Annexure 22.12

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD)
Re-accredited with A++ Grade by NAAC, CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

Department of Computer Science and Engineering
M.E. Artificial Intelligence and Data Science

Programme Outcomes (PO):

1. Develop an in depth understanding about the principles, tools and techniques of AI & Data Science.
2. Implement state of the art Data Analysis techniques in different computing platforms.
3. Identify, formulate and solve engineering problems by applying mathematical foundations, algorithmic principles and design techniques in AI & Data Science environment to meet industrial challenges.
4. Analyse the suitable AI & Data Science solutions required for the implementation of software systems.
5. Apply modern tools to provide innovative solutions in the domain of AI & Data Science.
6. Able to communicate the findings of their analysis to scientific community through quality publications

Program Specific Outcomes (PSO):

PSO1: Arrive at actionable insight from data for solving business and engineering problems.

PSO2: Able to carry out fundamental research to cater the critical needs of the society through cutting edge technologies of AI & Data Science.

Scheme of Instruction & Examination

(For students admitted from 2024-2025 and onwards)

Part	*Course Code*	*Name of Course / Component*	*Hours of Instruction/week*		*Scheme of Examination*						
			T	*P*	*Duration of exam*	*CIA*		*CE*		*Total*	*Credits*
						T	P	T	P		
First Semester											
I	**Core Courses (CC)**										
	24MEAC01	Mathematical Foundations for Computer Science	3	-	3	40	-	60	-	100	4
	24MEAC02	Principles and Techniques of Data Science	3	-	3	40	-	60	-	100	3
	24MEAC03	Programming for Data Analysis	-	3	3	40		60	-	100	1.5
	24MEAC04	Data Structure & DBMS Laboratory	-	3	3	-	40	-	60	100	1.5
	24MEAC05	Research Methodology and IPR	3	-	3	40	-	60	-	100	3
	Program Electives (PE)										
	24MEAE11/ 24MEAE12/ 24MEAE13	Program Elective - I	3	-	3	40	-	60	-	100	3
	24MEAE21/ 24MEAE22/ 24MEAE23	Program Elective - II	3	-	3	40	-	60	-	100	3
II	**Non-Credit Mandatory Courses (NCMC)**										
	Audit Course (AC)										
	24MEMA11/ 24MEMA12/ 24MEMA13	Audit Course- I	3	-	2	100	-	-	-	100	Remark
	Extracurricular Course (ECC)										
		CSS/ Adult Education / Community Engagement and Social Responsibility	2	-	-	-	-	-	-	-	-

Program Elective-I: 24MEAE11Data Preparation and Analysis / 24MEDE12 Data visualization / 24MEAE13 Data Privacy & Security

Program Elective-II: 24MEAE21 Data Mining Techniques / 24MEAE22 Image Processing and Computer Vision / 24MEAE23 Cloud Computing

Second Semester											
Part	*Course Code*	*Name of Course/ Component*	*Hours of Instruction//week*		*Scheme of Examination*						
			T	P	*Duration of exam*	*CIA*		*CE*		*Total*	*Credits*
						T	P	T	P		
I	**Core Courses (CC)**										
	24MEAC06	Artificial Intelligence	3	-	3	40	-	60	-	100	3
	24MEAC07	Machine learning	3	-	3	40	-	60	-	100	3
	24MEAC08	Artificial Intelligence Laboratory	-	3	3	-	40	-	60	100	1.5
	24MEAC09	Machine Learning Laboratory	-	3	3	-	40	-	60	100	1.5
	24MEAC10	Mini Project with Seminar	-	2	-	-	100	-	-	100	1
	Program Electives (PE)										
	24MEAE31/ 24MEAE32/ 24MEAE33	Program Elective –III	3	-	3	40	-	60	-	100	3
	24MEAE41/ 24MEAE42/ 24MEAE43	Program Elective-IV	3	-	3	40	-	60	-	100	3
II	**Non-Credit Mandatory Courses (NCMC)**										
	Audit Course (AC)										
	24MEMA21/ 24MEMA22	Audit Course-II	3	-	2	100	-	-	-	100	Remark
	Extracurricular Course (ECC)										
	24MXCSS1/ 24MXAED1/ 24MXCSR1	CSS /Adult Education / Community Engagement and Social Responsibility	2	-	-	-	-	-	-	100	2
	Professional Certification Course (PCC)										
		Professional Certification Course	-	-	-	100	-	-	-	100	2
Internship during Summer Vacation (1 month)											
Program Elective III 24MEAE31 AI in Health Care/ 24MEAE32 AI in speech processing / 24MEAE33 AI in Natural Language Processing											
Program Elective IV 24MEAE41 Block chain Technology / 24MEAE42 Predictive Analysis / 24MEAE43 Big Data Framework for Data Science											
Third Semester											
I	**Core Courses (CC)**										
	24MEAC11	Research Project - I	-	20	-	-	100	-	-	100	10
	Program Electives (PE)										
	24MEAE51 / 24MEAE52/ 24MEAE53	Program Elective-V	3	-	-	-		100	-	100	3
	24MEAE61	Program Elective-VI Title of MOOC (SWAYAM-NPTEL)*	3	-	-	-		100	-	100	3
II	24MEAC12	Internship/ Training	-	-	-	-	100	-	-	100	2
*** One MOOC (12 weeks duration) through SWAYAM - NPTEL with credit transfer of 3 credits, as an alternative to one Program Elective Course, Program Elective – V in III Semester should be completed between 1st and 3rd semester. Title of the MOOC to be specified after enrolment.**											
Program Elective V 24MEAE51 Deep Learning / 24MEAE52 Cyber security / 24MEAE53 Reinforcement Learning											
Fourth Semester											
I	**Core Courses (CC)**										
	24MEAC13	Research Project -II	-	32	-	-	200	-	200	400	16
										Total credits	**73**

Requirements to earn the M.E. degree:

1 Total credits required to be earned in Part I & II component: 73
2 Minimum of 3 credits to be earned in MOOC (12 weeks duration) with credit transfer, as an alternative to one Program Elective in 3rd semester to be completed between 1st and 3rd semester from SWAYAM NPTEL.
3 Successful completion of Part II Non-Credit Mandatory Courses (NCMC).

List of Program Electives (PE)

S. No.	Course Code	Course Title
1.	24MEAE11	Data Preparation and Analysis
2.	24MEAE12	Data visualization
3.	24MEAE13	Data Privacy and Security
4.	24MEAE21	Data Mining Techniques
5.	24MEAE22	Image Processing and Computer Vision
6.	24MEAE23	Cloud Computing
7.	24MEAE31	AI in Health Care
8.	24MEAE32	AI in speech processing
9.	24MEAE33	AI in Natural Language Processing
10.	24MEAE41	Block chain Technology
11.	24MEAE42	Predictive Analysis
12.	24MEAE43	Big Data Framework for Data Science
13.	24MEAE51	Deep Learning
14.	24MEAE52	Cyber security
15.	24MEAE53	Reinforcement Learning
16.	24MEAE61	**MOOC (12 Weeks Course in SWAYAM- NPTEL)**

List of Audit Courses (Non-Credit Mandatory Course)

S. No.	Course Code	Audit Course –I
1.	24MEMA11	English for Research Paper Writing
2.	24MEMA12	Disaster Management
3	24MEMA13	Research and Publication Ethics

S. No.	Course Code	Audit Course- II
1.	24MEMA21	Pedagogy Studies
2.	24MEMA22	Value Education

Open Elective (OE) offered by CSE Department

S. No.	Course Code	Course Title
1.	24MEAO01	Foundations of Artificial Intelligence

Professional Certification Course Offered by CSE Department

S. No	Course Code	Course Title
1.	24MEOPC1	AWS Cloud Architect
2.	24MEOPC2	Red Hat Certified System Administrator
3.	24MEOPC3	Full Stack Development

Mathematical Foundations for computer Science

Semester I **Hours of Instruction/week: 4T**
24MEAC01 **No. of Credits: 4**

Course Learning Objectives:

CLO1: To understand the concept of mathematical logic and inference theory.

CLO2: To provide an overview of algebraic structures, recursive functions and lattices.

Unit I Logic **12**

Statements – Connectives – Truth Tables – Normal forms – Predicate calculus –Inference theory for Statement Calculus and Predicate Calculus – automata theorem proving.

Unit II Combinatorics **12**

Review of Permutation and Combination - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion - generating function – Recurrence relations.

Unit III Algebraic Structures **12**

Semi group - Monoid – Groups (Definition and Examples only) Cyclic group - Permutation Group (Sn and Dn) - Substructures - Homomorphism of semi group, monoid and groups - Cosets and Lagrange Theorem – Normal Subgroups - Rings and Fields (Definition and examples only)

Unit IV Recursive Functions **12**

Recursive functions - Primitive recursive functions - Computable and non - computable functions.

Unit V Lattices **12**

Partial order relation - Poset – Lattices - Hasse diagram - Boolean algebra

Total Hours: 60

References:

1. ***Lidl and pitz (1984), Applied Abstract Algebra,*** Springer - Verlag, New York.
2. ***K.H. Rosen (1999), Discrete Mathematics and its Applications***, Tata McGraw – Hill publishing Company Ltd., New Delhi.
3. ***J.P. Tremblay and R. Manohar (2008), Discrete Mathematical Structure and its Application to Computer Science***, TMG Edition, Tata McGraw – Hill publishing Company Ltd., New Delhi.
4. ***Kenneth H. Rosen, Kamala Krithivasan (2012), Discrete Mathematics and its Applications (with Combinatorics and Graph Theory),*** Tata McGraw – Hill publishing Company Ltd., New Delhi.

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

- **CO1:** Understand mathematical reasoning, proof techniques and the structure of mathematical objects
- **CO2:** Apply combinatorial principles and techniques to solve counting problems.
- **CO3:** Analyse the concepts and properties of various algebraic structures.
- **CO4:** Evaluate problems using recursive functions.
- **CO5:** Understand lattices as algebraic structures

CO-PO Mapping

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

Principles and Techniques of Data Science

Semester I **Hours of Instruction /week: 3T**
24MEAC02 **No. of Credits: 3**

Prerequisite:
Data Science.

Course Learning Objectives:
CLO1: To identify the scope and essentiality of Data Science.
CLO2: To analyze the data, data science lifecycle, data collection and cleaning, exploratory data analysis and visualization.

Unit I Introduction **9**

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Scien Project – Applications of Data Science in various fields – Data Security Issues

Unit II Data Collection and Data Pre-Processing **9**

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration a Transformation – Data Reduction – Data Discretization

Unit III Exploratory Data Analytics **9**

Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table Heat Map – Correlation Statistics – ANOVA

Unit IV Model Development **9**

Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distributi Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction a Decision Making-Model Evaluation

Unit V Data Visualisation **9**

Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retir variables, mapping variables to encodings, Visual encodings

Total Hours: 45

References:

1. ***Daimi. Kevin. et al. Ed. Hamid R. Arabnia (2020). Principles of Data Science,*** Springer.
2. ***Han Jiawei Micheline Kamber and Jian Pei. (2011). Data mining concepts and techniques Third Edition.*** Elsevier
3. ***Sinan Ozdemir (2016). Principles of Data Science: Mathematical techniques and theory to succeed in data-driven industries.*** Packt Publishing Limited.

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

- **CO1:** Explore the evolution, roles and stages in data science for various security issues.
- **CO2:** Identify the different Strategies of Data Collection and pre-processing techniques.
- **CO3:** Examine the various statistical measures used to find the insights of data.
- **CO4:** Analyze the various methods of model development in data analytics.
- **CO5:** Interpret the importance of data visualization in data science.

CO-PO Mapping

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

Programming for Data Analysis Laboratory

Semester I **Hours of Instruction /week: 3P**

24MEAC03 **No. of Credits: 1.5**

Course Learning Objectives:

CLO1: To introduce core programming basics required for Data Science using Python language.

CLO2: To introduce the important Data Science modules NumPy, SciPy and Matplotlib.

List of Experiments:

1. Write a Python Program(s) to demonstrate the Python data types.
2. Write a Python Program to demonstrate the Python operators and their order of preference.
3. Write a Python program which demonstrate the use of Lists, Tuples Dictionaries and Sets
4. Write a Python Program using function which accepts a number 'n' and list the first 'n' Fibonacci numbers
5. Write a Python program demonstrating the NumPy matrix operations such as accepting two matrices finding the dimension, adding the two matrices
6. Write a Python program to find the det, inv, eigenvalues and eigenvectors of a matrix using corresponding SciPy module functions.
7. Write a Python program demonstrating the Pandas indexing capabilities, identifying the null values in the dataset and filling them with or dropping them from the dataset.
8. Write Python programs to generate a normal distribution, binomial distribution and Poisson distribution using Python and visualize them.
9. Write a Python program to implement the Simple Linear Regression model to predict the wine quality using the physicochemical and sensory variables by using Scikit-Learn module and estimate the statistical significance of the model.
10. Write Python program to check the normality of a dataset, which a foremost important test, required to determine whether to apply parametric tests or nonparametric tests on the given test. These tests include Histogram, Quantile-quantile plot, Shapiro-Wilk test, D'Agotino's K-squared test, Anderson-Darling test.

Total Hours : 45

Software Requirements:

Python, Matlab, Jupyter, Anaconda, spaCy.

References:

1. ***Wes McKinney (2022). Python for Data Analysis: Data Wrangling with Pandas, Numpy and Jupyter,*** Third edition, O'Reilly.
2. ***Jake VanderPlas. (2022). Python Data Science Handbook: Essential Tools for Working with Data.*** Second Edition, O'Reilly.

Course Outcomes:

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

CO1: Decompose a Python program into functions.
CO2: Manipulate with 1-d, 2-d and multidimensional data using Python.
CO3: Develop algorithmic solutions to Data Science related problems.

CO-PO Mapping

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

Data Structures and DBMS Laboratory

Semester I **Hours of Instruction/week: 3P**
24MEAC04 **No. of Credits: 1.5**

Course Learning Objective:

CLO1: To understand and gain knowledge on the advanced concepts of DS and DBMS.
CLO2: To get familiar Data types and various Procedures in PL/SQL.

List of Experiments:

1. Implementation of recursive function for tree traversal and Fibonacci
2. Implementation of iteration function for tree traversal and Fibonacci
3: Implementation of Merge Sort and Quick Sort
4: Implementation of a Binary Search Tree
5: Red-Black Tree Implementation
6: Heap Implementation
7. Learning basic DDL, DML, DCL and TCL commands
8. Working with dual table.
9. PL/SQL-Data types, control structures.
10. Creating Stored Procedures with PL/ SQL.
11. Error handling and Implement Timestamp Ordering in PL/ SQL.
12. Cursor Management and Deadlock Avoidance in PL/ SQL.

Total Hours: 45

References:

1 ***Lipschutz Seymour(2014). Data Structures Schaum's Outlines Series,*** Tata McGraw Hill, 3rd Edition.
2 ***Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman (2006), Data Structures and Algorithms,*** Pearson Education, Reprint.
3 ***Silberschatz, Korth, Sudarshan (2019, Database System Concepts.*** 7rd Edition. Tata McGraw Hill,

Course Outcomes:

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

CO1: Implement tree traversals, sorting, searching and heap algorithms
CO2: Infer database language commands to create simple database.
CO3: Analyze the database using queries to retrieve records.

CO-PO Mapping

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

Research Methodology and IPR

Semester I **Hours of Instruction/week:3T**

24MEAC05 **No. of Credits: 3**

Objectives:

CLO1: To introduce the concept of Scientific Research and its processes and intellectual property rights.

CLO 2: To Explore and identify an appropriate research problem in their interesting domain.

Unit I Introduction **9**

Meaning of research problem- Sources of research problem- Criteria Characteristics of a good research problem- Errors in selecting a research problem- Scope and objectives of research problem. Approaches of investigation of solutions for research problem data collection analysis-interpretation Necessary instrumentations.

Unit II Literature Survey **9**

Effective literature studies approaches – Analysis Plagiarism – Research ethics-Effective technical writing – How to write report – Paper–Developing a Research Proposal-Format of research proposal –presentation and assessment by a review committee.

Unit III Intellectual Property Rights **9**

Nature of Intellectual Property: Patents – Designs –Trade and Copyright. Process of Patenting and Development: technological research – innovation-patenting-development. International Scenario: International co-operation on Intellectual Property. Procedure for grants of patents – Patenting under PCT.

Unit IV Patent Rights **9**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit V New Development in IPR **9**

Administration of Patent System – IPR of Biological Systems – Computer Software etc-Traditional knowledge Case Studies– IPR and IITs.

Total Hours: 45

References:

1. ***Stuart Melville and Wayne Goddard (1996).Research methodology: An introduction For science & engineering students***. Juta & CoLtd.,
2. ***Ranjit Kumar (2014). Research Methodology: A Step by Step Guide for beginners. 3rdEdition.****SAGE publications Ltd.,*
3. ***Robert P.Merges. Peter S.Menell. MarkA (2016). Lemley Intellectual Property in*** New Technological Age.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Formulate the research problem statement and present it.
CO2: Develop the skill in comprehensively surveying the articles for proposal writing and presentation.
CO3: Apply IPR for their developed products
CO4: Understand the procedure for applying patent rights for new innovations
CO5: Analyze and create new developments in IPR.

Artificial Intelligence

Semester II **Hours of Instruction/week: 3T**
24MEAC06 **No.of Credits: 3**

Prerequisite:
Data structure, Algorithms.

Course Learning Objectives:

CLO1: To provide the knowledge representation and Learning techniques to problem solving strategy.

CLO2: To design and solve real world problems using AI approaches.

Unit I Introduction and Intelligent Agents 9

Introduction: AI problems - AI technique - philosophy and development of Artificial intelligence. Intelligent Agents: Agents and Environments-Good Behavior: The Concept of Rationality- The Nature of Environments and The Structure of Agents. Case Studies: Intelligent agents in autonomous systems.

Unit II Problem Spaces and Search 9

State-space search, Uninformed and informed search techniques: BFS, A*, variations of A*. Local search and optimization: hill-climbing, simulated annealing. Minimax algorithm, alpha-beta pruning, stochastic games, Constraint- satisfaction problems. Case Studies: Search techniques for a sliding tile problem.

Unit III Knowledge, reasoning and planning 9

Knowledge based Agents- First-Order Logic and Its Inference- Classical Planning, Planning and Acting in the Real World, Knowledge Representation.

Unit IV Uncertain Knowledge and Reasoning 9

Quantifying Uncertainty- Probabilistic Reasoning- Probabilistic Reasoning over Time- Making Simple Decisions- Making Complex Decisions. Case Studies: Application of planning to a production system.

Unit V Natural Language Processing 9

Introduction: Brief history - Basic Concepts - Phases of NLP - Application of chatbots etc. NLP using Python - Make use of any of the NLP libraries like NLTK -spacy.

Total Hours: 45

References:

1. ***Elaine Rich, Kevin Knight (2017). Artificial Intelligence***. Tata McGraw Hill.
2. ***S. Russell and P. Norvig (2011).Artificial Intelligence: A Modern Approach***. Third Edition, Prentice Hall.
3. ***Daniel Jurafsky, James H. Martin (2019). Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech***. Pearson Publication.

Course Outcomes:

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

CO1: Identify the need of Intelligent agents in problem solving.
CO2: Compare and analyze different search techniques applied for problem solving.
CO3: Apply the knowledge representation method and reasoning for given decision problem.
CO4: Design and analyze a learning technique for a given system in different AI application domains like marketing, healthcare, banking, finance, education.
CO5: Explain the knowledge of language at the levels of Morphology and Part of Speech Tagging.

CO-PO Mapping

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

Machine Learning

Semester II **Hours of Instruction/week: 3T**
24MEAC07 **No.of Credits: 3**

Course Learning Objectives:

CLO1: To learn how to apply and interpret machine learning algorithms for various applications.

CLO2: To solve real life problems using supervised, unsupervised algorithms.

Unit I Supervised Learning 9

Supervised Learning - Distance-based methods- Nearest-Neighbours, Decision Trees- Naive Bayes- Linear models: Linear Regression- Logistic Regression- Generalized Linear Models- Support Vector Machines- Nonlinearity and Kernel Methods -Beyond Binary Classification: Multi-class/Structured Outputs- Ranking.

Unit II Unsupervised Learning 9

Unsupervised Learning - Clustering: K-means/Kernel K-means- Dimensionality Reduction-PCA and kernel PCA-Matrix Factorization and Matrix Completion-Generative Models (mixture models and latent factor models).

Unit III Evaluation and Model Selection 9

Evaluating Machine Learning algorithms and Model Selection -Introduction to Statistical Learning Theory - Ensemble Methods (Boosting, Bagging, Random Forests).

Unit IV Sparse Model 9

Sparse Modelling and Estimation -Modelling Sequence/Time Series Data -Deep Learning and Feature representation Learning.

Unit V Semi-Supervised Learning 9

Scalable Machine Learning (Online and Distributed Learning) - Semi-supervised Learning- Active Learning- Reinforcement Learning- Inference in Graphical Models- Introduction to Bayesian Learning and Inference.

Total Hours: 45

References:

1. ***Kevin P.Murphy (2022***).Probabilistic Machine Learning: An introduction MIT Press.
2. ***JianxinWu (2020).*** Essentials of Pattern Recognition: An Accessible Approach. Cambridge university press
3. ***Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani (2021).***An Introduction to Statistical Learning. Springer.

Course Outcomes:

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

- **CO1:** Discuss the supervised learning algorithms in machine learning to build predictive models.
- **CO2:** Analyze and select appropriate unsupervised machine learning algorithms for various types of problems.
- **CO3:** Evaluate machine learning algorithms, model selection and importance of ensemble methods.
- **CO4:** Analyze the sparse model in machine learning.
- **CO5:** Examine the different aspects of semi-supervised learning and reinforcement learning.

CO-PO Mapping

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

Artificial Intelligence Laboratory

Semester II **Hours of Instruction/week: 3P**
24MEAC08 **No.of Credits: 1.5**

Course Learning Objectives:

CLO1: To write python code to solve wide range of real world problems.
CLO2: To build intelligent applications in-line with the recent trends, tools andtechniques.

List of Experiments:

1. Study of Tools and Libraries in Python for Artificial intelligence
2. Implementation of simple python programs
3. Implementation of Search Strategies
4. Implementation of Logic programming to solve problems
5. Design simple games like Hangman
6. and Tic-Tac-Toe
7. Plotting Graphs in python
8. Implementation of Image processing functions
9. Build applications using NLTK package
10. Creation of simple chatbot
11. Design of Voice Assistant
12. Study of AI applications
13. Creation of Intelligent Applications

Total Hours: 45

Software Requirements:

Python

References:

1. ***S. Russell and P. Norvig (2015). Artificial Intelligence: A Modern Approach.*** Third Edition, Prentice Hall.
2. ***Prateek Joshi (2017). Artificial Intelligence with Python.*** Packet Publishing.
3. ***Anthony Williams (2017). Python Programming.*** Create Space IndependentPublishing Platform; Combined edition.

Course Outcomes:

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

CO1: Implement the real-world problems using python.
CO2: Incorporate the usage of libraries and tools to develop sustainable solutions.
CO3: Explore intelligent solutions incorporating AI trends and techniques.

CO-PO Mapping

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

Machine Learning Laboratory

Semester II **Hours of Instruction /week: 3P**
24MEAC09 **No. of Credits: 1.5**

Course Learning Objectives:
CLO1: To implement different Machine learning algorithms.
CLO2: To build models for different types of applications using machine learning algorithms.

List of Experiments:

1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib, Scikit.
2. Perform Data exploration and preprocessing in Python.
3. Implement regularised Linear regression.
4. Implement Naive Bayes classifier for dataset stored as CSV file.
5. Implement regularized logistic regression.
6. Build models using different Ensembling techniques.
7. Build models using Decision trees.
8. Build model using SVM with different kernels.
9. Implement K-NN algorithm to classify a dataset.
10. Build model to perform Clustering using K-means after applying PCA and determining the value of K using Elbow method.

Total Hours: 45

Software Requirements:

Java, Python,Matlab.

References:

1. **Kevin P.Murphy (2022). Probabilistic Machine Learning: An introduction,** MIT Press.
2. ***Jianxin Wu (2020).Essentials of Pattern Recognition: An Accessible Approach***. Cambridge university press.
3. ***Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani(2021). An Introduction to Statistical Learning,*** Springer.

Course Outcomes:

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

CO1: Explore the concepts of various python libraries and implement preprocessing techniques using python.

CO2: Implement supervised machine learning algorithms on standard datasets to evaluate the performance metrics.

CO3: Apply unsupervised machine learning algorithms on standard datasets to evaluate the performance metrics.

CO-PO Mapping

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

Data Preparation and Analysis

PEI **Hours of Instruction/ week: 3T**
Semester I **No. of Credits: 3**
24MEAE11

Prerequisite:
Database Management Systems.

Course Learning Objectives:
CLO1: To understand the importance of data, data preprocessing, data cleaning and conditioning.

CLO2: To get acquainted with data visualization techniques for exploratory analysis.

Unit I Data Gathering and Data Discovery **9**

Identifying potential data sources- Gathering data -Data discovery- understanding the data - assessing data -data formats- Parsing -Selecting features-Transformation- Scalability and real-time issues.

Unit II Cleaning and Conditioning Data **9**

Data Preparation Basic Models: Data Integration- Data Cleaning- Data Normalization- Min-Max Normalization- Z-score Normalization- Decimal Scaling Normalization- Consistency checking- Heterogeneous and missing data- Dealing with missing values- Duplicate values- Noise.

Unit III Exploratory Analysis **9**

Formulating Hypothesis- Data Terminology- Data Exploration-Data Exploration through Summary Statistics-Data Exploration through Plots- Feature Engineering-Feature selection-Feature transformation-Dimensionality reduction.

Unit IV Data Visualization **9**

Visualization techniques-Different types of plots-Designing visualizations- Time series-Geolocated data-Correlations and connections- Hierarchies and networks- Interactivity.

Unit V Advanced Tools for Data Preparation **9**

Web scraping -Data from social networks- Open-source tools for data preparation: Open Refine-R/Python libraries for data preparation and visualization.

Total Hours: 45

References:

1. ***Glenn J. Myatt (2014) Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining.***Wiley Publication.
2. ***Salvador García. JuliánLuengo. Francisco Herrera(2015). Data Preprocessing in Data Mining.*** Springer International Publishing Switzerland .
3. ***Ruben Verborgh Max De Wilde(2013) .Using OpenRefine : the essential Open Refine guide that takes you from data analysis and error fixing to linking your dataset to the Web. -*** Birmingham, England: Packet Publishing, 2013.

Course Outcomes:

At the end of the course, students will be able to

CO1: Explore the concept of data gathering to discover data formats to transform to the suitable format.
CO2: Identify the models of data preparation, normalization and to remove the missing and duplicate values.
CO3: Gain insights from dataset and the basics of feature engineering with the knowledge gained from data exploration**.**
CO4: Examine the importance of data visualization technique to identify the patterns, trends and outliers in large dataset.
CO5: Demonstrate the use of open source tools for data preparation.

CO-PO Mapping

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

Data Visualization

PE I

Semester I **Hours of Instruction/week: 3T**

24MEAE12 **No. of Credits: 3**

Prerequisite Courses:

Data Mining, Image Processing

Course Learning Objectives:

CLO 1: To learn element of visualization well to perceive information well and different types of data and its visualization

CLO 2: To identify quantitative and non quantitative data visualization.

Unit I Introduction to Data Visualization **9**

Need for data visualization. Types of Data, Stages of Data visualization, Fitts Law, Human Visual perception and cognition .Case study on Installation of Tableau Public and analysing different types of data.

Unit II Visualization of numerical data **9**

Types of Data visualization: Basic charts, scatterplots, Histogram, advanced visualization Techniques like streamline and statistical measures. Case study to Perform constellation modelling of high dimensional data and analyse the properties.

Unit III Visualization of non-numeric data **9**

Plots, Graphs, networks, Hierarchies, symbol and shaded maps, tree map.

Case study: A roadmap with symbols representing cities and colored lines representing roads between the cities. Provide node-link diagram. Perform search to find the node symbol and extract the alternate paths.

Unit IV High dimensional data **9**

Mapping of high dimensional data into suitable visualization method-Principal component analysis, multi dimensional, clustering study of High dimensional data visualization in R, Python, Google chart API. Case study: Make use of IMDB movie dataset and apply classification and use suitable data visualization techniques.

Unit V Static moving data and visualization tools **9**

Gestalt laws, texture theory and data mapping, perception of transparency, overlapping data, perceiving patterns in multidimensional discrete data, patterns in motion . Evaluation of visualization, Tableau, Desktop workspace in Tableau, visual control, data analytics. Case study: Take the example of traffic signal, analyse the pattern and use suitable method to visualize pattern in motion.

Total Hours: 45

References:

1. ***Colin Ware (2013).Information visualization perception for design***, 3rd Edition, MK publication.
2. ***Big data black book (2016).***Dream tech publication.
3. ***Andykrik (2019). Data Visualization : A hand book for data driven design,*** Sage Publications.

Course Outcomes:

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

CO1: Explore the various types of data and data visualization methods.
CO2: Identify the need of data visualization.
CO3: Apply visualization technique for quantitative data.
CO4: Analyze High dimensional data visualization using R, Python, Google chart API.
CO5: Examine data visualization using open source tool Tableau and Evaluate the performance of visualization technique.

CO-PO Mapping

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

Data Privacy and Security

PE I **Hours of Instruction /week: 3T**
Semester I **No. of Credits: 3**
24MEAE13

Course Learning Objectives:

CLO1: To understand the knowledge of data hiding and the steganography types.
CLO2: To inculcate the asymmetric, digital signature in cryptographic systems.

Unit I Introduction 9

Introduction: Mathematical background: Probability theory -Information theory - Complexity theory -Number theory. Symmetric (Private) Key Cryptographic Systems: Caesar – Affine - Monoalphabetic Substitution – Transposition - Homophonic substitution – Product ciphers - Lucifer and DES.

Unit II Asymmetric (Public) Key Cryptographic Systems 9

Concept of PKCS -RSA Cryptosystem- Variants of RSA - Primarily testing - Security of RSA - Elliptical Curve Cryptography. Stream ciphers and block ciphers: The one-time pad - Synchronous stream ciphers - Self-synchronizing stream ciphers - Feedback shift registers - Linear Complexity – Non-linear feedback shift registers - Stream ciphers based LFSRs.

Unit III Digital Signatures 9

Properties - Generic signature schemes - Rabin Lamport – Matyasmeyer- RSA - Multiple RSA and ElGamal Signatures - Digital signature standard - Blind Signatures- RSA Blind.Secret Sharing Algorithms: Threshold secret sharing - Shamir scheme - Blakley scheme and modular Scheme.Pseudo random number generators: Definition of randomness and pseudo-randomness - Statistical tests of randomness - Linear congruential generator.

Unit IV Data Hiding 9

Data hiding in text-Application of data hiding – Watermarking-Intuitive methods-Simple digital methods-Data hiding in Text-Mimic functions-Data hiding in images-LSB Encoding-Lossless data hiding.

Unit V Spread Spectrum Steganography 9

BPCS Steganography-Data hiding by Quantization – Patchwork-Signature casting in images Transform domain methods-Robust datahiding in JPEG images-Detecting malicious tampering Robust frequency domain watermarking.

Total Hours: 45

References:

1. ***Padmanabhan T R. Shyamala C and HariniN(2011). Cryptography and Security.*** Wiley Publications.
2. ***Josef Pieprzyk. Thomas Hardjono and Jenifer Seberry (2010).Fundamentals of Computer Security.*** Springer Publications.
3. ***David Solmann (2012).Data Privacy and Security: Concepts and Techniques.***Pearson Education.
4. ***Douglas R Stinson(2005). Cryptography:Theory and Practice.***CRC Press.

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

CO1: Explore the concepts of Data Security and Data Privacy perspective in Public key cryptographic systems.

CO2: Infer the concepts of Data Security and Data Privacy perspective in Private key cryptographic systems.

CO3: Apply the concepts of digital signature and their hiding techniques for data privacy protection.

CO4: Analyze the applications of data hiding in text and images.

CO5: Examine the concepts of Spread Spectrum Steganography.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**
CO1	2	1	2	3	2	2	-	-	3	1	1	2
CO2	3	3	2	3	2	2	-	1	1	3	2	3
CO3	2	3	2	3	2	2	-	1	1	3	2	2
CO4	2	2	1	3	2	-	-	1	1	2	1	2
CO5	2	3	3	3	2	1	3	1	3	3	2	3

Data Mining Techniques

PE II **Hours of Instruction/ week: 3T**
Semester I **No. of Credits : 3**
24MEAE21

Prerequisite:
Database Management System.

Course Learning Objectives:
CLO1: To understand the scope and necessity of Data Mining algorithms.
CLO2: To apply various data mining functionalities such as association rule mining, clustering, classification and outlier analysis to solve the real time problems.

Unit I Introduction 9

Data mining - Related technologies -OLAP- Data Mining Goals-Stages of the Data Mining Process - Components of Data Mining Algorithms- Major Issues in Data Mining – Data mining architecture- Data Mining Techniques – Knowledge Representation Methods – Applications - Data pre-processing- Need for Pre-processing the Data -Data cleaning- Data transformation - Data reduction - Discretization and generating concept hierarchies.

Unit II Association and Classification Algorithms 9

Association rules: Basic idea: item sets - Generating item sets and rules efficiently - Correlation analysis-Classification: Basic learning/mining tasks - Inferring rudimentary rules: 1R algorithm - Decision trees –Pruning process - Bayes Classification Methods - Rule-Based Classification - Model Evaluation and Selection - Techniques to Improve Classification Accuracy.

Unit III Other Classification Algorithms 9

Bayesian Belief Networks - Classification by Back propagation - Support Vector Machines - Classification Using Frequent Patterns - k-Nearest- Neighbour Classifiers - Case-Based Reasoning- Multiclass Classification - Semi-Supervised Classification- Mining Time series Data- Periodicity Analysis for time related sequence data.

Unit IV Clustering Techniques 9

Cluster Analysis - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods-Partitioning methods: k-means- expectation maximization (EM) - Hierarchical methods: distance-based agglomerative and divisible clustering - Density-Based Methods – Grid-Based Methods Conceptual clustering.

Unit V Outlier Detection 9

Outliers and Outlier Analysis- Outlier Detection Methods- Statistical Approaches- Proximity Based Approaches- Clustering-Based Approaches- Classification-Based Approaches- Mining Contextual and Collective Outliers- Outlier Detection in High-Dimensional Data.

Total Hours: 45

References:

1. ***Peter C. Bruce, Galit Shmueli, Peter Gedeck, InbalYahav, Nitin R. Patel (2023).Machine Learning for Business Analytics: Concepts, Techniques, and Applications in R.***
2. ***Xin-She Yang, (2019).Introduction to Algorithms for Data Mining and Machine Learning.***
3. ***Ian H. Witten and Eibe Frank (2016). Data Mining: Practical Machine Learning Tools and Techniques. Fourth Edition.*** Morgan Kaufmann Publishers***.***

Course Outcomes:

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

CO1: Interpret the data mining process, techniques, components, issues and pre-processing methods.
CO2: Identify association and classification algorithms for data mining.
CO3: Analyse various advanced classification algorithms to predict data model for real time application.
CO4: Apply various clustering algorithms and hierarchal methods for developing data models.
CO5: Analyse the various outlier methods and approaches used for detecting outliers in Large datasets.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**
CO1	3	2	2	3	2	2	-	-	3	1	1	3
CO2	3	2	2	2	2	2	-	-	1	2	2	3
CO3	2	1	3	2	2	2	-	-	1	2	2	3
CO4	2	2	1	3	2	-	-	1	1	2	1	3
CO5	2	3	3	3	2	1	3	1	3	3	2	3

Image Processing and Computer Vision

PE II

Semester I **Hours of Instruction/week: 3T**
24MEAE22 **No. of Credits: 3**

Prerequisite:
Image Processing.

Course Learning Objectives:

CLO1: To introduce students the fundamentals of image formation.

CLO2: To develop an appreciation for various issues in the design of computer vision and object recognition systems; and to provide the student with programming experience from implementing computer vision and object recognition applications.

Unit I Data Structures for Image Analysis 9

Levels of Image Data Representation - Traditional Image Data Structures - Matrices - Chains - Topological Data Structures - Relational Structures - Hierarchical Data Structures - Pyramids - Quadtrees - Other Pyramidal Structures.

Unit II Segmentation 9

Watershed Segmentation - Region Growing Post-Processing - Matching - Matching Criteria - Control Strategies of Matching - Evaluation Issues in Segmentation - Supervised Evaluation - Unsupervised Evaluation-Mean Shift Segmentation - Active Contour Models - Snakes - Traditional Snakes and Balloons - Extensions - Gradient Vector Flow Snakes - Geometric Deformable Models - Level Sets and Geodesic Active Contours - Towards 3D Graph Based Image Segmentation - Simultaneous Detection of Border Pairs - Sub-optimal Surface Detection - Graph Cut Segmentation - Optimal Single and Multiple Surface Segmentation

Unit III Shape Representation and Description 9

Region Identification - Contour-Based Shape Representation and Description - Chain Codes - Simple Geometric Border Representation - Fourier Transforms of Boundaries - Boundary Description using Segment Sequences - B-Spline Representation - Other Contour-Based Shape Description Approaches - Shape Invariants - Region-Based Shape Representation and Description - Simple Scalar Region Descriptors - Moments - Convex Hull - Graph Representation Based on Region Skeleton - Region Decomposition - Region Neighborhood Graphs - Shape Classes

Unit IV Object Recognition 9

Knowledge Representation - Statistical Pattern Recognition - Classification Principles - Classifier Setting - Classifier Learning - Support Vector Machines - Cluster Analysis - Neural Nets - FeedForward Networks - Unsupervised Learning – Hope field Neural Nets - Syntactic Pattern Recognition - Grammars and Languages - Syntactic Analysis- Syntactic Classifier - Syntactic Classifier Learning- Grammar Inference - Recognition as Graph Matching - Isomorphism of Graphs and Sub-Graphs - Similarity of Graphs - Optimization Techniques in Recognition.

Unit V Image Understanding **9**

Image Understanding Control Strategies - Parallel and Serial Processing Control - Hierarchical Control - Bottom-Up Control - Model-Based Control - Combined Control - Non-Hierarchical Control - RANSAC: Fitting via Random Sample Consensus - Point Distribution Models - Active Appearance Models - Pattern Recognition Methods in Image Understanding - Classification-Based Segmentation - Contextual Image Classification - Boosted Cascade of Classifiers for Rapid Object Detection - Scene Labeling and Constraint Propagation - Discrete Relaxation - Probabilistic Relaxation - Searching Interpretation Trees - Semantic Image Segmentation and Understanding - Semantic Region Growing

Total Hours: 45

References:

1. ***Milan Sonka, Vaclav Hlavac, Roger Boyle. Image Processing, Analysis, and Machine Vision.*** Third Edition, Thomson Brooks/Cole Pub**.**
2. ***D. L. Baggio et al.(2012).Mastering OpenCV with Practical Computer Vision Projects,*** Packt Publishing.
3. ***Simon J. D. Prince.(2012.)Computer Vision: Models, Learning, and Inference,*** Cambridge University Press.

Course Outcomes

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

CO1: Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
CO2: Describe known principles of human visual system.
CO3: Describe basic methods of computer vision related to multi-scale representation-edge detection and detection of other primitives- stereo- motion and object recognition.
CO4: Formulate a design of a computer vision system for a specific problem.
CO5: Analyze various process control mechanisms and classification methods used for computer vision.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	2	3	2	3	2	2	-	-	3	1	1	3
CO2	2	2	2	2	2	3	-	-	1	2	1	3
CO3	2	1	3	3	2	2	-	-	1	2	2	3
CO4	3	2	1	3	2	-	-	1	2	3	2	3
CO5	3	3	2	3	2	1	3	1	3	3	2	3

Cloud Computing

PE II
Semester I **Hours of Instruction/week: 3T**
24MEAE23 **No. of Credits: 3**

Course Learning Objectives:
CLO1: To interpret the basics of cloud computing.
CLO2: To learn about concepts of virtualization and virtualization infrastructure.

UNIT I Cloud Architecture and Models 9
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Characteristics – Cloud deployment models – Cloud service models– Pros and Cons of Cloud;

Unit II Introduction to Virtualization 9
Basics of Virtualization – Virtualization Types – Implementation Levels of Virtualization –Virtualization Structures / Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices– Virtual Clusters and Resource management – Virtualization for Data-Center Automation –Virtualization Support and Disaster Recovery – Taxonomy of Virtual Machines – Create VM Clusterusing VMWare or Virtual Box and deploy an application.

UNIT III Cloud Infrastructure 9
Cloud Infrastructure: Architectural design of compute and storage clouds – Layered cloud architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning andPlatform Deployment – Global Exchange of Cloud Resources.

UNIT IV Cloud Deployment Environment 9
Parallel Programming Framework: Hadoop Map Reduce – Google App Engine – Amazon AWS
– Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack – OpenNebula – Aneka– CloudSim.

UNIT V Cloud Security 9
Data Security and Storage; Identity and Access Management(IAM) – IAM Challenges – IAMArchitecture and Practice; Security Management in the Cloud – Security Management Standards– SaaS, Paas and IaaS Availability Management – Access Control; Security-As-A-Service.

Total Hours: 45

Reference(s):

1. Tim Mather, Subra Kumaraswamy, Shahed Latif (2009).Cloud Security and Privacy: an enterprise perspective on risks and compliance, O'Reilly Media,. (Unit V)
2. Danielle Ruest, Nelson Ruest(2009).Virtualization: A Beginner's Guide, McGraw-Hill Osborne Media,.
3. James E Smith, Ravi Nair (2005).Virtual Machines: Versatile Platforms for Systems and Processes. Elsevier/Morgan Kaufmann,.
4. Stephen Baron 2020 AWS: The Complete Beginner's Guide .
5. David Marshall, Wade A Reynolds (2006).Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center., Auerbach Publications.
6. ***Lizhe Wang, Rajiv Ranjan, Jinjun Chen, and Boualem Benatallah (2017) Cloud Computing: Methodology, Systems, and Applications*** CRC Press.

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

CO1: Summarize about the basics of Cloud Computing.
CO2: Apply the concept of virtualization and analyse its types.
CO3: Solve various design challenges in cloud environment.
CO4: Develop and deploy services on cloud and be able to set up a private cloud environment using open source software.
CO5: Outline the security challenges in cloud environment.

CO-PO Mapping

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

AI in Health Care

PE III **Hours of Instruction/week: 3T**

Semester II **No.of Credits: 3**

24MEAE31

Prerequisite:

Artificial Intelligence

Course Learning Objectives:

CLO1: Understand the role of AI and its application in healthcare now and in the near future

CLO2 : Understand what Artificial Intelligence and Machine Learning are, what are their benefits and limits

UNIT I Introduction to Artificial Intelligence in Health Care 9

Terminologies – Computational models of intelligence; conceptual frameworks from cognitive and educational psychology – Neuroscience – Information theory and linguistics; philosophical foundations of AI.

UNIT II Myths about AI Applications in Health Care 9

AI origins and definition – AI healthcare myths – AI myths – AI Is an existential threat – AI is just Machine Learning – AI overpromises and under delivers – True conversational AI already exists – AI as overlord – AI technology Myths – AI – First healthcare

UNIT III Artificial Intelligence in the Health Sector 9

Monitoring health through wearables and personal devices –Making smartphone selfies into powerful diagnostic tools – Revolutionizing clinical decision Making with artificial Intelligence at the bedside –Cognitive systems in hospital claims management – Benefits for health sectors – Diagnosis processes – Treatment protocol development – Drug development – Personalized medicine and Patient monitoring and care.

UNIT IV Artificial Intelligence Versus Human Intelligence 9

Artificial Narrow Intelligence (ANI) Artificial General Intelligence (AGI) – Artificial Super Intelligence –Artificial Intelligence application – Manufacturing robots. – Self driving cars – Smart assistants – Disease mapping – Human intelligence –Humans in learning – understanding and solving problem

UNIT V Future of Artificial Intelligence in the Health Sector 9

Real world applications of AI in Medicine – Health trending and analytics – Patient Risk Identification – Administrative workflows – Image analysis – Robotic surgery – Virtual assistants and clinical decision support.

Total Hours: 45

References:

1. ***Dr.Parag Suresh MahajanMD(2021).Artificial Intelligence in Healthcare***,Second Edition. Notion Press.
2. ***Dr Parag Suresh MahajanMD(2019). Artificial Intelligence in Healthcare: AI, Machine Learning, and Deep and Intelligent Medicine Simplified for Everyone,*** Medmantra, LLC.

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

- **CO1:** Summarize about the computational models of intelligence and philosophical foundations of AI.
- **CO2:** Outline the myths and applications of AI in healthcare.
- **CO3:** Compare Artificial Intelligence Versus Human Intelligence, and justify their use and limitations.
- **CO4:** Apply appropriate intelligent system models and computational tools to specific problems in biomedicine and healthcare.
- **CO5:** Analyze the Real world applications and future of AI in Medicine.

CO-PO Mapping

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

AI in Speech Processing

PE3 **Hours of Instruction/week: 3T**
Semester II **No.of Credits: 3**
24MEAE32

Prerequisites:

Artificial Intelligence, Natural Language Processing

Objectives:

CLO1: To identify the features necessary for Speech processing and learn about the sources of sound and its representation

CLO2 : To familiarize on the steps involved in Speech Recognition and Synthesis

UNIT I Speech Source and Representation 9

Speech Fundamentals – Articulatory Phonetics – Production and Classification of Speech Sounds – Acoustic Phonetics – acoustics of speech production – Review of Digital Signal Processing concepts – Short-Time Fourier Transform – Filter– Bank and LPC Methods

UNIT II Speech Features 9

Speech Analysis – Features – Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual –Spectral Distance – Cepstral Distances – LPC – PLP and MFCC Coefficients – Time Alignment and Normalization – Dynamic Time Warping – Multiple Time – Alignment Paths.

UNIT III Speech Recognition 9

Speech Modeling – Hidden Markov Models: Markov Processes – HMMs – Evaluation – Optimal State Sequence – Viterbi Search – Baum –Welch Parameter Re-estimation – Implementation issues – Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – N-grams –Context dependent sub-word units – Applications and present status – Speech Recognition – Framework.

UNIT IV Speech Synthesis 9

Speech Synthesis – Text-to-Speech Synthesis – Concatenative and waveform synthesis methods – Subword units for TTS – Intelligibility and naturalness – Role of prosody – Applications and present status – Speech synthesis framework – Case study.

UNIT V Applications 9

Speaker Recognition – Verification – Voice biometrics – Music processing – Issues – representation – Pitch – Melody – Timbre – Music Features – Singer identification – Instrument identification.

Total Hours: 45

References:

1 ***Nilanjan Dey (2021). Applied Speech Processing: Algorithms and CaseStudies***. Elsevier Science

2 ***Sadaoki Furui (2018). Digital Speech Processing: Synthesis, and Recognition.*** Second Edition**.** CRC Press.

3 ***Daniel Jurafsky, James H Martin (2013). Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics,and Speech Recognition***. Pearson Education

4 ***Soumya Sen, Anjan Dutta, Nilanjan Dey (2019). Audio Processing and Speech Recognition: Concepts, Techniques and Research Overviews***. Springer.

Course Outcomes:

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

CO1: Interpret the representation of speech and influence of features in recognizing and synthesizing speech.

CO2: Identify the appropriate combination of features and methods for applications involving speech processing and recognition.

CO3: Apply new strategies and decide the combination of signal features for music processing.

CO4: Applying the approaches for speech synthesis and do the case study analysis.

CO5: Applying the various speech processing techniques in real word applications.

CO-PO Mapping

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

AI in Natural Language Processing

PE III
Semester II **Hours of Instruction/week: 3T**
24MEAE33 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To learn the fundamentals of natural language processing
CLO2: To understand word level and syntactic analysis and parsing.

Unit I Overview and Language Modelling 9

Overview: Origins and challenges of NLP Language and Grammar-Processing Indian Languages- NLP Applications Information Retrieval. Language Modeling: Various Grammar- based Language Models Statistical Language Model.

Unit II Word Level Analysis and Morphology 9

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff– Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoStagging – Hidden Markov and Maximum Entropy models- Morphological analysis and generation using Finite State Automata and Finite State transducer

Unit III Syntactic Analysis 9

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar –Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

Unit IV Information retrieval and Lexical Resources 9

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame NetStemmers-POS Tagger-Research Corpora.

UNIT V Applications in NLP 9

Question Answering with SQUAD – Dependency Parsing – Machine Translation –Conference Resolution – Text Summarization-WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Total Hours: 45

Reference(s):

1. Steven Bird, Ewan Klein and Edward Loper(2009). Natural Language Processing with Python, First Edition, OReilly Media.

***2. Breck Baldwin(2015). Natural Language Processing with Java and LingPipe Cookbook*‖,** Atlantic Publisher.

3. Richard M Reese(2015). Natural Language Processing with Java, First Edition, Packt Publishing,.

Course Outcomes
At the end of the course, students will be able to

CO1: Tag a given text with basic Language features.
CO2: Design an innovative application using NLP components.
CO3: Implement a rule based system to tackle morphology/syntax of a language.
CO4: Design a tag set to be used for statistical processing for real-time applications.
CO5: Apply NLP and machine translation.

CO-PO Mapping

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

Block Chain Technology

PE IV
Semester II **Hours of Instruction/week: 3T**
24MEAE41 **No. of Credits: 3**

Course Learning objectives:
CLO1: To understand the fundamentals of computer.
CLO2: To provide an overview of database management systems, software development, operating systems, computer networks and an outlook of autonomous systems

Unit I Introduction **9**

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Unit II Decentralization and Cryptography **9**

Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys

Unit III Bitcoin and Alternative Coins **9**

A:Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Unit IV Smart Contracts and Ethereum 101 **9**

Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts

UNIT V Alternative Block chains **9**

Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance,

Total Hours: 45 45

Reference(s):

1 ***Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, 2016.***
2 ***Daniel Drescher(2017).Blockchain Basics: A Non-Technical Introduction in 25 Steps,*** Apress, First Edition.
3 ***Andreas M. Antonopoulos. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, ,*** O'Reilly.

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Course Outcomes

At the end of the course, students will be able to

CO1: Define and explain the fundamentals of Blockchain.
CO2: Illustrate the technologies of Blockchain.
CO3: Describe the models of Blockchain.
CO4: Analyze and demonstrate the Ethereum.
CO5: Illustrate alternative Block chains

CO-PO Mapping

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

Predictive Analysis

PEIV **Hours of Instruction /week: 3T**
Semester II **No. of Credits: 3**
24MEAE42
Prerequisite:
Machine Learning

Course Learning Objectives:

CLO1: To apply the concept of Analytics for Business.

CLO2: To be familiar with tools, technologies and programming languages which is used to solve real time problems

Unit I Introduction **9**

Analytics - Introduction to Tools and Environment - Application of Modelling in Business - Databases & Types of data and variables - Data Modelling Techniques - Missing imputations etc. Need for Business Modelling - Regression – Blue property-assumptions-Least Square Estimation - Variable Rationalization and Model Building.

Unit II Logistic Regression **9**

Model Theory -Model fit Statistics- Model Conclusion -Analytics applications to various Business Domains etc. Regression Vs Segmentation – Supervised and Unsupervised Learning- Tree Building – Regression –Classification - Over fitting - Pruning and complexity -Multiple Decision Trees etc.

Unit III Objective Segmentation **9**

Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression - Classification - Over fitting - Pruning and complexity - Multiple Decision Trees etc.,- Introduction to Knowledge skills & competences - Training & Development - Learning & Development - Policies and Record keeping.

Unit IV Time Series Methods / Forecasting, Feature Extraction **9**

Arima - Measures of Forecast Accuracy- STL approach - Extract features from generated model as Height-Average- Energy etc and Analyze for prediction.

Unit V Working With Documents **9**

Standard Operating Procedures for documentation and knowledge sharing - Defining purpose and scope documents - Understanding structure of documents – case studies – articles - white papers - technical reports - minutes of meeting etc. - Style and format - Intellectual Property and Copyright - Document preparation tools – PowerPoint – Word - Excel etc.- Version Control - Accessing and updating corporate knowledge base - Peer review and feedback.

Total Hours: 45

References:

1. ***Gareth James. Daniela Witten. Trevor Hastie Robert Tibshirani(2017). An Introduction to Statistical Learning with Applications in R***
2. ***Eric Siegel, Wiley.Predictive Analytics,2016***
3. ***By John D. Kelleher, Brian Mac Namee and Aoife D'Arc. Fundamentals of Machine Learning for Predictive Data Analytics, 2015,MIT Press***

Course Outcomes:

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

CO1: Extract knowledge using logistic Regression in Analytics.
CO2: Develop familiarity with popular tools and software used in industry for predictive analytics.
CO3: Identify the appropriate method for predictive analysis, and how to build effective predictive models.
CO4: Illustrate the time series methods, forecasting techniques and feature extraction.
CO5: Applying the predictive analysis strategies to work with various documents.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO101	PO11	PO12
CO1	2	2	1	2	2	2	1	-	-	-	-	3
CO2	3	3	3	2	3	3	2	1	-	-	3	3
CO3	2	3	3	2	2	3	3	2	2	-	3	1
CO4	2	3	2	1	2	3	-	-	-	-	2	3
CO5	1	3	3	3	3	3	-	2	1	3	1	3

Big Data Framework for Data Science

PE IV
Semester II **Hours of Instruction/ week: 3T**
24MEAE43 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To differentiate various big data technologies like Hadoop MapReduce, Pig, Hive, Hbase and No-SQL.

CLO2: To optimize business decisions and create competitive advantage with Big Data analytics.

Unit I Introduction **9**

Big Data definition- History of Data Management- Structuring Big Data- Elements of Big Data- Use of Big Data in Social Networking- Use of Big Data in preventing Fraudulent Activities in Insurance Sector & in Retail Industry.

Unit II Hadoop **9**

Distributed and parallel computing for Big Data-Hadoop Ecosystem- Hadoop Distributed File System-Hadoop I/O- Hadoop Cluster- Hadoop security- AWS-Running Hadoop on AWS- Hadoop YARN.

Unit III Mapreduce **9**

MapReduce-Map Reduce Framework- Developing a Map Reduce application- Controlling MapReduce Execution with Input Format- Reading Data with Custom Record Reader.

Unit IV Pig and Hbase **9**

PIG- HBASE: Pig Latin- User defined functions- Data processing operators HBasics- Installation- Clients- Combing HBase and HDFS.

Unit V Nosql for Big Data Analytics **9**

Introduction to NoSQL - aggregate data models - document data models - relationships - graph databases - schemaless databases - materialized views - distribution models–master-slave replication - peer-peer replication - sharding and replication - consistency.

Total Hours: 45

References:

1. ***V.Naresh Kumar, Prashant Shindgikar(2018). Modern Big Data Processing with Hadoop.*** O`Reilly Publishers.
2. ***Tom White.(2015). Hadoop: The Definitive Guide.*** O`Reilly Publishers. USA. Fourth Edition.
3. ***Paul Zikopouloset al- (2012) .Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data.*** Mc Graw Hill Professional. USA. First Edition.

Course Outcomes:

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

CO1: Describe the fundamentals and use of big data analytics.

CO2: Develop big data solution using Hadoop ecosystem with AWS security.

CO3: Implement appropriate Map Reduce Logic for solving computational problems.

CO4: Illustrate the various Pig and Hbase tools in big data analytics.

CO5: Examine the application of NoSQL for storage of big data.

CO-PO Mapping

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

Deep Learning

PE V

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24MEAE51 **No. of credits: 3**

Prerequisite:
Artificial intelligence

Course Learning Objectives (CLOs):

CLO1: To learn the concepts of deep learning for solving real life problems.
CLO2: To acquire knowledge on the applications of deep learning in various scenarios.

UNIT - I Introduction **9**

Biological Neuron - Idea of computational units - McCulloch-Pitts unit and Thresholding logic - Linear Perceptron - Perceptron Learning Algorithm - Linear separability - Convergence theorem for Perceptron Learning Algorithm.

UNIT - II Feed Forward Networks and Convolutional Networks **9**

Feed forward Networks: Multilayer Perceptron Gradient Descent - Back propagation - Empirical Risk Minimization - regularization - auto encoders.
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

UNIT - III Recurrent Neural Networks and Deep Generative Models **9**

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs
Deep Generative Models: Boltzmann Machines - Restricted Boltzmann Machines - Introduction to MCMC and Gibbs Sampling gradient computations in RBMs - Deep Belief Networks- Deep Boltzmann Machines

UNIT - IV Autoencoders, Representation Learning And Structured Models **9**

Autoencoders (AE) – AE variants - Applications of AE - Representation Learning – Greedy pre-training – Transfer learning and domain adaptation - Structured Probabilistic Models for Deep Learning - Using Graphs to Describe Model Structure- Sampling from Graphical Models - Restricted Boltzmann Machine

UNIT - V Applications **9**

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing - Other Applications

Total Hours: **45**

References:

4 Ian Goodfellow.YoshuaBengio, Aaron Courville (2017), *Deep Learning*, MIT Press.

5 Magnus Ekman. (2021). *Deep Learning*, Addison-Wesley Professional.

6 Charu C. Aggarwal. (2018). Neural *Networks and Deep Learning*, Springer.

7 Adam Gibson, Josh Patterson (2017). *Deep Learning: A Practitioner's Approach*, OReilly.

8 Umberto Michelucci. (2018). *Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks.* Apress.

9 Nicholas Locascio and Nikhil Buduma.(2017). *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms*. OReilly.

10 Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy. (2017). *Deep Learning with TensorFlow: Explore neural networks with Python*, Packt Publisher.

Course Outcomes:

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

CO1: Acquire knowledge in the basic concepts of deep learning

CO2: Identify Convolution Neural Network models for various application

CO3: Apply Recurrent Neural Networks to solve real world problems

CO4: Examine the concept of Autoencoders, Representation Learning And Structured Models

CO5: Implement the deep learning concepts in various applications

CO - PO MAPPING

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

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Cyber Security

PE V

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24MEAE52 **No. of credits: 3**

Prerequisite:
Networks, Cryptography

Course Learning Objectives (CLOs):

CLO1: To understand the cybercrime, cyber law, cyber-attacks and tools for mitigating them
CLO2: To learn to detect and prevent cyber-attack.

UNIT - I Introduction **9**

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT - II Attacks and Countermeasures **9**

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures

UNIT - III Reconnaissance **9**

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

UNIT - IV Intrusion Detection and Prevention **9**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort. Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations –Intrusion Prevention Systems – Example Unified Threat Management Products.

UNIT - V Social Engineering Attacks **9**

Social Engineering Attacks - Insider Threats - Cloud based cyberattacks – Remote Working - Targeted Randomware and Zeroday flaw – Zero trust Architecture – Homomorphic encryption

Total Hours: **45**

References:

1 Anand Shinde. (2021). *Introduction to Cyber Security Guide to the World of Cyber Security*. Notion Press.

2 Nina Godbole, SunitBelapure. (2011). *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*. Wiley Publishers.

3 Patrick Engebretson. (2011). *The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy*. Elsevier.

4 William Stallings, Lawrie Brown. (2015). *Computer Security Principles and Practice*. Third Edition. Pearson Education

Course Outcomes:

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

CO1: Acquire knowledge in the basics of cyber security, cybercrime and cyber law.

CO2: Classify various types of attacks and learn the tools to launch the attacks.

CO3: Examine various tools to perform information gathering.

CO4: Apply intrusion techniques to detect intrusion.

CO5: Analyze intrusion prevention techniques to prevent intrusion.

CO - PO MAPPING

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

Reinforcement Learning

PE V

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24MEAE53 **No. of credits: 3**

Prerequisite:
Basics of Statistics

Course Learning Objectives (CLOs):

CLO1: Understand the basics of reinforcement learning networks.
CLO2: Apply decision process concepts to optimize performance of learning networks.

UNIT - I The Reinforcement Learning Problem **9**

Reinforcement learning - Examples - Elements of reinforcement learning - Limitations and scope- An extended example: Tic – Tac - Toe - History of reinforcement learning – Multi- Arm bandits – An armed bandit problem – Action -Value methods - Incremental implementation -Tracking a non stationary problem- Optimistic initial values – Upper – Confidence Introduction - Bound action selection - Gradient bandits- Associative search (contextual bandits).

UNIT - II Finite Markov Decision Processes **9**

The Agent– Environment interface - Goals and rewards - Returns -Unified notation for episodic and continuing tasks - The markov property - Markov decision processes -Value functions - Optimal value functions-Optimality and approximation. Dynamic programming- Policy evaluation - Policy improvement - Policy iteration -Value iteration - Asynchronous Dynamic programming - Generalized policy iteration - Efficiency of dynamic programming.

UNIT - III Monte Carlo methods **9**

Monte carlo prediction - Monte carlo estimation of action values -Monte carlo control - Monte carlo control without exploring starts – Off- Policy prediction via importance sampling -Incremental implementation – Off- Policy monte carlo control - Importance sampling on truncated returns.

UNIT - IV Temporal-difference learning **9**

TD Prediction - Advantages of TD prediction methods -Optimality of TD (0) -Sarsa: On- Policy TD control - Q-Learning: Off-Policy TD control. Eligibility traces-n-step TD prediction the forward view of TD (λ). The backward view of TD(λ)- Equivalences of forward and backward views- Sarsa(λ) - Watkins's Q(λ) – Off- Policy eligibility traces using importance sampling -Implementation issues - Variable λ.

UNIT - V Policy approximation **9**

Actor– Critic methods -Eligibility traces for actor– Critic methods - R-Learning and the average - Reward setting– On-policy approximation of action values - Value prediction with function approximation – Gradient- Descent methods - Linear methods - Control with function approximation -Off-policy approximation of action values.

Total Hours: **45**

References:

1 Warren B. Powell. (2022). *Reinforcement Learning and Stochastic Optimization: A Unified Framework for Sequential Decisions*. PublisherJohn Wiley & Sons –

2 Alexey Piunovskiy, Yi Zhang. (2020). *Continuous-Time Markov Decision Processes: Borel Space Models and General Control Strategies*

3 Adrian Barbu, Song-Chun Zhu. (2020). *Monte Carlo Methods*. Springer Nature Singapore

Course Outcomes:

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

CO1: Explore the fundamentals of reinforcement learning.

CO2: Asses the mathematical model and iterative technique for Dynamic programming.

CO3: Analyse the various models to predict the probabilistic control to obtain numeric result for policy evaluation.

CO4: Apply the temporal difference learning method for reinforcement learning.

CO5: Examine the policy approximate based reinforcement learning method.

CO - PO MAPPING

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

Audit Course-I
English for Research Paper Writing
(Non-credit Mandatory Course)

Semester I **Hours of Instruction/ week: 3T**
24MEMA11

Course Learning Objectives:

CLO1: To familiarize with language for a research paper and research ethics
CLO2: To educate the students to write an effective research paper

Unit I Language of a Research Paper and Ethics **9**

Scientific Papers - Definition, Key characteristics - Clarity, Understanding the signals, Language of a scientific paper, Research ethics, rights and permissions- originality and authorship, avoiding ambiguity and vagueness

Unit II Title Writing **9**

Components of a research paper- Importance and requirements while choosing a title. Importance of Syntax in title, Title as a label, matching title to relevance of study

Unit III Abstract and Content Writing **9**

Preparation of abstract. Types of abstracts, Economy of words, Introduction, Reasons for rules, Citations and abbreviations; Writing of Materials and Methods- Purpose, Materials, online resources, Methods, Measurements and analysis, Need for -Tabular materials, References and correct form and Grammar, Abbreviations and Jargons

Unit IV Result Writing **9**

Results and discussion: Results - Contents, Striving for clarity, Handling of numbers, Discussion- components, Factual relationship, significance of the paper, Defining scientific truth. Tables and Illustrations- Graphs, Photographs-when, where and how to use. Importance of Conclusion

Unit V Journal Writing **9**

Citing of references-Rules to follow, reference styles and systems, Titles and inclusive pages, Journal abbreviations. Journal publication - Factors to be considered in choosing the journal, Cover letter to journals for publishing the manuscript. Use and misuse of English in manuscript, Ten commandments of good writing.

Total Hours: 45

References:

1. ***Adrian Wallwork, (2011)"English for Writing Research Papers",*** Springer New York Dordrecht Heidelberg London,.
2. ***Day R, (2006)"How to Write and Publish a Scientific Paper***", Cambridge University Press,.
3. ***Goldbort R,(2006)"Writing for Science"***, Yale University Press.

Course Outcomes:

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

CO1: Write technical papers in a proper format with clarity and readability.

CO2: Describe the key components of a research paper and choose an appropriate title.

CO3: Develop the writing style of the sections in a manuscript.

CO4: Comprehend the results and discussions with clarity.

CO5: Apply correct style of referencing, identify a good journal and develop a good quality research paper for publication.

Audit Course-I
Disaster Management
(Non-credit Mandatory Course)

Semester I **Hours of Instruction/week: 3T**
24MEMA12

Course Learning Objectives:

CLO1: To provide broad understanding about the basic concepts of disaster management.

CLO2: To be familiar with the concepts of risk assessment and disaster mitigation.

Unit I Introduction **9**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit II Repercussions of Disasters and Hazards **9**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit III Disaster Prone Areas in India **9**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

Unit IV Disaster Preparedness and Management **9**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness

Unit V Risk Assessment and Disaster Mitigation **9**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Total Hours: 45

References:

1. ***R. Nishith, Singh AK,(*2004)*"Disaster Management in India: Perspectives, Issues and Strategies",*** New Royal book Company,.
2. ***Sahni, Pardeep et.al. (Eds.)(*2009), *"Disaster Mitigation Experiences and Reflections",*** Prentice Hall of India, New Delhi,.
3. ***Goel S. L.,(*2008) *"Disaster Administration and Management Text and Case Studies"***, Deep & Deep Publication Pvt. Ltd., New Delhi,.

Course Outcomes:

Upon completion of the course, the students will be able to:

CO1: Differentiate between natural and man-made disasters.
CO2: Deliberate on the repercussions of disasters and hazards and their impact on society, economy and human lives.
CO3: Identify the disaster prone zones in India.
CO4: Analyze the phenomena triggering a disaster, evaluate risk and manage disasters
CO5: Illustrate the concepts of risk assessment and disaster mitigation.

Audit Course-I

Research and Publication Ethics
(Non-credit Mandatory Course)

Semester I **Hours of Instruction/week: 3T**
24MEMA13

Course Learning Objectives:

CLO1: To understand the basics of philosophy of science and ethics, research integrity, publication ethics and identify research misconducts.

CLO2: To understand indexing and citation database, open access publications, research metrics and plagiarism tools.

Unit I Philosophy, Ethics and Scientific Conduct **9**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions
3. Ethics with respect to science and research
4. Intellectual honesty and research integrity
5. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
6. Redundant publications: duplicate and overlapping publications, salami slicing
7. Selective reporting and misrepresentation of data

Unit II Publication Ethics **9**

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

Unit III Open Access Publishing & Publication Misconduct **9**

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Unit IV: Publication Misconduct **9**

A. Group Discussions Subject specific ethical issues, FFP, authorship

1. Conflicts of interest
2. Complaints and appeals: examples and fraud from India and abroad

B. Software Tools

Use of plagiarism software like Turnitin, Urkund and other open source software tools

Unit V: Databases and Research Metrics **9**

A. Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, HO index, altmetrics

Total hours: 45

References:

1. ***Bird, A.***"***Philosophy of Science".*** Routledge, 2006
2. ***Maclntyre, Alasdair***"***A Short History of Ethics".*** London.1967
3. ***P. Chaddah***, "***Ethics in Competitive Research: Do not get scooped; do not get plagiarized"***, ISBN:978- 93874808652018
4. ***National Academy of Sciences, (*2009)*National Academy of Engineering and Institute of Medicine. On Being a Scientist: A Guide to Responsible Conduct in Research***: Third Edition. National Academies Press.
5. ***Resnik, D. B. (*2011)*What is ethics in research & why is it important.*** National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfrn6.Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489179a
6. ***Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance***, ISBN: 978-81-939482-1-7. http://www.insaindia.res.in/pdf/ Ethics Book.

Course Outcomes:

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

CO1: Infer the importance of publication ethics, scientific misconduct and honesty
CO2: Apply open access publishing concepts.
CO3: Use available data bases and research metrics for their paper publications.
CO4: Comprehend the philosophy of science and ethics and research integrity.
CO5: Differentiate indexing and citation databases, open access publication and research metrics.

Audit Course-II
Pedagogy Studies
(Non-credit Mandatory Course)

Semester II **Hours of Instruction/week: 3T**
24MEMA21

Course Learning Objectives:

CLO1: To impart knowledge about pedagogy methods

CLO2: To be able to evaluate attainment in learning

Unit I Introduction and Methodology **9**

Understanding student's cognitive and perceptual abilities, Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teaching Learning outcome, Teacher education, Research questions**,** Overview of methodology and Searching.

Unit II Thematic Overview and Learner Intelligences **9**

Pedagogical practices, formal and informal classroom, multiple intelligences, Curriculum and syllabus, adopting teaching methods that appeal to different intelligences

Unit III Evidence on the Effectiveness of Pedagogical Practices **9**

Methodology of teaching, Materials for teaching, support system for effective pedagogical practices, online and blended classrooms, Think-Write-Pair-Share, developing e content, approaches and strategies, engaging learners in the virtual mode, Brain-based learning, Principles of Brain based learning

Unit IV Professional Development **9**

Follow-up support, Peer, Individual, group learning, Barriers to learning, Special Learning Disabilities, Dyslexia, Dysgraphia, Dyspraxia, Dyscalculia. Use of technological tools to enhance learning, Classroom management, online teaching for rural India

Unit V Measuring Attainment in Learning and Future Directions **9**

Difference between assessment and Evaluation, Formative and Summative Assessment, Methods of assessing in classroom, Concept Questions and Peer Instruction, Background Knowledge Probe and Peer Review. Rubrics Methods of Evaluation, Inspiring students to be autonomous learners, online tests, and evaluation (Quizzes. Polling, drag and drop, identification, chat, software tools etc.), motivating students with career guidance and research focus.

Total Hours: 45

References:

1. http://www.jensenlearning.com/what-is-brain-based-research/
2. ***Anandan, K.N.,"Tuition to Intuition"***, Transcent, Calicut, 2006
3. ***Daniel Kenneth Apple,"Process Education: Teaching Institute Handbook : Teaching, Learning, Self-grower, Assessment, Facilitation, Curriculum Design",*** Pacific Crest Software, 1998
4. ***Thomas A. Angelo, K. Patricia Cross,"Classroom Assessment Techniques: A Handbook for College Teachers"***, Wiley, 1993
5. ***Harwell, J. M, "Complete Learning Disabilities Handbooks"***, NewYork. The Centre for Applied Research in Education, 1989
6. ***Raj, F, "Breaking Through, A Handbook for Teachers and Parents of Children with Specific Learning Disabilities***". VIFA Publications, Secunderabad, 2010.
5. ***Seffetullah Kuldas, Hairul Nizam Ismail, Shahabuddin Hashim***, Unconscious learning processes: mental integration of verbal and pictorial instructional materials

Course Outcomes:

Upon completion of the course, the students will be able to:

CO1: Recognize conceptual framework and enhance teaching learning outcomes.

CO2: Differentiate different pedagogical practices and teaching methodologies.

CO3: Understand teaching methods, identify materials and support systems for effective pedagogical practices.

CO4: Communicate in a better way with learners of diverse cognitive abilities.

CO5: Differentiate between assessment and evaluation, attainment of targeted learning outcomes and appreciate the tools for evaluation.

Audit Course-II
Value Education
(Non-credit Mandatory Course)

Semester II **Hours of Instruction/week: 3T**
24MEMA22

Course Learning Objectives:

CLO1: To understand value of education and self- development

CLO2: To motivate students to imbibe good values.

Unit I Value Education and Human Rights **9**

Value education-Meaning, objectives, importance, Scope and needs. Types-Personal, social, religious, spiritual, universal, cultural and moral values. Values in life and developing a Mission statement. Human rights- meaning, and laws on violation of human rights.

Unit II Values, Goals and Standards **9**

Values, goals and standards-meaning and importance in life. Goals- short term and long term goals. Personal goals, family goals. Relationship among values, goals and standards in life. Standards- meaning and its importance and criteria in setting standards and practicing.

Unit III Human Values and Cultivation of Values **9**

Self-assessment and self-awareness. Importance of cultivation of values-sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, Cleanliness, honesty, humanity, Power of faith, National unity, Love for nature, Discipline. Corporate ethics-Ethical values and global values.

Unit IV Personality and Behavior Development **9**

Social and scientific attitude, developing responsible attitude- Accepting responsibilities in personal and professional life, developing readiness to accept changes in life and society. Integrity and discipline, Effective personality- 7 habits of effective people. Positive thinking-meaning and importance. Understanding positive thinking and self-talk, How to avoid negative thinking, Putting into practice and practicing positive thinking in everyday life.

Unit V Importance of Character and Competence **9**

Character and competence, Achievement motivation, Self-management and good health Importance of religion in life- Holy books vs. Blind faith, Role of women in inculcating moral values in family to nurture good citizens of the society. Self-control-meaning, importance and ways to help improve self-control and build good habits.

Total Hours: 45

References:

1. ***R.P.Shukla*(2004)"*Value Education and Education for Human Rights***" - Sarup and sons, New Delhi,.
2. ***Chakraborty S.K.,* (1998) *"Values and Ethics for Organizations- Theory and Practice***", Oxford University Press, New Delhi.
3. ***Peale Norman Vincent,(* 2016) *"The Power of Positive Thinking***" Edition 1.
4. ***Home management - Values, Goals and Standards – BrainKart www.brainkart.com › article › Home-management***
5. ***Frances Bridges (*2018) *"Contributor Careers- Self-control.***

Course Outcomes:

Upon completion of the course, the students will be able to:

CO1: Differentiate the values in life and recognize human rights.

CO2: Realize the significance of goals and standards in life.

CO3: Develop good habits and lead a disciplined and meaningful life.

CO4: Accept the responsibilities, develop an effective personality and avoid negative thinking.

CO5: Practice self-control and inculcate moral values to become good citizens of the society.

AWS Cloud Architect

No. of Credits: 2

Semester II

24MEAPC1

1. AWS Services for compute, storage database, networking, monitoring and security.
2. Datalake creation and operations in secure way.
3. Organize data into datalake.
4. Optimize performance and costs.
5. Design architectural solutions for operational excellence and business challenges.

Total Hours: 40

Red Hat Certified System Administrator

Semester II **No. of Credits: 2**
24MEAPC2

1. Accessing Systems and Obtaining SupportKilling
2. Navigating File Systems
3. Managing Local Users and Groups
4. Controlling Access to Files
5. Managing SELinux Security
6. Managing SELinux Security – Context
7. Tuning System Performance
8. Tuning System Performance – Tuning
9. Scheduling Future Tasks
10. Installing and Updating Software Packages
11. Managing Basic Storage
12. Manage the Storage Stacks
13. Controlling Services and the Boot Process
14. Controlling Services and the Boot Process - Root Password Break
15. Analyzing and Storing Logs
16. Managing Networking
17. Accessing Network-Attached Storage
18. Managing Network Security
19. Running containers
20. Running containers - As a System Service

Total Hours: 40

Full Stack Development

No. of Credits: 2

Semester II

24MEAPC3

1. Front – End development languages and tools: HTML,CSS, Javascript, React and Bootstrap

2. Program applications using backend languages and framework: Express,Node.js,Python,Django

3. Deplay applications using cloud native methodologies and tools like containers, Kubernotes, Micro servers and serverless functions.

Total Hours: 40

Department of Computer Science and Engineering

Foundations of Artificial Intelligence
(Open Elective Course)

(Applicable for the M.E. students admitted in the other Engineering departments from the academic year 2024-2025 & onwards)

Semester: II **Hours of Instruction/week: 3T**

Course Code: 24MEAO01 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To use various techniques and strategies of AI for data searching, learning and decision making.
CLO2: To design and solve real world problems using AI approaches.

UNIT - I Introduction and Intelligent Agents 9

AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT - II Problem Spaces and Search 9

Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions

UNIT - III Uncertain Knowledge and Reasoning 9

Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Baye's probabilistic interferences and dempstershafer theory.

UNIT - IV Knowledge Representation and Learning 9

First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

UNIT - V AI Applications 9

Applications – Chatbots – Voice assistants - NLP - Speech Recognition - Object Recognition – Robotics - Case study : Word2Vec Problem

Total Hours: **45**

References:

1 Elaine Rich, Kevin Knight. (2017). *Artificial Intelligence*. Tata McGraw Hill.

2 S. Russell and P. Norvig. (2011).*Artificial Intelligence: A Modern Approach*. Third Edition, Prentice Hall.

3 Daniel Jurafsky, James H. Martin (2019). *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech*. Pearson Publication.

Course Outcomes:

Upon completion of this course, students will be able to:

CO1: Explore the fundamentals of reinforcement learning.

CO2: Asses the mathematical model and iterative technique for Dynamic programming.

CO3: Analyse the various models to predict the probabilistic control to obtain numeric result for policy evaluation.

CO4: Apply the temporal difference learning method for reinforcement learning.

CO5: Examine the policy approximate based reinforcement learning method.

CO - PO MAPPING

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