Department of Information Technology

M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

(w.e.f. the batch of students admitted from the academic year 2024-2025)

Scheme(R21)

I YEAR I Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD511	Advanced Data Structures and Algorithms	3		40	60	3	100
2	AD512	Principles of Artificial Intelligence	3		40	60	3	100
3	AD513	Introduction to data Science	3		40	60	3	100
4	AD514	Professional Elective-I	3		40	60	3	100
5	AD515	Professional Elective-II	3		40	60	3	100
6	AD516	Professional Elective-III	3		40	60	3	100
7	AD551	Advanced Data Structures and Algorithms Lab		4	40	60	2	100
8	AD552	Artificial Intelligence and Machine Learning Lab		4	40	60	2	100
		Total	**18**	**8**	**320**	**480**	**22**	**800**

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I YEAR II Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD521	Advanced Java Programming	3		40	60	3	100
2	AD522	Generative AI	3		40	60	3	100
3	AD523	Data Visualization and Interpretation	3		40	60	3	100
4	AD524	Professional Elective-IV	3		40	60	3	100
5	AD525	Professional Elective-V	3		40	60	3	100
6	AD526	Professional Elective-VI	3		40	60	3	100
7	AD561	Advanced Java Programming Lab		4	40	60	2	100
8	AD562	Data Visualization Lab		4	40	60	2	100
9	MC01	Research Methodology and IPR	3		100	-	-	100
		Total	**21**	**8**	**420**	**480**	**22**	**900**

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II YEAR III Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD611	MOOCS	-	-	-	100	2	100
2	AD651	Internship	-	-	100	-	2	100
3	AD652	Dissertation Phase-I	-	-	100	-	6	100
		Total	**-**	**-**	**200**	**100**	**10**	**300**

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II YEAR IV Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD661	Dissertation Phase-II	-	-	40	60	14	100
		Total	-	**-**	**40**	**60**	**14**	**100**

Proposed Electives:

Professional Electives List	
Course Code	**Courses**
ADEL01	Statistics with R
ADEL02	Statistical Foundations For Data Science
ADEL03	Artificial Neural Networks
ADEL04	Machine Learning
ADEL05	Natural Language Processing
ADEL06	Computer Vision
ADEL07	Soft Computing
ADEL08	Reinforcement Learning
ADEL09	Big Data Analytics
ADEL10	Deep Learning
ADEL11	Optimization Techniques for Data Analysis
ADEL12	Data Science Applications of NLP
ADEL13	Generative AI Tools & Techniques
ADEL14	Virtual and Augmented Reality
ADEL15	Scalable Algorithms for Data Analysis
ADEL16	Web Mining and Social Network Analysis

ADEL17	Quantum Computing
ADEL18	Visual Recognition
ADEL19	Edge AI
ADEL20	Responsible AI
ADEL21	Optimization Techniques in Machine Learning
ADEL22	Information Retrieval
ADEL23	Image and Video Analytics
ADEL24	Industry Recommended Elective

AD 511	Advanced Data Structures and Algorithms I Year I Semester	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives: At the end of the Course Students will understand
1. Fundamentals of analysis of algorithm at depth.
2. Study of advanced data structures and its uses.
3. Analysis of problems from different domains

Course Outcomes: After successful completion of this course, students are able to
1. Identify and use suitable data structures for given problem from different domains
2. Appreciate the role of Linked List algorithms in solving variety of problems
3. Appreciate the role of Optimization by using linear programming
4. Analyze the various algorithms from different domains.
5. Understand the importance of advanced algorithms and techniques.

UNIT- I [CO 1] [10 Periods]
Data Structures: Introduction, Algorithm Analysis: Asymptotic Notations.
Linked List: Introduction, operations on linked lists, applications of linked lists
Stack and Queue: Introduction, Array Representation of Stack, Linked List Representation of stack, Application of stack, Queue, Array Representation of Queue, Linked List Representation of Queue.

UNIT- II [CO 2] [10 Periods]
Trees: Definitions and Concepts, Representations of Trees, Tree Traversal, Binary Search Tree(BST): Representation, Operations on BST.
Graphs: Representations and Traversal Techniques, Hashing: hash functions, Collision resolution techniques.

UNIT- III [CO 3] [10 Periods]
Divide and Conquer: General Method, Merge sort, Quick sort,
Greedy Method: Knapsack Problem, Spanning Trees, Single Source Shortest Path.

UNIT- IV [CO 4] [10 Periods]
Dynamic Programing: Multi stage Graph, All pair shortest paths algorithm, Single Source Shortest Problem, 0/1 Knapsack Problem, String editing, Travelling Sales Person Problem.

UNIT- V [CO 5] [10 Periods]
Backtracking: N-Queen Problem, Graph coloring, Knapsack problem
Branch and Bound: 15 puzzle problem, 0/1 Knapsack problem, Travelling sales person problem

Text Book(s)::
1. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed. “Fundamentals of Data structures in C”, Second Edition, University Press, 2008(UNIT I & II).
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. “Fundamentals of computer algorithms”, Second Edition Galgotia Publications. (UNIT III, IV & V)

References Book(s)::
1. Robert Sedgewick Philippe Flajolet, “An Introduction to the Analysis of Algorithms”, First Edition,
2. G.A.V. Pai, “Data Structures and Algorithms”, TMH, 2009

AD 512	Principles of Artificial Intelligence	L	T	P	C	Int	Ext
	I Year I Semester	3	-	-	3	40	60

Course Objectives: At the end of the course the students will understand
1.To present fundamental concepts and problem solving methodologies of artificial intelligence.
2.To learn various search strategies and game playing methods
3.To describe logical representation of natural language sentences.
4.To present various knowledge representation strategies.

Course Outcomes: After successful completion of this course, students are able to
1. Explain the fundamental concepts of artificial intelligence and state space representation of aproblem.
2.Apply heuristic search techniques for solving simple AI problems and game playing strategies.
3. Inferring new knowledge using forward/ backward reasoning for the given natural language sentences .
4. Expain various knowledge representation techniques.

UNIT- I [CO 1] [10 Periods]
Introduction to Artificial Intelligence: Introduction, Brief History, Intelligent Systems, Foundations of AI, Sub-areas of AI, Applications, Tic-Tac-Toe Game Playing, Development of AI Languages, Current Trends in AI.
Problem Solving: State Space Search and Control Strategies: Introduction, General Problem Solving, Characteristics of Problem.

UNIT- II [CO 2] [12 Periods]
Search Techniques: Exhaustive Searches, Heuristic Search Techniques, Iterative Deepening A*, Constraint Satisfaction.
Problem Reduction and Game Playing: Introduction, Problem Reduction, Game Playing, Bounded Look-Ahead Strategy and Use of, Alpha- Beta Pruning, Two-Player Perfect Information Games.

UNIT- III [CO 3] [12 Periods]
Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Proportional Logic, Predicate Logic, Logic Programming..

UNIT- IV [CO 4] [10 Periods]
Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT- V [CO 4] [10 Periods]
Advanced Knowledge Representation Techniques: Introduction, Conceptual Dependency theory, Script Structure, CYC Theory, Case Grammars, and Semantic Web

Text Book(s):
1. Saroj Kaushik, Artificial Intelligence, CENGAGE Learning.

Reference Book(s):
1. Stuart Russel and Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education/ PHI.
2. Elaine Rich & Kevin Knight, Artificial Intelligence, Pearson Education.

AD 513	Introduction to Data Science	L	T	P	C	Int	Ext
	I Year I Semester	3	-	-	3	40	60

Course Objectives: At the end of the course the students will understand
1. Fundamental concepts and architectures of database system
2. To impart features and design of conceptual and relational data models
3. The data science fundamentals and process.
4. The importance of choosing correct algorithms and data structures for handling large amounts of data
5. To analyze text mining techniques for handling large volumes of data and visualize the data.

Course Outcomes: After successful completion of this course, students are able to
1. Discuss the fundamental concepts and architecture of database systems and data models
2. Use relational query languages and SQL for querying the database.
3. Illustrate and explain the various stages of data science.
4. Implement distributing data storage and processing frameworks and identifying the differences between NoSQL and relational databases
5. Apply the data and text mining models to solve problems by extracting knowledge from data

UNIT- I [CO 1] [10 Periods]

Introduction to Databases: Introduction - An Example - Characteristics of the Database Approach - Actors on the Scene - Workers behind the Scene - Advantages of Using the DBMS Approach - A Brief History of Database Applications.

Overview of Database Languages and Architecture: Data Models, Schemas, and Instances - Three-Schema Architecture and Data Independence - Database Languages and Interfaces - The Database System Environment - Centralized and Client/Server Architectures for DBMSs - Classification of Database Management Systems.

UNIT- II [CO 2] [10 Periods]

Conceptual Data Modeling Using Entities and Relationships: Using High-Level Conceptual Data Models for Database Design – A Sample Database Application - Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints - Weak Entity Types - Refining the ER Design for the COMPANY Database - ER Diagrams, Naming Conventions, and Design Issues.

SQL: SQL Data Definition and Data Types - Specifying Constraints in SQL – Basic Retrieval Queries in SQL-INSERT, DELETE, and UPDATE Statements in SQL-More Complex SQL Retrieval Queries- Views (Virtual Tables) in SQL-Schema Change Statements in SQL.

UNIT- III [CO 3] [12 Periods]

Data science in a big data world -Benefits and uses of data science and big data, Facets of data, The data science process, The big data ecosystem and data science, An introductory working example of Hadoop.

The data science process- Overview of the data science process, Step 1: Defining research goals and creating a project charter, Step 2: Retrieving data, Step 3: Cleansing, integrating, and transforming data, Step 4: Exploratory data analysis, Step 5: Build the models, Step 6: Presenting findings and building applications on top of them.

Machine learning - What is machine learning and why should you care about it? , The modeling process, Types of machine learning, Semi-supervised learning.

UNIT- IV [CO 4] [10 Periods]

Handling large data on a single computer- The problems you face when handling large data , General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Case study 1: Predicting malicious URLs, Case study 2: Building a recommender system inside a database.

First steps in big data- Distributing data storage and processing with frameworks, Case study: Assessing risk when loaning money.

Join the NoSQL movement- Introduction to NoSQL, Case study: What disease is that?

UNIT- V [CO 5] [10 Periods]

The rise of graph databases- Introducing connected data and graph databases, Introducing Neo4j: a graph database, Connected data example: a recipe recommendation engine.

Data visualization to the end user- Data visualization options , Crossfilter, the JavaScript MapReduce lib, Creating an interactive dashboard with dc.js, Dashboard development tools.

Text mining and text analytics- Text mining in the real world , Text mining techniques: Bag of words, Stemming and lemmatization ,Decision tree classifier.

Text Book(s):

1.Database Systems, Ramez Elmasri and Shamkant B.Navathe, Pearson Education, 6th edition. (UNIT I, and UNIT II)

2. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, John Wiley & Sons. (UNIT III, UNIT IV, and UNIT V)

Reference Book(s):

1.Data Sciences & Analytics, V.K. Jain, Khanna Publishing House.

2.Business Analytics: The Science of Data - Driven Decision Making, U Dinesh Kumar, John Wiley & Sons.

3.Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher.

4.Jake VanderPlas, Python Data Science Handbook, Shroff Publisher/O'Reilly PublisherMedia.

5.Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher/O'Reilly Publisher Media.

AD 514 (ADEL02)	STATISTICAL FOUNDATIONS FOR DATA SCIENCE I Year I Semester	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives: At the end of the Course Students will understand
1. To provide students with basic concepts of probability distributions.
2. To gain knowledge about random variables and its regression, correlations and curve fitting.
3. To decide whether to accept or reject a specific value of the parameters
4. To provide the most appropriate interval estimator of the parameters in statistical inferences
5. To avoid or at least minimize, the problems of estimating the effects of the independent variables by experimental designs.

Course Outcomes: After successful completion of this course, students are able to
1. Discrete and continuous random variables and various standard distributions and their properties.
2. Understand and apply the Curve fitting, regression and Correlation
3. Use statistical tests in testing the hypotheses on data
4. Interval estimation for population parameters such as mean and standard deviation.
5. List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.

UNIT- I [CO 1] [10 Periods]
PROBABILITY DISTRIBUTIONS
Random variables (Discrete and Continuous). Discrete distributions like Binomial and Poisson. Continuous distributions like Gamma and Normal distributions.

UNIT- II [CO 2] [10 Periods]
CURVE FITTING, REGRESSION AND CORRELATION
The method of least squares, Inferences based on the least squares estimators, Curve linear Regression, Multiple regression, checking the adequacy of the model, Correlation.

UNIT- III [CO 3] [10 Periods]
TESTING OF HYPOTHESIS
Sampling distributions-Type I and Type II errors-Tests basedon Normal, t, Chi square and F distributions for testing of mean, variance and proportions –Tests for independence of attributes and goodness of fit.

UNIT- IV [CO 4] [10 Periods]
ESTIMATION THEORY
Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT- V [CO 5] [10 Periods]
DESIGNOF EXPERIMENTS
Basic principles of design of experiments, Completely Randomized Design, Randomized Block Design, Latin Square Design

Text Book(s)::
1. Johnson,R.A.,Miller,I and Freund J.,"Miller and Freund' Probability and Statistics for Engineers", 9th Edition,Pearson Education,Asia,2016
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms", Second Edition Galgotia Publications. (UNIT III, IV & V)

References Book(s)::

1. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.
2. Devore,J.L., "Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning, 2014.
3. Rice, J.A., "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5thEdition, Elsevier, 2014.

AD 515	ARTIFICIAL NEURAL NETWORKS	L	T	P	C	Int	Ext
(ADEL03)	I Year I Semester	3	-	-	3	40	60

Course Objectives: At the end of the Course Students will understand
1. Explain the principles and core components of these techniques.
2. Equip students with practical skills to learn various types of Artificial Neural Networks.
3. To investigate some common models and their applications

Course Outcomes: After successful completion of this course, students are able to
1. Understand the principles and concepts of neural networks and other related techniques.
2. Ability to select the Learning Networks in designing, training, and implementing neural networks real world systems
3. Ability to design, implement and evaluate associative memory networks, as well as their training methods and practical applications.
4. Implement common learning algorithms Adaptive resonance theory.
5. Describe back propagation neural networks to classification and recognition problems.

UNIT- I [CO 1] [10 Periods]

Artificial Neural Network - Definition, Advantages and Application scope of Neural Networks, Fundamental Concept, Evolution of Neural Networks , Basic Models of Artificial Neural Networks- Connections, Learning, Activation Functions, Important Terminologies of ANN's, McCulloch Pitt model, Linear separability

Simple Neural Networks for Pattern Classification: General Discussion, Hebb Net: Theory, Flowchart of Training Algorithm, Training Algorithm..

UNIT- II [CO 2] [10 Periods]

Supervised Learning Network- Introduction, perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons.

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization.

UNIT- III [CO 3] [10 Periods]

Associative Memory Networks: Introduction, Training Algorithms for Pattern Association, Hetero associative Memory Neural Network, Auto associative Net, Iterative Auto associative Net, Bidirectional Associative Memory (BAM).

UNIT- IV [CO 4] [10 Periods]

Adaptive Resonance Theory Network: Fundamental Architecture, Fundamental Algorithm
ART1: Architecture, Flowchart of Training process, Training Algorithm.
ART2: Architecture, Flowchart of Training process, Training Algorithm.

UNIT- V [CO 5] [10 Periods]

BACKPROPAGATION NEURAL NET: Standard Back Propagation Neural Net
Fixed Weight Nets for Constrained Optimization: Boltzmann Machine, Gaussian Machine, Cauchy Machine, Boltzmann with Machine Learning, Simple Recurrent Net.

Text Book(s):

1. Fundamentals of Neural Networks–Laurence Fausett, Pearson Education.2004
2. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication

References Book(s)::

1) Introduction to Neural Networks Using Matlab6.0- S.N. Sivanandam, S.Sumathi,S.N.Deepa.
2) Neural Networks –James A.Freeman/ David A.Skapura, Pearson Education.
3) Neural Networks –Simon Haykin–2nd edition, Pearson Education.
4) Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
5) S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication (for practicals)

AD 516	MACHINE LEARNING	L	T	P	C	Int	Ext
(ADEL04)	I Year I Semester	3	-		3	40	60

Course Objectives: At the end of the Course Students will understand
1. Basic concepts and applications of machine learning.
2. Supervised learning and its applications.
3. Unsupervised learning and its applications.

Course Outcomes: After successful completion of this course, students are able to
1. apply the machine learning concepts in real life problems.
2. design solutions for supervised learning problems.
3. use rule sets and reinforcement learning to solve real world problems.
4. discuss the issues in dimensionality reduction and unsupervised learning algorithms.

UNIT- I [CO 1] [10 Periods]

Introduction: Well posed learning problems, Designing a Learning System, Perspectives and Issues in machine learning, Supervised learning, Unsupervised learning.

Concept Learning and general to specific ordering: concept learning Task , Concept learning as a search, Find-S: Finding a Maximally Specific Hypothesis , Version Spaces and Candidate Elimination Algorithm..

UNIT- II [CO 2] [10 Periods]

Decision Tree Learning : Decision Tree Representation, appropriate problems for decision tree, the basic decision tree Algorithm, Issues in decision tree learning.

Bayesian Learning: Bayes Theorem, Maximum Likelihood and Least Square Error Hypotheses, Bayes Optimal Classifier, Naïve-Bayes Classifier, Bayesian Belief Network.

UNIT- III [CO 2] [10 Periods]

Neural Networks: Introduction, Neural Network Representation, appropriate problems for neural network, Perceptrons , Multilayer Networks and the Back Propagation Algorithm

Instance Based Learning: Introduction, KNN Learning, Locally Weighted Regression , Radial Bias Functions, Case-Based Reasoning

UNIT- IV [CO 3] [10 Periods]

Learning Sets of Rules: Sequential Covering Algorithm , Learning Rule Sets: summary , Learning First Order Rules, Learning set of first order rules: FOIL.

Reinforcement Learning: Introduction, the Learning Task , Q Learning , Non Deterministic Rewards and Actions , Temporal Difference Learning , Generalizing from Examples , Relationship to Dynamic Programming.

UNIT- V [CO 4] [10 Periods]

Clustering: Introduction, Partitioning methods: K-Means Clustering, Hierarchical methods: DIANA and AGNES, Density-Based Methods : DBSCAN, Grid-based Method: STING.

Association Rules : Introduction, Apriori algorithm and FP growth algorithm

Dimensionality Reduction : Introduction, Feature Selection methods: subset selection, Feature extraction methods: Principal component analysis, Multidimensional Scaling, Linear Discriminant analysis..

Text Book(s):

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013. (UNIT I , UNIT II, UNIT III, and UNIT IV)
2. Ethem Alpaydin, Introduction to Machine Learning , MIT Press, Prentice Hall of India, Third Edition 2014. (UNIT V)

References Book(s)::

1) Data Mining Concepts & Techniques, Jiawei Han, Micheline Kamber, andJian Pei, 3/e, Morgan Kaufmann Publishers.
2) Stephen Marsland, —Machine learning: An Algorithmic Perspectivell, CRC Press, 2009
3) Machine Learning: a Probabilistic Perspective, Kevin P. Murphy, MIT Press, 2012.

AD 551	Advanced Data Structures and Algorithms Lab	L	T	P	C	Int	Ext
	I Year I Semester	-	-	4	2	40	60

Course Objectives: At the end of the Course Students will

1. Understand and Implement Core Data Structures.
2. Explore Advanced Data Structures and Algorithms.
3. Develop Problem-Solving Techniques with Algorithmic Strategies.
4. Enhance Computational Efficiency and Optimization.

Course Outcomes: After completion of course, the student will be able to

1. Implement linear and non-linear ADTs.
2. Solve real world problems using searching, sorting and hashing algorithms.
3. Develop solutions for the given problems using appropriate data structures.
4. Implement complex problems using the design strategy.

List of Experiments to implement:

1. Single Linked List ADT.
2. Single Circular List ADT.
3. Doubly Linked List ADT.
4. Stack ADT.
5. Queue ADT.
6. BST ADT.
7. Graph traversal techniques.
8. Hashing Techniques.
9. Problems related to Divide and Conquer strategy.
10. Problems related to Greedy Strategy.
11. Graph Related Problems using Greedy Strategy.
12. Problems related to Dynamic Programming.
13. Graph Related Problems using Dynamic Programming.
14. Problems related to Backtracking Strategy.
15. Problems related to Branch and Bound.
16. String Matching Problems.

AD 552	Artificial Intelligence and Machine Learning Lab	L	T	P	C	Int	Ext
	I Year I Semester	-	-	4	2	40	60

Course Objectives: The main objectives of this course are:

- Introduce Basic Python concepts, Numpy and Pandas
- Discuss Artificial Intelligence search algorithms and constraint satisfaction problems.
- Introduce basic concepts and applications of machine learning.
- Demonstrate supervised and unsupervised learning and its applications

Course Outcomes: After successful completion of the course, the students are able to:

1. Use Python concepts in implementing AI & ML algorithms.
2. Implement search and constraint satisfaction problems.
3. Implement machine learning solutions to classification, regression, and clustering.
4. Use machine algorithms to solve complex problems.

LAB CYCLE 01 – Programs in Python

- Usage of control structures
- Python Functions
- Python Lists
- NumPy arrays
- Pandas DataFrames

LAB CYCLE 02 – Programs in Aritificial Intelligence

- Tic-tac-toe game playing.
- Water-jug problem (BFS)
- A* Search (8-puzzle).
- N-Queen Problem (Constraint Satisfaction Problem).
- Graph Coloring Problem (Constraint Satisfaction Problem).

LAB CYCLE 03 – Programs in Machine Learning

- Concept Learning
- Bayesian Learning
- Decision Tree learning
- Neural network learning
- Instance based learning
- Unsupervised learning – Clustering and regression
- Supervised learning methods performance evaluation using scikit-learn package

AD 521	Advanced Java Programming	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

Course Objectives:

The main objectives of this course are
1. Introducing database applications.
2. Introducing network applications by using TCP/IP sockets.
3. Introducing Web Applications with servlets, JSP and Spring MVC.

Course Outcomes:

After successful completion of the course, the students will be able to:
CO1. Create Database applications using JDBC.
CO2. Develop socket applications.
CO3. Design and develop server side applications using java Servlets and JSP.
CO4. Design and develop Applications with Spring Framework.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Java Database Connectivity (JDBC): Introduction, JDBC Drivers, JDBC Architecture, JDBC Classes and Interfaces, Loading a Driver, Making a Connection, Execute SQL Statement, SQL Statements, Retrieving Result, Getting Database Information, Scrollable and Updatable Resultset, Result Set Metadata.

UNIT – II **[CO2]** **10 Hours**

Advance Networking : Networking Basics, Introduction of Socket, Types of Socket, Socket API, TCP-IP Client/Server Sockets, URL, URLConnection,UDP: Datagrams, java.net package classes: Socket, ServerSocket, InetAddress.

Java Remote Method Invocation : RMI Architecture, Client Server Application using RMI**.**

UNIT – III **[CO3]** **10 Hours**

Servlets: Introduction to Java Servlets, Servlet interface, GenericServlet, HttpServlet, Servlet life Cycle, Servlet Request and Response Model, Deploying a Servlet, Servlet State Transitions, Servlet Config and ServletContext, Servlet Redirection and Request Dispatch, Maintaining Client State: Cookies, URL rewriting, Hidden form fields, Session Tracking

UNIT – IV **[CO3]** **10 Hours**

JSP: Introduction to JSP, JSP & Servlet as Web Components, Servlets vs. JSP, JSP Lifecycle, JSP Page Lifecycle Phases, General Rules of Syntax, JSP syntactic elements, JSP element syntax, Template content.JSP elements directives, declarations, expressions, scriptlets, actions.

JSP Standard Actions: jsp:useBean, jsp:getPreoperty, jsp:setProperty, jsp:include, jsp:forward, jsp:plugin,jsp:param,java

UNIT –V **[CO4]** **10 Hours**

Spring MVC : Springing into action : Unleashing the power of POJOs , Injecting dependencies , Applying aspects ,Working with an application context ,A bean's life , Spring modules.
Wiring beans : Exploring Spring's configuration options , Automatically wiring beans.
Wiring beans with Java ,Wiring beans with XML . Scoping beans.
Building Spring web applications -Getting started with Spring MVC , Writing a simple controller , Accepting request input , Processing forms.

Learning Resources:

Text Book:

1. Herbert Schildt , Java™:The Complete Reference, Seventh Edition(**UNIT – I, UNIT – II)**
2. Professional Java Server Programming by Subrahmanyam Allamaraju, Cedric Buest Apress Publication(**UNIT – III, UNIT – IV)**
3. Spring in Action 4th edition , Craig walls, Manning Publication (**UNIT – V)**

Reference Books:

1. Black Book "Java server programming" J2EE, 1st ed., Dream Tech Publishers, 2008.

2. Core Java, Volume II: Advanced Features by Cay Horstmann and Gary Cornell, Pearson Publication.

3. Complete Reference J2EE by James Keogh mcgraw publication.

4. Beginning JSP, JSF and Tomcat, Giulio Zambon, Apress

AD 522	GENERATIVE AI	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

COURSE OBJECTIVES:

At the end of the course the students will understand

- To understand what Generative AI is and why it matters.
- To know how it's shaping the future of business.
- To analyze different AI tools.
- To decide about the application of Generative AI in various domains.

COURSE OUTCOMES:

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

- Explain the technical terminology surrounding Generative AI.
- Analyse the significance of Generative AI in today's digital landscape.
- Gain hands-on experience with state-of-the-art AI tools.
- Use the concept of Prompt Engineering.
- Make informed decisions about the application of Generative AI in various domains.

UNIT-I [CO1] 10 Periods

Introduction to Deep Learning: Deep Feed forward Networks: Learning XOR, Gradient Based Learning, Hidden Units, Architecture Design, Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Data Types.
Applications: Computer Vision, Natural Language Processing.

UNIT-II [CO2] 10 Periods

Generative Modeling, What Is Generative Modeling? Generative Versus Discriminative Modeling, Probabilistic Generative Models, The Challenges of Generative Modeling.
Variational Auto encoders: Autoencoders, Building a Variational Auto encoder, Using VAEs to generate Faces.

Unit-III [CO3] 10 Periods

Generative Adversarial Networks: Introduction to GANs, The Discriminator, The Generator, Training the GAN, GAN Challenges, LSTM Network, Generating New Text, Encoder-Decoder Models, The Future of Generative Modeling: The Transformer- BERT,GPT-2.

Unit-IV [CO4] 10 Periods

Understanding Prompting and Prompt Techniques: Introducing LLM Prompts, Types of LLM prompts, Components of LLM Prompt, Challenges and limitations of using LLM prompts, LLMs for creative writing-using AI for creative writing, using AI to generate fiction.

Unit-V [CO5] 10 Periods

Unlocking Insights from Unstructured Text-AI Techniques for Text Analysis, Sentiment Analysis, Organizing unstructured data, Cleaning up dirty data, Making sense of unstructured data-pattern matching for information extraction.

Learning Resources:

TEXT BOOKS:

1. "Deep Learning" Good fellow,Yoshua Bengio, Aaron Courville, MIT Press.[Unit-1]
2. "Generative Deep Learning", David Foster 1st edition. [Unit-II & III]
3. "Unlocking the Secrets of Prompt Engineering", Gilbert Mizrahi,1st edition. [Unit-IV & V]

Reference Books:

1. "Generative AI on AWS" by Chris Fregly, Antje Barth, Shelbee Eigenbrode.
2. "Artificial Intelligence & Generative AI for Beginners" by David M.Patel.

AD 523	Data Visualization and Interpretation	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

Course Objectives:
The main objectives of this course are

1. This course introduces the visualization techniques of data.
2. To enable students to make more effective use of data.
3. To utilize various levels and types of summarization of data
4. Give an insight into the statistical methods of data analysis and prediction

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

CO1. Articulate objectives of Data Visualization and techniques
CO2. Analyze data to create a visualization for various real-time applications
CO3. Develop programs and map visual layouts & graphical properties.
CO4. Create and publish visualizations that enable clear interpretations of big, complex and real world data.

UNIT – I **[CO1] 10 Hours**

The Context of Data Visualization: Visualization as a discovery tool, The bedrock of visualization knowledge, Defining data visualization, Visualization skills for the masses, the data visualization methodology, visualization design objects.

Setting the Purpose and Identifying Key Factors: Establishing intent – the visualization's function, Establishing intent – the visualization's tone, Key factors surrounding a visualization project, The " eight hats" of data visualization design

UNIT – II **[CO2] 10 Hours**

Conceiving and Reasoning Visualization Design Options: Data visualization design is all about choices, The visualization anatomy – data representation, The visualization anatomy – data presentation

Taxonomy of Data Visualization Methods: Data visualization methods, Choosing the appropriate chart type, Assessing hierarchies and part-to-whole relationships.

UNIT – III **[CO3] 10 Hours**

Constructing and Evaluating Your Design Solution: For constructing visualizations, technology matters, The construction process, Approaching the finishing line Post-launch evaluation. Case Studies on real-time applications

UNIT – IV **[CO4] 10 Hours**

An Introduction to Connecting to Data: An Introduction to Connecting to Data in Tableau, Shaping Data for Use with Tableau, Getting a Lay of the Land: Tableau Terminology, View the Underlying Data, View the Number of Records, Dimension Versus Measure, What Is a Measure? What Is a Dimension? Discrete Versus Continuous Five Ways to Make a Bar Chart/An

UNIT –V **[CO4] 10 Hours**

Introduction to Aggregation: Five Ways to Create a Bar Chart in Tableau An Introduction to Aggregation in Tableau, Line Graphs, Independent Axes, and Date Hierarchies, How to Make a Line Graph in Tableau, Independent Axes in Tableau, Date Hierarchies in Tableau, Marks Cards, Encoding, and Level of Detail, An Explanation of Level of Detail, An Introduction to Encoding, Label and Tooltip Marks Cards..

Learning Resources:

Text Books:

1. Andy Kirk, ”Data Visualization: a successful design process”, Packt Publishing December 2012. (UNIT-1, UNIT-II, UNIT-III)

2. Ryan Sleeper, Practical Tableau, O’Reilly Media, Inc. April 2018. (UNIT-IV, UNIT-V)

Reference Books:

1. Chakrabarti, S,”Mining the web: Discovering knowledge from hypertext data “, Morgan Kaufman Publishers, 2003.
2. Ben Fry, Villisualizing data, Sebastopo, O‘Reily, 2007

AD 524 (ADEL05)	Natural Language Processing	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

***Course Objectives**:*

The main objectives of this course are:

1. Understand the Representation and Layers of NLP.
2. Represent the sentences as parse trees.
3. Use and create sentiment lexicons.
4. Describe extractive Summarization in three generations and LLMs

Course Outcomes:

After successful completion of the course, the students are able to:

1. Describe the different generations of NLP.
2. Analyze the different parsing techniques.
3. Recognize the techniques to identify named entities for example sentences.
4. Analyze the sentiment analysis, question answering of natural language sentences.
5. Distinguish between extractive and abstractive summarization and LLMs.

UNIT I **[CO 1][10 Periods]**

Introduction: Language and Linguistics, Ambiguity and Layers of NLP, Generations of NLP.

Representation and NLP: Ambiguity and Representations, Generation 1: Belongingness via Grammars, Generation 2: Discrete Representational Semantics, Generation 3: Dense Representations.

UNIT II **[CO 2][10 Periods]**

Introduction to Natural Language Understanding: Applications of Natural Language Understanding, Evaluating Language Understanding Systems, The Different Levels of Language Analysis.

Grammars and Parsing: Grammars and Sentence Structure, A Top- Down parser, A Bottom- Up chart parser, Transition Network Grammars, Top-Down Chart Parsing, Finite State Models and Morphological Processing.

UNIT III **[CO 3] [10 Periods]**

Named Entity Recognition: Problem Formulation, Ambiguity in Named Entity Recognition, Datasets, First Generation: Rule-Based Approaches, Second Generation: Probabilistic Models, Third Generation: Sentence Representations and Position Wise Labelling.

Machine Translation: Introduction, Rule-Based Machine Translation, Indian Language Statistical Machine Translation, Phrase-Based Statistical Machine Translation, Factor-Based Statistical Machine Translation, Cooperative NLP: Pivot-Based Machine Translation, Neural Machine Translation.

UNIT IV **[CO 4][10 Periods]**

Sentiment Analysis: Problem Statement, Ambiguity for Sentiment Analysis, Lexicons for Sentiment Analysis, Rule-Based Sentiment Analysis, Statistical Sentiment Analysis, Neural approaches to Sentiment Analysis.

Question Answering: Problem Formulation, Ambiguity in Question Answering, Dataset Creation, Rule-based Q&A, Second Generation, Third Generation.

UNIT V **[CO 5][10 Periods]**

Summarization: Ambiguity in Text Summarization, Problem Definitions, Early Work, Summarization Using Machine Learning.

Large Language Models: Background, Ambiguity Resolution, Generative LLMs, Usage of LLMs

Text Book:

1. Natural Language Processing, Pushpak Bhattacharyya, Aditya Joshi, Wiley, 2023. (UNIT I, UNIT III, UNIT IV & UNIT V).
2. James Allen, Natural Language Understanding, Second Edition, Pearson Education.(UNIT II)..

Reference Books:

1. Daniel Jurafsky and James H Martin,"Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.
2. C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA: 1999

AD 525 (ADEL07)	Soft Computing	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

1. explain the principles and core components of these techniques.
2.equip students with practical skills to apply soft computing techniques to real-world problems.
3.independently analyze, model, and solve complex problems using soft computing methods.
4.assess when and where soft computing approaches are most suitable and articulate their reasoning.

Course Outcomes:

After successful completion of the course, the students will be able to:
CO1.define the principles and concepts of soft computing, including fuzzy sets, neural networks, genetic algorithms, and other related techniques.
CO2.apply fuzzy logic, Sets, relations in decision-making and control systems.
CO3.demonstrate fuzzy membership functions and defuzzification.
CO4.demonstrate fuzzy arithmetic and fuzzy measures, fuzzy rule based and approximate reasoning.
CO5.apply genetic algorithms to optimization and search problems.

Course Content:

UNIT – I **[CO1, CO2] 10 Hours**

Introduction: Neural Networks, Application Scope of Neural Networks, Fuzzy Logic, Genetic Algorithm, Hybrid Systems, Soft Computing.

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Introduction to Fuzzy Logic, Classical Sets, Fuzzy Sets.

Classical Relations and Fuzzy Relations: Introduction, Cartesian Product of Relation, Classical Relation, fuzzy Relations, Tolerance and Equivalence Relations, Non interactive Fuzzy Sets.

[CO1, CO3] 10 Hours

UNIT – II

Membership Functions: Introduction, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments

Defuzzification: Introduction, Lambda-Cuts for Fuzzy Sets (Alpha-Cuts), Lambda-Cuts for Fuzzy Relations, Defuzzification Methods

[CO1, CO4] 10 Hours

UNIT – III

Fuzzy Arithmetic and Fuzzy Measures : Introduction, Fuzzy Arithmetic, Extension Principle, Fuzzy Measures, Measures of Fuzziness, Fuzzy Integrals

Fuzzy Rule Base and Approximate Reasoning: Introduction, TruthValuesandTablesin Fuzzy Logic, Fuzzy Propositions, Formation of Rules, Decomposition of Rules, Aggregation of Fuzzy Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Overview of Fuzzy Expert System.

UNIT – IV **[CO1, CO5] 10 Hours**

Genetic Algorithms: Introduction, Biological Background, Traditional Optimization and Search Techniques, Genetic Algorithm and Search Space, Generic Algorithm vs. Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA, General Genetic Algorithm.

Operators in Generic Algorithm: Encoding, Selection, Crossover, Mutation.

[CO1, CO5] 10 Hours

UNIT –V

Constraints in Genetic Algorithm

Problem Solving Using Genetic Algorithm: Maximizing a Function

Classification of Generic Algorithm: Messy Genetic Algorithms, Adaptive Genetic Algorithms, Hybrid Genetic Algorithm, Parallel Genetic Algorithm, Independent Sampling Genetic Algorithm (ISGA), RealCoded Genetic Algorithms.

Learning Resources:

Text Book:

1. Principles of Soft Computing by S. N. Sivanandan and S. N. Deepa, 2nd edition, Wiley India 2007.

Reference Books:

1. NEURAL NETWORKS, FUZZY LOGIC, AND GENETIC ALGORITHMS: SYNTHESIS ANDAPPLICATIONS (WITH CD-ROMby S. Rajasekaran and G. A. VijayalakshmiPai, PHI, 2013.

2. Soft computing and Intelligent Systems: Theory and Applications, by Naresh K. Sinha, Madan N. Gupta, Academic Press 2000.

AD 526 (ADEL09)	Big Data Analytics	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

Course Objectives:

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data
- To learn about stream computing.
- To know about the research that requires the integration of large amounts of data.

Course outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

- Recognize Big Data and its analytics in the real world.
- Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.
- Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.
- Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics.
- Implement Big Data Activities using Hive.

UNIT – I **[CO1] [10 Hours]**

Overview of Big Data: What is Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics

Exploring the use of Big Data in Business Context: Use of Big Data in social Networking, use of Big Data in preventing Fraudulent Activities, use of Big Data in detecting Fraudulent Activities Insurance sector, use of Big Data in Retail Industry

Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Introducing Hadoop, In-Memory Computing Technology for Big Data

UNIT – II **[CO2] [10 Hours]**

Understanding hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, MapReduce, Hadoop YARN, HBase, Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie

Understanding MapReduce Fundamentals and HBase: MapReduce Framework, Techniques to Optimize MapReduce Jobs, Uses of MapReduce, Characteristics of HBase.

Understanding Big Data Technology Foundations: Exploring the Big Data Stack, Virtualization and Big Data, Virtualization approaches.

UNIT – III **[CO3] [10 Hours]**

Storing Data in Databases and Data Warehouses: RDMS and Big Data, Nom-Relational Database, Polyglot Persistence, Integrating Big Data with traditional Data Warehouses, Big Data Analysis and Data

Warehouses, Changing deployment in Big Data Era

Storing Data in Hadoop: Introducing HDFS, Introducing HBase, Combining HBase and HDFS, Selecting the suitable Hadoop Data organization for Applications.

UNIT – IV **[CO4] [10 Hours]**

NoSQL Data Management: Introduction to NoSQL, Aggregate Data Models, Key Value Data Models, Document Databases, Relationships, Graph Databases, Schema-Less Databases, Materialized Views, Distribution Models, Sharding, MapReduce Partioning and Combining, Composing MapReduce Calculations .

Understanding Analytics and Big Data: Comparing Reporting and Analysis, The Analytic Process, Types of Analytics .

UNIT – V **[CO5] [10 Hours]**

Analytical Approaches and Tools to Analyze Data: Analytical Approaches, History of Analytical Tools, Introducing Popular Analytical Tools, Comparing various Analytical Tools.

Social Media Analytics and Text Mining: Introducing Social Media, Introducing Key Elements of Social Media, Introducing Text Mining, Understanding Text Mining Process, Sentiment Analysis.

Text Book:

1. **BIG DATA Black Book , Dreamtech Press, 2016 First Edition**

Reference Books:

1. Bill Franks, Taming The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
2. Frank J. Ohlhorst, Big Data Analytics,1st Edition, Wiley, 2012.
3. Hadoop: The Definitive Guide, Tom White, 3rd Edition (2012), O'Reilly(SPD).

AD 561	Advanced Java Programming Lab	L	T	P	C	Int	Ext
	I Year II Semester	-	-	4	2	40	60

Course Objectives:

The main objectives of this course are
Introducing database applications.
Introducing network applications by using TCP/IP sockets.
Introducing Web Applications with servlets, JSP and Spring MVC.

Course Outcomes:

After successful completion of the course, the students will be able to:
CO1. Create Database applications using JDBC.
CO2. Develop socket applications.
CO3. Design and develop server side applications using java Servlets and JSP.
CO4. Design and develop Applications with Spring Framework.

List of Experiments to implement:

Develop an application using JDBC for select, insert, and update operations.
Develop an application to demonstrate Meta Data .
Develop Network application using TCP protocol
Develop Network application using UDP protocol
Develop an application using RMI
Develop server side application with Generic Servlet.
Develop server side application with Http Servlet
Develop server side application with Http Servlet
Develop a server side application to perform operations on data base by using JDBC
Develop a server side application using JSP.
Develop a server side application using JSP Action Tags.
Develop Spring MVC application.

AD 562	Data Visualization Lab	L	T	P	C	Int	Ext
	I Year II Semester	-	-	4	2	40	60

Course Objectives:

This course enables the students:

- To interpret data plots and understand core data visualization concepts such as correlation, linear relationships, and log scales.
- To explore the relationship between two continuous variables using scatter plots and line plots.
- To translate and present data and data correlations in a simple way.

Course Outcomes:

Upon successful completion of this course, Students will be able to:

1. Design effective data visualizations in order to provide new insights into a research question or communicate information to the viewer.
2. Find and select appropriate data that can be used in order to create a visualization that answers a particular research question.
3. Properly document and organize data and visualizations in order to prepare them for reuse.

List of Experiments to implement:

1. Loading and Distinguishing Dependent and Independent parameters
2. Exploring Data Visualization tools
3. Drawing Charts
4. Drawing Graphs
5. Data mapping
6. Creating Scatter Plot maps
7. Using BNF Notations
8. Working with REGEX
9. Visualize Network Data
10. Understanding Data Visualization frameworks