (e.g., Miller-Rabin) and integer factorization (e.g., trial division, Pollard's rho method).
7. Implement the naive string matching and Rabin-Karp algorithms.
8. Implement string matching using finite automata and the Knuth-Morris-Pratt algorithm.
9. Implement Monte Carlo and Las Vegas algorithms for solving problems.
10. Implement probabilistic algorithms for numerical computations

Course Outcomes:

1. Implement and analyze algorithms with different time complexities using asymptotic notations.
2. Solve and analyze recurrence relations using various methods for time complexity evaluation.
3. Implement shortest path and network flow algorithms to solve graph problems.
4. Apply cryptographic algorithms like RSA and techniques for primality testing and factorization.
5. Implement string matching and probabilistic algorithms to solve computational problems.

II SEMESTER

Machine Learning

Course Code	**24MCS21**	CIE Marks	50
Teaching Hours / Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Describe the Fundamentals of Machine Learning and Concept Learning
2. Implement and Analyze Artificial Neural Networks and Genetic Algorithms
3. Apply Bayesian Learning and Instance-Based Learning Techniques
4. Explore Analytical and Reinforcement Learning Approaches
5. Develop Skills in Clustering Techniques for Unsupervised Learning

Module-1

Machine Learning: Well posed learning problems, Designing a Learning System.
Concept Learning: Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm.
Classification: Decision Tree Learning - Introduction, Decision tree representation, Appropriate problems, ID3 algorithm, Hypothesis Search Space, Inductive Bias and Issues in Decision Tree Learning.

Module-2

Prediction: Artificial Neural Network - Introduction, NN representation, Appropriate problems, Perceptron's, Back propagation algorithm & its Remarks. RBF Network, Design issues in ANN, Recurrent Network.

Genetic Algorithms: – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.

Module-3

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Naive Bayes classifier (NBC, m-estimate & Text classification).

Instance based learning: k-Nearest Neighbor Learning, Locally weighted regression.

Module-4

Analytical Learning & Reinforced Learning: Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

Module-5

Clustering: Overview- Types of clustering, Types of clusters, K-Means, Agglomerative Hierarchical, Clustering, Density-Based Clustering, Graph-Based Clustering, Cluster evaluation.

Course Outcomes:

1. Demonstrate proficiency in Machine Learning and Concept Learning
2. Design and Implement Artificial Neural Networks and Genetic Algorithms
3. Apply Bayesian and Instance-Based Learning Techniques for Classification
4. Analyze and Implement Analytical Learning and Reinforcement Learning
5. Implement and Evaluate Clustering Algorithms for Unsupervised Learning

Text Books:

1**.** Machine Learning by Tom M Mitchel, McGraw-Hill Science

2. Data Mining: Concepts & Techniques by Jiawei Han & Micheline Kamber, Jian Pei The Morgan Kaufmann Series, 3rd Edition.

Advanced Computer Networks

Course Code	**24MCS22**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course Objectives:

1. Understand Networking Fundamentals.
2. Explore Internetworking and IP Protocols.
3. Study Advanced Routing Techniques.
4. Examine End-to-End Protocols.
5. Learn Congestion Control and Network Services.

Module-1

Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay XBand width Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait, Sliding Window, Concurrent Logical Channels.

Module-2

Internetworking I: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges andLAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, DatagramForwarding in IP,sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels.

Module-3

Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, TheGlobalInternet,RoutingAreas,RoutingamongAutonomoussystems(BGP),IPVersion6(IPv6),MobilityandMobile IP

Module-4

End-to-End Protocols: Simple Demultiplexer (UDP),Reliable Byte Stream(TCP),End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion. Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery

Module-5

Congestion Control and Resource Allocation Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System(DNS), Electronic Mail:(SMTP,POP,IMAP,MIME), World Wide Web(HTTP),Network Management (SNMP)

Lab Experiments:

1. Simulate different network topologies (bus, star, ring, mesh) using a network simulation tool.
2. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
3. Implement a client-server model using TCP/IP and UDP protocols.
4. Simulate the transmission of packets in a network with congestion and compare the

results of different algorithms.

5. Simulate the Bellman-Ford algorithm to find the shortest path and update routing tables dynamically.
6. Measure the performance (latency, throughput, and packet loss) of TCP vs UDP protocols under different network conditions.
7. Configure firewall by creating firewall rules using ip tables to block certain IP addresses or ports.

Course Outcomes:

1. Describe the fundamental concepts and components of computer networks.
2. Apply internetworking techniques to design and configure interconnected networks.
3. Analyze various routing protocols and their impact on network performance.
4. Evaluate end-to-end protocols to ensure reliable data transmission across networks.
5. Explore and assess congestion control mechanisms and network services for efficient data flow.

Text Books:

1. ComputerNetworks:ASystemApproach,LarryPetersonandBruceSDavis,Elsevier,5th Edition2014
2. Internet working with TCP/IP,Principles, Protocols and Architecture, Douglas E Comer, PHI, 6thEdition 2014.

Reference Books:

1. Computer Networks, Protocols, Standards and Interfaces, Uyless Black,PHI,2nd Edition
2. TCP/IP Protocol Suite, Behrouz A Forouzan, Tata McGraw-Hill,4th Edition.

PROFESSIONAL ELECTIVE-1

Wireless Networks & Mobile Computing

Course Code	**24MCS231**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives

1. Understand mobile communication, system architecture, devices, network management, and security challenges.
2. Analyze GSM services, radio interfaces, protocols, and advanced wireless technologies like 3G, 4G, and beyond.
3. Learn IP networking in mobile environments, focusing on packet delivery, handover, and mobile TCP/IP protocols.
4. Explore data organization and database management with power-aware and context-aware computing.
5. Understand data dissemination and synchronization using tools and standards for efficient communication.

Module-1

Fundamentals of Mobile Communication and Computing: Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices Mobile System Networks, Data Dissemination, Mobility Management, Security Cellular Networks and Frequency Reuse, Mobile Smartphone, Smart Mobiles, and Systems Handheld Pocket Computers, Handheld Devices, Smart Systems, Limitations of Mobile Devices Automotive Systems

Module-2

GSM and Advanced Wireless Communication Technologies: GSM-Services and System Architecture, Radio Interfaces of GSM, Protocols of GSM Localization, Call Handling Handover, Security, New Data Services, General Packet Radio Service High-speed Circuit Switched Data, DECT, Modulation, Multiplexing, Controlling the Medium Access Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS),Coding Methods, Code Division Multiple Access, IMT-2000 3G Wireless Communication Standards, WCDMA 3G Communications Standards ,CDMMA2000 3G Communication Standards, Imode, OFDM, High Speed Packet Access (HSPA) 3G Network Long-term Evolution, WiMaxRel 1.0 IEEE 802.16e, Broadband Wireless Access,4G Networks, Mobile Satellite Communication Networks.

Module-3

IP Networking and Protocols in Mobile Environments IP and Mobile IP Network Layers, Packet Delivery and Handover Management Location Management, Registration, Tunnelling and Encapsulation, Route Optimization Dynamic Host Configuration Protocol, VoIP, IPsec Conventional TCP/IP Transport Layer Protocols, Indirect TCP, Snooping TCP Mobile TCP, Other Methods of Mobile TCP-layer Transmission ,TCP

over 2.5G/3G Mobile Networks
Module-4
Data Management and Organization in Mobile Computing: Data Organization, Database Transactional Models – ACID Rules, Query Processing Data Recovery Process, Database Hoarding Techniques , Data Caching, Client-Server Computing for Mobile Computing and Adaptation Adaptation Software for Mobile Computing, Power-Aware Mobile Computing, Context-aware Mobile Computing.
Module-5
Data Dissemination and Synchronization in Mobile Computing: Communication Asymmetry, Classification of Data-delivery Mechanisms, Data Dissemination Broadcast Models, Selective Tuning and Indexing techniques, Digital Audio Broadcasting (DAB), Digital Video Broadcasting Synchronization, Synchronization Software for Mobile Devices, Synchronization Software for Mobile Devices SyncML-Synchronization Language for Mobile Computing,Sync4J (Funambol), Synchronized Multimedia Markup Language (SMIL).

Course Outcomes:
At the end of the course the student will be able to:

1. Explain the fundamentals of mobile communication, system architecture, network design, and device limitations.
2. Describe and compare GSM services and advanced wireless standards, including 3G and 4G technologies.
3. Manage and configure IP networks in mobile environments, focusing on packet delivery and handover processes.
4. Apply data management strategies such as database hoarding and power-aware computing in mobile systems.
5. Implement data dissemination and synchronization techniques using appropriate tools and standards.

Text Books:

1. Raj kamal: Mobile Computing, 2ND EDITION, Oxford University Press, 2007/2012.

2. MartynMallik: Mobile and Wireless Design Essentials, Wiley India, 2003

Reference Books:

1. Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.
2. ItiSaha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.

Big Data Analytics			
Course Code	**24MCS232**	CIE Marks	50
Teaching Hours / Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives

1. Introduce alternative techniques to perform big data processing
2. Introduce applications of Big Data Processing
3. Use tools and techniques to analyze a large data corpus
4. Technologies for performing processing at large scale
5. Perform a group-based activity to apply tools and techniques learnt to a real world problem.

Module-1

Introduction and MapReduce: Introduction, Hadoop ecosystem overview, HDFS overview, formats, MapReduce architecture, YARN, limitations of MapReduce, Algorithms: Page Rank.

Module-2

In Memory processing: Alternatives to Map Reduce – Iterative, Workflow processing - PIG, Graph Processing, In-memory computation., Workflow model case study – Apache Spark – RDDs, Scala Performance advantages.

Module-3

Models and algorithms: Graph model case study – Pregel/Graph. Computation model. Introduction to machine learning. Machine learning with Spark, Clustering, and Collaborative filtering Algorithms applied to Big Data. Case study – Tensorflow, Watson.

Module-4

Timeseries analysis: Business applications of timeseries data, challenges/tools to process timeseries data. Searching/Matching algorithms.

Module-5

Multimedia –Speech Processing: Variety in Big data, Business cases for Multimedia-Speech processing. Hidden Markov Models, Case study: Sphinx. Video Processing

Course Outcomes

At the end of the course the student will be able to:

1	Motivate and explain trade-offs in big data processing technique design and analysis in written and oral form.
2	Demonstrate the usage of tools to design Big Data applications.
3	Demonstrate development of analytics applications using alternative technologies to Hadoop.
4	Demonstrate ability to work in a small team to solve a real world problem with applications to the society
5	Communicate the design through a presentation and build a prototype to showcase the design.

Text Books:

1. “Big Data Analytics Beyond Hadoop”: Real-Time Applications with Storm, Spark, and More Hadoop Alternatives, Vijay Srinivasa Agneeswaran PhD, 1st Edition, Pearson, 2014

Reference Books:

1. “Mining of Massive Datasets”, Anand Rajaraman, Jure Leskovec, Jerey D. Ullman, 2 nd Edition, Cambridge University Press, 2014
2. Abu-El-Haija, Sami, Nisarg Kothari, Joonseok Lee, Paul Natsev, George Toderici, Balakrishnan Varadarajan, and SudheendraVijayanarasimhan. "Youtube-8m: A large-scale video classification benchmark." arXiv preprint arXiv:1609.08675 (2016).
3. Huang, Qi, Petchean Ang, Peter Knowles, Tomasz Nykiel, IaroslavTverdokhlib, Amit Yajurvedi, Paul Dapolito IV et al. "SVE: Distributed video processing at Facebook scale." In Proceedings of the 26th Symposium on Operating Systems Principles, pp. 87-103. ACM, 2017

Data Warehouse & Data Mining

Course Code	**24MCS233**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives

1. Introduction to general issues of Data Warehouse and Data Mining.
2. Understanding of the different architectures and mining techniques
3. The role and functions of Data Warehouse and Data Mining
4. Explain the stages and process different data mining techniques.
5. Learn mining and warehouse techniques through the use of different tools

Module-1

Data Warehouse: Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction Transformation-Loading, Logical (Multi- Dimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; Fact Less-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP.

Module-2

Introduction to Data Mining: Introduction, what is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and Dissimilarity-Basics.

Module-3

Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns.

Module-4

Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.

Module-5

Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms.

Course Outcomes:
At the end of the course the student will be able to:

1 Explain data warehousing architectures and tools for strategic decision-making.
2 Apply the KDD process to find patterns in data warehouses.
3 Analyze patterns discovered through association rule mining.
4 Evaluate patterns for predictions and classification from large datasets.
5 Design and select suitable methods for data mining and analysis.

Text Books:

1 Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

2 Data Mining-Concepts and Techniques- Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2. Data Ware Housing Fundamentals, Pualraj Ponnaiah, Wiley Student Edition.
3. The Data Ware House Life Cycle Toolkit- Ralph Kimball, Wiley Student Edition.
4. Data Mining, Vikaram Pudi, P Radha Krishna, Oxford University

Image Processing & Machine Vision

Course Code	**24MCS234**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives

1. Understand the basics of digital image processing and pixel relationships.
2. Learn image enhancement techniques in spatial and frequency domains.
3. Explore image restoration, noise reduction, and compression methods.
4. Master image segmentation and morphological processing techniques.
5. Introduce computer vision techniques and advanced algorithms for practical applications.

Module-1

Introduction and Digital Image Fundamentals: Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels.

Module-2

Image Enhancement in the Spatial and Frequency Domain: Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Gray Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

Module-3

Image Restoration and Image Compression: Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

Module-4

Image Segmentation and Morphological Image Processing: Discontinuity based segmentation, similarity based segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, some basic Morphological Algorithms.

Module-5

Object Representation and description and Computer Vision Techniques: Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications.

Course Outcomes
At the end of the course the student will be able to:

1 Explain the fundamentals of image processing and computer vision.

2 Illustrate the image enhancement techniques.

3 Illustrate Image restoration and image compression technique.

4 Tell about image segmentation morphological image processing.

5 Summarize computer vision techniques and its uses.

Text Books:
1. Digital Image Processing Rafael C. Gonzalez & Richard E. Woods Pearson Education 3rd edition
2. Computer Vision: A Modern Approach David A. Forsyth, Jean Ponce Prentice Hall
3. Fundamental of Digital Image Processing A.K. Jain PHI

Reference Books:

1. Digital Image Processing W.K. Pratt

PROFESSIONAL ELECTIVE-2

Pattern Recognition

Course Code	**24MCS241**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Explain pattern recognition principles
2. Able to implement algorithms for Pattern Recognition.
3. Ability to analyze decision trees.

Module-1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation Minimum risk estimators, problems.

Module-2

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation

Module-3

Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error a classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naïve Bayes classifier, Bayesian belief network.

Module-4

Naïve Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Overfitting & Pruning, Examples, Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM.

Module-5

Clustering: Hierarchical (Agglomerative, single / complete/ average linkage, wards, Partitional (Forgy's, k means, Iso data), clustering large datasets, examples, An application: Hand written Digit recognition.

Course Outcomes:

At the end of the course the student will be able to:

1. Explain pattern recognition principals
2. Develop algorithms for Pattern Recognition.
3. Develop and analyze decision tress.
4. Design the nearest neighbor classifier.
5. Apply Decision tree and clustering techniques to various applications

Textbook/ Textbooks

1. Pattern Recognition (An Introduction) V Susheela Devi, M Narsimha Murthy Universities Press 2011.
2. Pattern Recognition & Image Analysis Earl Gose, Richard Johnsonbaugh, Steve Jost PH 1996.

Reference Books

1. Pattern Classification Duda R. O., P.E. Hart, D.G. Stork John Wiley and sons 2000.

Learning the Data

Course Code	**24MCS242**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Understand the fundamentals of learning problems
2. Explore the theory of generalization in machine learning
3. Learn the application of linear classification, regression and explore non-linear transformations
4. Identify and address overfitting
5. Understand key principles guiding learning

Module-1

The Learning Problem: Problem Setup, Types of Learning, Is Learning Feasible, Error and Noise, Problems

Module-2

Training vs Testing: Theory of generalization, Interpreting the Generalization Bound, Approximation and Generalization Tradeoff, Problems.

Module-3

The Linear Model: Linear Classification, Linear Regression, Logistic Regression, Non Linear Transformation, Problems.

Module-4

Outfitting: When does outfitting Occur?, Regularization, Validation, Problems.

Module-5

Three Learning Principles: Occams's Razor, Sampling Bias, Data Snooping, Problems.

Course Outcomes:

Students will be able to

1. Explain various types of learning problems and assess the feasibility of learning under different conditions.
2. Differentiate between training and testing datasets, and effectively interpret generalization bounds for making reliable predictions.
3. Build and apply linear and logistic regression models, including handling non-linear transformations when needed.
4. Detect overfitting, apply regularization techniques, and perform validation to improve the model's generalization ability.
5. Apply foundational learning principles, recognize potential biases, and ensure robustness in their model evaluation process.

Text Book:

1. Learning From Data, Abu-Mostafa Yaser S., Malik Magdon-Ismail, Hsuan-Tien Lin (2012).

Distributed Database Systems

Course Code	**24MCS243**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Understand Distributed Data Processing and Databases.
2. Analyze Distributed Database Architecture.
3. Learn Query Processing and Optimization.
4. Master Transaction and Concurrency Management.
5. Examine Reliability and Object-Oriented Distributed Databases.

Module-1

Introduction: Distributed Data Processing, Distributed Database System, Promises of DDBSs, Problem areas.

Distributed DBMS Architecture: Architectural Models for Distributed DBMS, DDMBS Architecture.

Distributed Database Design: Alternative Design Strategies, Distribution Design issues Fragmentation, Allocation.

Module-2

Query processing and Decomposition: Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data.

Distributed query Optimization: Query optimization, centralized query optimization, distributed query optimization algorithms.

Module-3

Transaction Management: Definition, properties of transaction, types of transactions, distributed concurrency control: serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms, deadlock Management.

Module-4

Distributed DBMS Reliability: Reliability concepts and measures, fault-tolerance in distributed systems, failures in Distributed DBMS, local & distributed reliability protocols, site failures and network partitioning.

Parallel Database Systems: Parallel database system architectures, parallel data placement, parallel query processing, load balancing, database clusters.

Module-5

Distributed object Database Management Systems: Fundamental object concepts and models, object distributed design, architectural issues, object management, distributed object storage, object query Processing.

Course Outcomes:

1. Explain DDBMS architectures and apply fragmentation techniques to solve problems.
2. Analyze semantic integrity control costs and understand query processing steps.
3. Apply and optimize query algorithms to improve distributed database performance.
4. Evaluate transaction management and concurrency control approaches in distributed systems.
5. Apply algorithms for deadlock prevention, detection, and recovery in distributed databases.

Text Books:

1. M. Tamer OZSU and Patuck Valduriez: Principles of Distributed Database Systems, Pearson Edn. Asia, 2001.
2. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases, McGraw Hill.

Reference Books:

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: "Database Systems: The Complete Book", Second Edition, Pearson International Edition

Internet of Things

Course Code	**24MCS244**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Understand IoT Concepts: Grasp the fundamentals, definitions, and frameworks of IoT.
2. Learn Key IoT Technologies: Study identification, structure, and evolving standards in IoT.
3. Explore Connectivity Solutions: Understand wireless and IPv6 technologies for IoT.
4. Analyze IoT Applications: Review case studies in home automation, smart cities,and agriculture.
5. Master Data Analytics: Learn to apply tools like Hadoop, Spark, and Storm for IoT data analysis.

Module-1

Internet of Things:

What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation. Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication Examples-Overview, Smart Metering/Advanced Metering InfrastructureHealth/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.

Module-2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO

Module-3

Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M, Layer 3 Connectivity: IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.

Module-4

Case Studies :illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture Productivity Applications

Module-5

Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Realtime Data Analysis, Structural Health Monitoring Case Study.

Course Outcomes:

1. Define IoT: Ability to explain IoT concepts, motivations, and applications.
2. Identify IoT Technologies: Understand key technologies and standards driving IoT evolution.
3. Apply Connectivity: Implement IoT solutions using wireless and IPv6 technologies.
4. Design IoT Solutions: Develop IoT systems for various real-world applications.
5. Analyze IoT Data: Perform data analysis using Hadoop, Spark, and other frameworks

Text Books:

1. Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications Daniel Minoli Wiley 2013
2. Internet of Things: A Hands-on Approach Arshdeep Bahga, Vijay Madisetti Universities Press 2015

References:

1. Designing the Internet of Things Adrian McEwen, Hakim Cassimally, Wiley,1st Edition.
2. Getting Started with the Internet of Things, Cuno Pfister, O'Reilly,1st Ed.

Machine Learning Laboratory

Course Code	**24MCSL26**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	1:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	02	Exam Hours	03

Course Objectives:

1. Implement basic machine learning algorithms like Find-S and Perceptron.
2. Apply advanced algorithms such as Genetic Algorithms and Naive Bayes.
3. Execute clustering techniques like K-Means and hierarchical clustering.
4. Detect overfitting and apply regularization to improve models.
5. Evaluate models, address biases, and ensure robustness.

Suggested Lab Programs:

1. Write a Python program to implement the Find-S algorithm for learning a maximally specific hypothesis from a given set of training examples.
2. Implement the Candidate Elimination algorithm for concept learning with suitable example.
3. Write a program to implement the Perceptron learning algorithm to classify data points into two categories.
4. Use a genetic algorithm to find the optimal solution for a given mathematical function.
5. Implement the Naive Bayes algorithm for text classification (e.g., spam detection).
6. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set.
7. Implement the FOCL (First Order Combined Learner) Algorithm for explanation-based learning.
8. Implement Q-Learning for an agent navigating in a grid-world environment.
9. Write a Python program to implement K-Means clustering on a given dataset.
10. Implement agglomerative hierarchical clustering using a bottom-up approach.

Course Outcomes:

1. Successfully implement foundational machine learning algorithms.
2. Apply advanced techniques to solve complex problems.
3. Perform clustering on datasets to identify patterns.
4. Detect and address overfitting using regularization methods.
5. Evaluate model performance and manage biases effectively

III SEMESTER

Deep Learning

Course Code	**24MCS31**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course Objectives:

1. Understand neural networks and deep learning concepts.
2. Gain hands-on knowledge of neural network architectures and deep learning techniques.
3. Explore and tune parameters for deep learning models.
4. Learn optimization strategies for training deep models.
5. Apply deep learning to practical problems like vision, NLP, and speech.

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Over fitting and Under fitting, Hyper parameters and Validation Sets, Estimator, Biasand Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms,Stochastic Gradient DeMCSnt, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feed forward Networks: Gradient-Based Learning ,Hidden Units, Architecture Design, Back Propagation. Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.

Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision,NLP, Speech.

Course Outcomes:

1. Explain neural networks and deep learning fundamentals.
2. Implement and configure neural network architectures effectively.
3. Optimize deep learning models using various strategies.
4. Apply sequence modelling techniques such as RNNs and LSTMs.
5. Evaluate and apply deep learning in real-world applications.

Text Books

1. Deep Learning, Lan Good fellow and Yoshua Bengio, MITPress
2. Neural Networks: Asystematic Introduction,RaúlRojas,1996.
3. Pattern Recognition and machine Learning, Chirstopher Bishop,2007.

PROFESSIONAL ELECTIVE-3

Natural Language Processing

Course Code	24MCS321	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Understand the Fundamental Concepts of NLP
2. Develop Skills in Word and Syntactic Analysis
3. Master Semantic Analysis and Text Mining
4. Explore Information Retrieval Techniques
5. Hands-on Experience with NLP Tools

Module-1

OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-InformationRetrieval.LanguageModeling:VariousGrammar-basedLanguageModels-Statistical Language Model.

Module-2

WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes Part-of Speech Tagging. Syntactic Analysis: Context- free Grammar-Constituency- Parsing-Probabilistic Parsing.

Module-3

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case studying Natural Language Based Web Search: In Fact System Overview, The Global Security. Org Experience.

Module-4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite- State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Module-5
NFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Course Outcomes:

1. Analyze and process natural language text using fundamental NLP techniques.
2. Generate natural language output by applying language modeling and syntactic analysis methods.
3. Demonstrate the ability to perform text mining for extracting meaningful information from large datasets.
4. Apply information retrieval techniques to process and retrieve relevant linguistic information.
5. Implement various algorithms and models for semantic analysis, text classification, and relation extraction in natural language processing applications.

Text Books

1. Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.
2. Natural Language Processing and Text Mining Anne Kao and Stephen R. Potee Springer-Verlag London Limited 2007
3. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky and James H Martin, Prentice Hall 2008, 2nd Edition
4. Natural Language Understanding, James Allen Benjamin / Cummings, publishing company2ndEdition,1995.

Speech Processing			
Course Code	**24MCS322**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To provide an understanding of the fundamental concepts in speech signal processing, including digital models and time-domain models for speech signals.
2. To introduce students to the digital representation of speech waveforms and methods such as short-term Fourier analysis for analyzing speech signals.
3. To explore advanced speech processing techniques like homomorphic speech processing and their applications in speech analysis.
4. To develop a thorough understanding of linear predictive coding (LPC) of speech, including its principles, methods, and computation.
5. To familiarize students with the practical applications of speech processing in man-machine communication, such as speech recognition and synthesis.

Module-1

Introduction, Fundamentals of Digital Speech Processing

Module-2

Digital models for the speech signals, Time domain models for speech processing

Module-3

Digital representation of the speech waveform, short term Fourier analysis

Module-4

Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Comutation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.

Module-5

Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications Digital speech for man machine communication by voice

Course Outcomes:

1. Analyze and model speech signals using time-domain techniques and digital models for speech processing.
2. Identify and apply digital representation techniques, including short-term Fourier analysis, for analyzing speech waveforms.
3. Apply advanced speech processing methods, such as homomorphic analysis, to real-world speech processing scenarios.
4. Perform linear predictive coding (LPC) analysis, compute LPC parameters, and solve LPC equations effectively.
5. Apply speech processing techniques to modern applications, including man-machine communication and speech recognition systems.

Text Books:

1. Digital Processing of Speech Signals, Lawrence R. Rabiner , Ronald W. Schafer, Pearson education, 2004

Reference book:

1. Digital Speech Processing, and Recognition, Sadoaki Furui, Second Edition, Mercel Dekker 2002.
2. Designing with speech processing chips, Ricardo Jimenez, Academic press, INC 1991.

Virtual Reality

Course Code	**24MCS323**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. To introduce the fundamental concepts of Virtual Reality (VR) including hardware, software, and perceptual psychology.
2. To understand the optical systems and human sensory systems and their implications for VR experiences.
3. To explore graphical rendering techniques and physics simulations in VR environments.
4. To provide knowledge on tracking systems, sensor fusion, and interaction mechanisms in VR.
5. To analyze sound propagation, auditory perception, and advanced interfaces like brain-machine interfaces in VR systems.

Module-1

Introduction: Definition of VR, modern experiences, historical perspective. Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics. Geometric modelling, transforming rigid bodies, yaw, pitch, roll, axis-angle representation, quaternions, 3D rotation inverses and conversions, homogeneous transforms, transforms to displays, look-at and eye transforms, canonical view and perspective transforms, viewport transforms.

Module-2

Visual Perception: Light propagation, lenses and images, diopters, spherical aberrations, optical distortion; more lens aberrations; spectral properties; the eye as an optical system; cameras; visual displays. Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, and other implications of physiology on VR. Depth perception, motion perception, vection, stroboscopic apparent motion, color perception, combining information from multiple cues and senses, implications of perception on VR.

Module-3

Graphical rendering :ray tracing, shading, BRDFs, rasterization, barycentric coordinates, VR rendering problems, anti-aliasing, distortion shading, image warping (time warp), panoramic rendering. Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion, vection

Module-4

Tracking systems- estimating rotation, IMU integration, drift errors, tilt and yaw correction, estimating position, camera-feature detection model, perspective n-point problem, sensor fusion, lighthouse approach, attached bodies, eye tracking, inverse kinematics, map building, SLAM. Remapping, locomotion, manipulation, social interaction, specialized interaction mechanisms.

Module-5

Sound propagation, ear physiology, auditory perception, auditory localization; Fourier analysis; acoustic modelling, HRTFs, rendering, naturalization. Perceptual training, recommendations for developers, best practices, VR sickness, experimental methods that involve human subjects Touch,

haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.

Course Outcomes

1. Describe basic VR system components, including hardware, sensors, and software.
2. Explain how human vision, depth perception, and sensory physiology affect VR design.
3. Apply VR rendering techniques and simulate motion, collision, and physics.
4. Implement tracking systems and develop interaction mechanisms in VR.
5. Demonstrate knowledge of sound rendering, auditory perception, and advanced VR interfaces like haptics and telepresence.

Text Books

1. Virtual Reality by Steven M. LaValle. Cambridge University Press 2016
2. HANDBOOK OF VIRTUAL ENVIRONMENTS: Design, Implementation, and Applications Kelly S. Hale Kay M. Stanney CRC Press 2nd Edition, 2015

DevOps			
Course Code	**24MCS324**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

1. To introduce DevOps terminology, definition & concepts
2. To understand the different Version control tools like Git, Mercurial
3. To understand the concepts of Continuous Integration/ Continuous Testing / Continuous Deployment.
4. To understand Configuration management using Ansible.

Module-1

INTRODUCTION TO DEVOPS: Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

Module-2

COMPILE AND BUILD USING MAVEN & GRADLE: Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

Module-3

CONTINUOUS INTEGRATION USING JENKINS: Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

Module-4

CONFIGURATION MANAGEMENT USING ANSIBLE: Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

Module-5

BUILDING DEVOPS PIPELINES USING AZURE: Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines. yaml file

Course Outcomes:

1. Describe actions performed using version control tools like Git.
2. Implement Continuous Integration, Testing, and Deployment with Jenkins, Maven, and Gradle.
3. Execute automated Continuous Deployment processes.
4. Manage configurations using Ansible.
5. Utilize cloud-based DevOps tools with Azure DevOps.

Text Books

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016. 138.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

References

1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020
2. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
3. https://www.jenkins.io/user-handbook.pdf
4. https://maven.apache.org/guides/getting-started/

PROFESSIONAL ELECTIVE-4

Modern Cryptography

Course Code	**24MCS331**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. To learn about Modern Cryptography.
2. To focus on how cryptographic algorithms and protocols work and how to use them.
3. To build a Pseudo random permutation.
4. To construct Basic cryptanalytic techniques.
5. To provide instruction on how to use the concepts of block ciphers and message authentication codes.

Module-1

INTRODUCTION: Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

Module -2

FORMAL NOTIONS OF ATTACKS: Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model.

Module-3

RANDOM ORACLES: Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

Module-4

BUILDING A PSEUDORANDOM PERMUTATION: The Luby Rack off Construction: Formal Definition, Application of the Luby Rack off Construction to the construction of Block Ciphers, The DES in the light of Luby Rack off Construction.

Module-5

MESSAGE AUTHENTICATION CODES: Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols

Course Outcomes:

By the end of this course, students will be able to:

1. Interpret the basic principles of cryptography and cryptanalysis.
2. Explain symmetric encryption and authentication concepts.
3. Identify public key encryption, digital signatures, and key establishment methods.
4. Articulate and analyze cryptographic algorithms to build simple cryptographic solutions.
5. Explain the use of Message Authentication Codes (MACs).

Text Books:

1. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

References:

1. ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/. 158
2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3. William Stallings, “Cryptography and Network Security: Principles and Practice”, PHI 3rd Edition, 2006.

Software Defined Networks			
Course Code	**24MCS332**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. To understand the evolution of Software Defined Networking (SDN) and the key principles behind control and data plane separation.
2. To explore the architecture and functionality of SDN controllers such as Open Daylight (ODL) and Open Network Operating System (ONOS).
3. To provide knowledge on network programmability and its role in enabling flexible network management.
4. To understand the concepts of data center virtualization and Network Function Virtualization (NFV) within the SDN framework.
5. To learn how to troubleshoot and verify SDN implementations, and explore real-world use cases for SDN in bandwidth management and traffic monitoring.

Module-1

Introduction-Centralized and Distributed Control and Data Planes, Open Flow.

Module-2

SDN Controllers, Network Programmability.

Module-3

Data Center Concepts and Constructs, Network Function Virtualization.

Module-4

Network Topology and Topological Information Abstraction, Building an SDN Framework

Module-5

Use Cases for Band width Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions.

Course Outcomes:

By the end of this course, students will be able to:

1. Explain SDN concepts, architecture, control and data plane separation, and the OpenFlow protocol.
2. Demonstrate SDN controllers, network programmability, and their impact on network management.
3. Analyze SDN integration with data centers and the role of NFV.
4. Design and implement SDN frameworks focusing on topological abstraction and network scalability.
5. Apply SDN principles to real-world scenarios like bandwidth scheduling, traffic classification, and network monitoring, and troubleshoot SDN environme

Text Books:

1. SDN:Software Defined Networks,KenGray,ThomasD.Nadeau.,O'Reilly.2013.
2. Software Defined Networks, Paul Goransson,Chuck Black Timothy Culver, Elsevier 2nd Edition,2016.

Block chain Technology			
Course Code	**24MCS333**	CIE Marks	50
Teaching Hours/Week(L:P:S)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

1. Learn blockchain fundamentals, consensus, and decentralization.
2. Understand Bitcoin, alternative coins, and smart contracts.
3. Explore the Ethereum ecosystem, Ether transactions, and development.
4. Learn Web3, smart contracts, and Hyper ledger frameworks.
5. Study new platforms, scalability, and research trends.

Module-1

INTRODUCTION TO BLOCKCHAIN: Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

Module-2

INTRODUCTION TO CRYPTOCURRENCY: Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

Module-3

ETHEREUM: Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

Module-4

WEB3 AND HYPERLEDGE: Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

Module-5

EMERGING TRENDS : Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

Course Outcomes:

1. Explain the concepts of blockchain and decentralization.
2. Describe cryptocurrencies and implement smart contracts.
3. Identify Ethereum components and configure Ethereum networks.
4. Deploy smart contracts and utilize Hyperledger.

5. Evaluate new blockchain platforms and explore research trends.

Text Books:

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018.
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
3. ArshdeepBahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

Reference Books:

1. Blockchain Basics:ANon-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition,2017
2. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M.Antonopoulos, O'Reilly Media, FirstEdition,2014.

Generative AI

Course Code	24MCS334	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

1. Introduce the concept of generative AI and its applications.
2. Provide hands-on experience in building generative models using TensorFlow and Keras.
3. Explore various generative model architectures (RBMs, VAEs, GANs, LSTMs, Transformers).
4. Understand the challenges and limitations of generative models.
5. Develop skills in applying generative models to real-world problems.

Module-1

An Introduction to Generative AI: "Drawing" Data from Models, Applications of AI, the rules of probability, why use generative models? Style transfer and image transformation, Unique challenges of generative models. Setting Up a Tensor Flow Lab: Deep neural network development and Tensor Flow, VS Code Docker: A lightweight virtualization solution, Kubernetes: Robust management of multi-container applications, Kube flow: an end-to-end machine learning lab, A brief tour of Kube flow's components, Kube flow pipelines Using Kube flow Katib to optimize model hyper parameters.

Module-2

Building Blocks of Deep Neural Networks: Perceptrons – a brain in a function, Multi-layer perceptrons and backpropagation, Varieties of networks: Convolution and recursive, Networks for sequence data, Building a better optimizer. Teaching Networks to Generate Digits: The MNIST database, Restricted Boltzmann Machines: generating pixels with statistical mechanics, Stacking Restricted Boltzmann Machines to generate images: the Deep Belief Network 117 Creating an RBM using the Tensor Flow Keras layers API 120 Creating a DBN with the Keras Model API

Module-3

Painting Pictures with Neural Networks Using VAEs: Painting Pictures with Neural Networks Using VAEs Creating separable encodings of images The variational objective, Inverse Autoregressive Flow, Importing CIFAR, Creating the network from TensorFlow Image Generation with GANs: The taxonomy of generative models Generative adversarial networks, Vanilla GAN Improved GANs, Progressive GAN, and Challenges.

Module-4

The Rise of Methods for Text Generation: Representing text, Text generation and the magic of LSTMs, LSTM variants and convolutions for text NLP 2.0: Using Transformers to Generate Text: Attention, Contextual embedding's, Self-attention, Transformers, GPT 1, 2, 3…

Module-5

Composing Music with Generative Models: Getting started with music generation, Music generation using LSTMs, Music generation using GANs, Muse GAN – polyphonic music generation. Emerging Applications in Generative AI: Introduction Finding new drugs with generative models, Solving partial differential equations with generative modeling Few shot learning for creating videos from images Generating recipes with deep learning.

Course Outcomes

1. Explain the underlying principles of generative AI.
2. Implement various generative models using TensorFlow and Keras.
3. Evaluate and compare the performance of different generative models.
4. Apply generative models to image generation, text generation, and music composition.
5. Analyze the potential and limitations of generative AI in various applications.

Textbooks

1 .Generative AI with Python and TensorFlow 2 Joseph Babcock Raghav Bali Packt Publishing Ltd. April 2021

Assessment Details for Theory (CIE and SEE) -PCC,PEC,MCC(RM&IPR)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE.

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

1. Three Unit Tests each of 20 Marks.

2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination (SEE) :

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

2. The question paper will have ten full questions carrying equal marks.

3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

4. Each full question will have a sub-question covering all the topics under a module.

5. The students will have to answer five full questions, selecting one full question from each module.

Assessment Details for Practical (CIE and SEE) -IPCC

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of IPCC

1. **Two Tests** each of 20 Marks
2. Two assignments each of 10 Marks/One Skill Development Activity of 20 marks
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to 30 marks.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15** marks are for conducting the experiment and preparation of the laboratory record, the other **05** marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks. Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to get a credit.

Assessment Details for Practical (CIE and SEE) -PCCL

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks.

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is 50 Marks.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40.**

- Each experiment to be evaluated for conduction with observation sheet and record write up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student’s performance and learning ability.
- The average of 02 tests is scaled down to 20 marks (40% of the maximum marks). The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up / conduction procedure and result / viva will be conducted jointly