JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. ARTIFICIAL INTELLIGENCE
COURSE STRUCTURE AND SYLLABUS (R22)

EFFECTIVE FROM ACADEMIC YEAR 2022 - 23 ADMITTED BATCH

I YEAR I SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core – I	Artificial Intelligence and Intelligent Systems	3	0	0	3
Professional Core – II	Statistical Foundations for Artificial Intelligence	3	0	0	3
Professional Elective – I	1. Advanced Data Structures 2. Machine Learning 3. Database Programming with PL/SQL	3	0	0	3
Professional Elective – II	1. Cognitive Systems 2. Game Theory and Applications 3. Computer Vision and Robotics	3	0	0	3
Lab – I	Artificial Intelligence and Intelligent Systems Lab	0	0	4	2
Lab – II	*Professional Elective- I Lab	0	0	4	2
	Research Methodology & IPR	2	0	0	2
Audit – I	Audit Course – I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

Professional Elective- I and Professional Elective- I Lab must be of same course.

I YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core – III	Deep Learning	3	0	0	3
Professional Core – IV	Speech Processing	3	0	0	3
Professional Elective – III	1. Big Data Analytics 2. Functional Programming 3. Enterprise Cloud Concepts	3	0	0	3
Professional Elective – IV	1. Reinforcement Learning 2. Machine Translation 3. Cyber Security	3	0	0	3
Lab – III	Deep Learning Lab	0	0	4	2
Lab – IV	*Professional Elective-III Lab	0	0	4	2
	Mini Project with Seminar	0	0	4	2
Audit – II	Audit Course – II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

Professional Elective- III and Professional Elective- III Lab must be of same course.

II YEAR I SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Elective – V	1. Block chain Technology 2. Nature Inspired Computing 3. Conversational AI	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review – II	0	0	12	6
	Total	**6**	**0**	**12**	**12**

II YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review – III	0	0	12	6
Dissertation	Dissertation Viva-Voce	0	0	28	14
	Total	**0**	**0**	**40**	**20**

Note: For Dissertation Work Review - I, Please refer 7.10 in R19 Academic Regulations.

Audit Course I & II:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by yoga
8. Personality Development Through Life Enlightenment Skills

Open Electives:

1. IPR
2. Fault Tolerance Systems
3. Intrusion Detection Systems
4. Digital Forensics
5. Optimization Techniques
6. Cyber Physical Systems
7. Graph Analytics

ARTIFICIAL INTELLIGENCE AND INTELLIGENT SYSTEMS (PC - I)

M.Tech AI & DS I Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: UG level course in Mathematics, Data Structures

Course Objectives:

1. To impart knowledge about Artificial Intelligence.
2. To give understanding of the main abstractions and reasoning for intelligent systems.
3. To enable the students to understand the basic principles of Artificial Intelligence in various applications.

Course Outcomes: After completion of course, students would be able to:

1. Solve basic AI based problems.
2. Define the concept of Artificial Intelligence.
3. Apply AI techniques to real-world problems to develop intelligent systems.
4. Select appropriately from a range of techniques when implementing intelligent systems.

UNIT - I

Introduction: Overview of AI problems, AI problems as NP, NP-Complete and NP Hard problems. Strong and weak, neat and scruffy, symbolic and sub-symbolic, knowledge-based and data-driven AI.

UNIT -II

Search Strategies: Problem spaces (states, goals and operators), problem solving by search, Heuristics and informed search, Min-max Search, Alpha-beta pruning. Constraint satisfaction (backtracking and local search methods).

UNIT - III

Knowledge representation and reasoning: propositional and predicate logic, Resolution and theorem proving, Temporal and spatial reasoning. Probabilistic reasoning, Bayes theorem. Totally-ordered and partially-ordered Planning. Goal stack planning, Nonlinear planning, Hierarchical planning.

UNIT - IV

Learning: Learning from example, Learning by advice, Explanation based learning, Learning in problem solving, Classification, Inductive learning, Naive Bayesian Classifier, decision trees.

Natural Language Processing: Language models, n-grams, Vector space models, Bag of words, Text classification. Information retrieval.

UNIT - V

Agents: Definition of agents, Agent architectures (e.g., reactive, layered, cognitive), Multi-agent systems- Collaborating agents, Competitive agents, Swarm systems and biologically inspired models.

Intelligent Systems: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Key Application Areas: Expert system, decision support systems, Speech and vision, Natural language processing, Information Retrieval, Semantic Web.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall

REFERENCES:

1. Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.
2. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education.

STATISTICAL FOUNDATIONS FOR DATA SCIENCE (PC - II)

M.Tech AI & DS I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Mathematics courses of first year of study.

Course Objectives:

1. The Number Theory basic concepts useful for cryptography etc
2. The theory of Probability, and probability distributions of single and multiple random variables
3. The sampling theory and testing of hypothesis and making inferences
4. Stochastic process and Markov chains.

Course Outcomes: After learning the contents of this course, the student must be able to

1. Apply the number theory concepts to cryptography domain
2. Apply the concepts of probability and distributions to some case studies
3. Correlate the material of one unit to the material in other units
4. Resolve the potential misconceptions and hazards in each topic of study.

UNIT - I

Greatest Common Divisors and Prime Factorization: Greatest common divisors, The Euclidean algorithm, The fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers Congruences: Introduction to congruences, Linear congruences, The Chinese remainder theorem, Systems of linear congruences

UNIT - II

Simple Linear Regression and Correlation: Introduction to Linear Regression, The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence. Discrete Probability Distributions: Binomial Distribution, Poisson distribution.

UNIT - III

Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial, Fundamental Sampling Distributions: Random Sampling, Sampling Distributions, Sampling, Distribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t–Distribution, F Distribution.

UNIT - IV

Estimation & Tests of Hypotheses: Introduction, Statistical Inference, Classical Methods of Estimation. Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Tolerance Limits, Estimating the Variance, Estimating a Proportion for single mean, Difference between Two Means, between Two Proportions for Two Samples and Maximum Likelihood Estimation.

UNIT - V

Stochastic Processes and Markov Chains: Introduction to Stochastic processes- Markov process. Transition Probability, Transition Probability Matrix, First order and Higher order Markov process, n step transition probabilities, Markov chain, Steady state condition, Markov analysis.

TEXT BOOKS:

1. Kenneth H. Rosen, Elementary number theory & its applications, sixth edition, Addison Wesley, ISBN 978 0-321-50031-1

2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
3. S. D. Sharma, Operations Research, Kedarnath and Ramnath Publishers, Meerut, Delhi

REFERENCE BOOKS:

1. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications
2. T.T. Soong, Fundamentals of Probability And Statistics For Engineers, John Wiley & Sons Ltd, 2004.
3. Sheldon M Ross, Probability and statistics for Engineers and scientists, Academic Press.

ADVANCED DATA STRUCTURES (Professional Elective - I)

M.Tech AI I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: A course on "Data Structures"

Course Objectives

1. Introduces the heap data structures such as leftist trees, binomial heaps, Fibonacci and min-max heaps
2. Introduces a variety of data structures such as disjoint sets, hash tables, search structures and digital search structures

Course Outcomes

1. Ability to select the data structures that efficiently model the information in a problem
2. Ability to understand how the choice of data structures impact the performance of programs
3. Design programs using a variety of data structures, including hash tables, search structures and digital search structures

UNIT - I

Heap Structures

Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.

UNIT - II

Hashing and Collisions

Introduction, Hash Tables, Hash Functions, different Hash Functions: Division Method, Multiplication Method, Mid-Square Method, Folding Method, Collisions

UNIT - III

Search Structures: OBST, AVL trees, Red-Black trees, Splay trees,
Multiway Search Trees: B-trees, 2-3 trees

UNIT - IV

Digital Search Structures

Digital Search trees, Binary tries and Patricia, Multiway Tries, Suffix trees, Standard Tries, Compressed Tries

UNIT - V

Pattern matching

Introduction, Brute force, the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, Naïve String, Harspool, Rabin Karp

TEXT BOOKS:

1. Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2. Introduction to Algorithms, TH Cormen, PHI

REFERENCES:

1. Design methods and analysis of Algorithms, SK Basu, PHI.
2. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Universities Press.

MACHINE LEARNING (Professional Elective - I)

M.Tech AI I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To have a thorough understanding of the Supervised and Unsupervised learning techniques
3. To study the various probability based learning techniques
4. To understand graphical models of machine learning algorithms

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

1. Distinguish between, supervised, unsupervised and semi-supervised learning
2. Apply the apt machine learning strategy for any given problem
3. Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
4. Design systems that use the appropriate graph models of machine learning
5. Modify existing machine learning algorithms to improve classification efficiency

UNIT - I:

Introduction: Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants: – Perceptron – Linear Separability – Linear Regression.

UNIT - II:

Linear Models: Multi-layer Perceptron– Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

UNIT - III:

Tree and Probabilistic Models: Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms

UNIT - IV:

Dimensionality Reduction and Evolutionary Models: Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example

UNIT - V:

Graphical Models: Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TEXT BOOKS:

1. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, —Machine Learning, First Edition, McGraw Hill Education, 2013.

REFERENCES:

1. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014
3. Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014

DATABASE PROGRAMMING WITH PL/SQL (Professional Elective - I)

M.Tech AI I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. Knowledge on significance of SQL fundamentals.
2. Evaluate functions and triggers of PL/SQL
3. Knowledge on control structures, packages in PL/SQL and its applications

Course Outcomes:

1. Understand importance of PL/SQL basics
2. Implement functions and procedures using PL/SQL
3. Understand the importance of triggers in database

UNIT - I

PL/SQL Basics: Block Structure, Behavior of Variables in Blocks, Basic Scalar and Composite Data Types, Control Structures, Exceptions, Bulk Operations, Functions, Procedures, and Packages, Transaction Scope.

UNIT - II

Language Fundamentals & Control Structures: Lexical Units, Variables and Data Types, Conditional Statements, Iterative Statements, Cursor Structures, Bulk Statements, Introduction to Collections, Object Types: Varray and Table Collections, Associative Arrays, Oracle Collection API.

UNIT - III

Functions and Procedures: Function and Procedure Architecture, Transaction Scope, Calling Subroutines, Positional Notation, Named Notation, Mixed Notation, Exclusionary Notation, SQL Call Notation, Functions, Function Model Choices, Creation Options, Pass-by-Value Functions, Pass-by-Reference Functions, Procedures, Pass-by-Value Procedures, Pass-by-Reference Procedures, Supporting Scripts.

UNIT - IV

Packages: Package Architecture, Package Specification, Prototype Features, Serially Reusable Precompiler Directive, Variables, Types, Components: Functions and Procedures, Package Body, Prototype Features, Variables, Types, Components: Functions and Procedures, Definer vs. Invoker Rights Mechanics, Managing Packages in the Database Catalog, Finding, Validating, and Describing Packages, Checking Dependencies, Comparing Validation Methods: Timestamp vs. Signature.

UNIT - V

Triggers: Introduction to Triggers, Database Trigger Architecture, Data Definition Language Triggers, Event Attribute Functions, Building DDL Triggers, Data Manipulation Language Triggers, Statement-Level Triggers, Row-Level Triggers, Compound Triggers, INSTEAD OF Triggers, System and Database Event Triggers, Trigger Restrictions, Maximum Trigger Size, SQL Statements, LONG and LONG RAW Data Types.

TEXT BOOKS:

1. Oracle Database 12c PL/SQL Programming Michael McLaughlin, McGrawHill Education

REFERENCES:

1. Benjamin Rosenzweig, Elena Silvestrova Rakhimov, Oracle PL/SQL by example Fifth Edition
2. Dr. P. S. Deshpande, SQL & PL / SQL for Oracle 11g Black Book

COGNITIVE SYSTEMS (Professional Elective - II)

M.Tech AI I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Probability theory

Course Objectives:

1. To provide an understanding of the central challenges in realizing aspects of human cognition.
2. To provide a basic exposition to the goals and methods of human cognition.
3. To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
4. To support human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

Course Outcomes:

1. Understand the basics of cognitive computing and comparisons with traditional approaches.
2. Plan and use the primary tools associated with cognitive computing.
3. Plan and execute a project that leverages cognitive computing.
4. Understand and develop the business implications of cognitive computing.

UNIT - I

Introduction to Cognitive Science: Understanding Cognition, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical systems approach to cognition

UNIT - II

Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics

UNIT - III

Cognitive Modeling: modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making

UNIT - IV

Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks

UNIT - V

DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems

Case study: IBM Watson

TEXT BOOKS:

1. The Cambridge Handbook of Computational Psychology by Ron Sun (ed.), Cambridge University Press.
2. Learning IBM Watson Analytics, James D Miller, Packt Publications

REFERENCES:

1. Formal Approaches in Categorization by Emmanuel M. Pothos, Andy J. Wills, Cambridge University Press.
2. Cognition, Brain and Consciousness: Introduction to Cognitive Neuroscience by Bernard J. Bears, Nicole M. Gage, Academic Press.
3. Cognitive Computing and Big Data Analytics by Hurwitz, Kaufman, and Bowles, Wiley

GAME THEORY AND APPLICATIONS (Professional Elective - II)

M.Tech AI I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Graph Theory

Course Objectives:
1. To teach students some strategic considerations to take into account making their choices.
2. To learn basic concepts of game theory.
3. To apply game theoretic models to real world problems

Course Outcomes:
1. Solve strategic games between two and more agents in non-cooperative scenario.
2. Analyze and solve both simultaneous-moves and sequential-moves games.
3. Learn different methods to solve games.

UNIT - I
Introduction: games and decisions, Games Strategies, Costs and Payoff, Basic Solution Concepts, Finding equilibria and Learning in Games

UNIT - II
Zero-Sum Games: secure strategy, Maximin, Maximax, and Minimax Regret Solvability, value of a game. Normal form games: dominance, iterated dominance, Nash equilibrium. N-player games, mixed strategy nash equilibria.

UNIT - III
Graphical Games: Computing Nash, equilibria in Tree Graphical Games, Graphical Games and correlated Equilibria. Extensive form games: subgame perfection, sequential equilibrium, Stackelberg Model of Duopoly, Buying Votes, Committee Decision-Making. Bargaining: Rubinstein bargaining, Nash bargaining.

UNIT - IV
Repeated Games: Folk theorem and repeated prisoner's dilemma. Tacit collusion. Incomplete information games: Bayesian equilibrium, higher order beliefs.

UNIT - V
Auctions and Mechanism Design: Basic auctions, voting, Vickrey-Clarke-Groves Auction.
Cryptography and Game theory: cryptographic influence on game theory and Game theoretic influence on cryptography

TEXT BOOKS:
1. A Course in Game Theory by M. J. Osborne & A. Rubinstein, MIT Press.

REFERENCES:
1. Algorithmic Game Theory by N. Nisan, T. Rougharden, E. Tardos and V. V. Vazirani, Cambridge University Press.
2. Game Theory and Applications by TatsuroIchiishi, Abraham Neyman and YairTauman, Elsevier.
3. Essentials of Game Theory: A Concise, Multidisciplinary Introduction by K. Leyton-Brown and Y.Shoham, Morgan & Claypool Publishers.

COMPUTER VISION AND ROBOTICS (Professional Elective - II)

M.Tech AI I Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: UG level Course in Linear Algebra and Probability.

Course Objectives:

1. To understand the Fundamental Concepts Related To sources, shadows and shading
2. To understand the The Geometry of Multiple Views

Course Outcomes:

1. Implement fundamental image processing techniques required for computer vision
2. Implement boundary tracking techniques
3. Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques and Implement motion related techniques.
5. Develop applications using computer vision techniques.

UNIT - I

Cameras: Pinhole Cameras
Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases
Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models
Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT - II

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates,
Edge Detection: Noise, Estimating Derivatives, Detecting Edges
Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

UNIT - III

The Geometry of Multiple Views: Two Views
Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras
Segmentation by Clustering: What Is Segmentation?, Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

UNIT - IV

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness
Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice,
Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples

UNIT - V

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations
Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry,

Case study: Mobile Robot Localization

Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

TEXT BOOKS:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

REFERENCES:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez and R. E. Woods “Digital Image Processing” Addison Wesley 2008.
3. Richard Szeliski “Computer Vision: Algorithms and Applications” Springer-Verlag London Limited 2011.

ARTIFICIAL INTELLIGENCE AND INTELLIGENT SYSTEMS LAB (Lab - I)

M.Tech AI I Year I Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. To provide skills for designing and analyzing AI based algorithms.
2. To enable students to work on various AI tools.
3. To provide skills to work towards solution of real-life problems

Course Outcomes:

1. Elicit, analyze and specify software requirements.
2. Simulate a given problem scenario and analyze its performance.
3. Develop programming solutions for given problem scenario.

List of Programs:

1. Installation and working on various AI tools viz. Python, R tool, GATE, NLTK, MATLAB, etc.
2. Data preprocessing and annotation and creation of datasets.
3. Learn existing datasets and Treebanks
4. Implementation of searching techniques in AI.
5. Implementation of Knowledge representation schemes.
6. Natural language processing tool development.
7. Application of Machine learning algorithms.
8. Application of Classification and clustering problem.
9. Working on parallel algorithms.
10. Scientific distributions used in python for Data Science - Numpy, scifi, pandas, scikit learn, statsmodels, nltk.

ADVANCED DATA STRUCTURES LAB (Lab - II)

M.Tech AI I Year I Sem.

L	T	P	C
0	0	4	2

Prerequisites:

1. A course on Computer Programming & Data Structures.

Course Objectives:

1. Introduces the basic concepts of Abstract Data Types.
2. Reviews basic data structures such as stacks and queues.
3. Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs, and B-trees.
4. Introduces sorting and pattern matching algorithms.

Course Outcomes:

1. Ability to select the data structures that efficiently model the information in a problem.
2. Ability to assess efficiency trade-offs among different data structure implementations or combinations.
3. Implement and know the application of algorithms for sorting and pattern matching.
4. Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and B-trees.

List of Programs

1. Write a program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.

2. Write a program for implementing the following sorting methods:
   a) Merge sort b) Heap sort c) Quick sort

3. Write a program to perform the following operations:
   a) Insert an element into a B- tree.
   b) Delete an element from a B- tree.
   c) Search for a key element in a B- tree.

4. Write a program to perform the following operations:
   a) Insert an element into a Min-Max heap
   b) Delete an element from a Min-Max heap
   c) Search for a key element in a Min-Max heap

5. Write a program to perform the following operations:
   a) Insert an element into a Lefiist tree
   b) Delete an element from a Leftist tree
   c) Search for a key element in a Leftist tree

6. Write a program to perform the following operations:
   a) Insert an element into a binomial heap
   b) Delete an element from a binomial heap.
   c) Search for a key element in a binomial heap

7. Write a program to perform the following operations:

a) Insert an element into a AVL tree.
b) Delete an element from a AVL search tree.
c) Search for a key element in a AVL search tree.

8. Write a program to perform the following operations:
a) Insert an element into a Red-Black tree.
b) Delete an element from a Red-Black tree.
c) Search for a key element in a Red-Black tree.

9. Write a program to implement all the functions of a dictionary using hashing.

10. Write a program for implementing Knuth-Morris-Pratt pattern matching algorithm.

11. Write a program for implementing Brute Force pattern matching algorithm.

12. Write a program for implementing Boyer pattern matching algorithm.

TEXT BOOKS:

1. Fundamentals of Data structures in C, E. Horowitz, S. Sahni and Susan Anderson Freed, 2nd Edition, Universities Press
2. Data Structures Using C – A.S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.
3. Introduction to Data Structures in C, Ashok Kamthane, 1st Edition, Pearson.

REFERENCES:

1. The C Programming Language, B.W. Kernighan, Dennis M. Ritchie, PHI/Pearson Education
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3. Data structures: A Pseudocode Approach with C, R.F. Gilberg And B.A. Forouzan, 2nd Edition, Cengage Learning

MACHINE LEARNING LAB (Lab - II)

M.Tech AI I Year I Sem.

L	T	P	C
0	0	4	2

Course Objective:

1. The objective of this lab is to get an overview of the various machine learning
2. Techniques and can demonstrate them using python.

Course Outcomes:

1. Understand modern notions in predictive data analysis
2. Select data, model selection, model complexity and identify the trends
3. Understand a range of machine learning algorithms along with their strengths and weaknesses
4. Build predictive models from data and analyze their performance

List of Experiments:

1. Write a python program to compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation
2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
3. Study of Python Libraries for ML application such as Pandas and Matplotlib
4. Write a Python program to implement Simple Linear Regression
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn
6. Implementation of Decision tree using sklearn and its parameter tuning
7. Implementation of KNN using sklearn
8. Implementation of Logistic Regression using sklearn
9. Implementation of K-Means Clustering
10. Performance analysis of Classification Algorithms on a specific dataset (Mini Project)

TEXT BOOK:

1. Machine Learning – Tom M. Mitchell, - MGH.

REFERENCE:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis.

DATABASE PROGRAMMING WITH PL/SQL LAB (Lab - II)

M.Tech AI I Year I Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. Knowledge on significance of SQL fundamentals.
2. Evaluate functions and triggers of PL/SQL
3. Knowledge on control structures, packages in PL/SQL and its applications

Course Outcomes:

1. Understand importance of PL/SQL basics
2. Implement functions and procedures using PL/SQL
3. Understand the importance of triggers in database

List of Experiments:

1. Write a Pl/SQL program using FOR loop to insert ten rows into a database table.
2. Given the table EMPLOYEE (EmpNo, Name, Salary, Designation, DeptID), write a cursor to select the five highest paid employees from the table.
3. Illustrate how you can embed PL/SQL in a high-level host language such as C/Java And demonstrates how a banking debit transaction might be done.
4. Given an integer i, write a PL/SQL procedure to insert the tuple (i, 'xxx') into a given relation.
5. Write a PL/SQL program to demonstrate Exceptions.
6. Write a PL/SQL program to demonstrate Cursors.
7. Write a PL/SQL program to demonstrate Functions.
8. Write a PL/SQL program to demonstrate Packages.
9. Write PL/SQL queries to create Procedures.
10. Write PL/SQL queries to create Triggers.

RESEARCH METHODOLOGY & IPR

M.Tech AI I Year I Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To understand the research problem
2. To know the literature studies, plagiarism and ethics
3. To get the knowledge about technical writing
4. To analyze the nature of intellectual property rights and new developments
5. To know the patent rights

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT- I:

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:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT- III:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT- IV:

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

UNIT- V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

REFERENCE BOOKS:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
1. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

DEEP LEARNING (PC - III)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: students will be able

1. To understand complexity of Deep Learning algorithms and their limitations
2. To be capable of performing experiments in Deep Learning using real-world data.

Course Outcomes:

1. Implement deep learning algorithms, understand neural networks and traverse the layers of data
2. Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
3. Understand applications of Deep Learning to Computer Vision
4. Understand and analyze Applications of Deep Learning to NLP

UNIT - I

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout

UNIT - II

Convolutional Neural Networks: Architectures, convolution/pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures. Deep Unsupervised Learning: Auto encoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models, Dynamic Memory Models

UNIT - III

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention Models for computer vision tasks

UNIT - IV

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Wordsmodel (CBOW), Glove, Evaluations and Applications in word similarity

UNIT - V

Analogy reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C, M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

SPEECH PROCESSING (PC - IV)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand the concept of speech processing.
2. To build speech based systems.
3. To analyze the performance of speech processing systems.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. The mechanism of human speech production and perception.
2. Each component of speech recognition systems.
3. The importance of probabilistic modeling in speech recognition.
4. Build a speech recognition system.

UNIT - I

Introduction: Speech and Language, Speech analysis, Speech coding, speech production models, speech analysis and analysis-synthesis systems, Mechanisms and Models of the Human Auditory System

UNIT - II

Linear Predictive Coding (LPC) Analysis: Speech recognition, Graphical models, Hidden Markov models, Recognition and training algorithms, Language models

UNIT - III

Search Algorithms: Optimization, adaptation, Noise robustness, Digital Coding of Speech. Message Synthesis from Stored Human Speech Components. Phonetic Synthesis by Rule. Speech Synthesis from Textural or Conceptual Input

UNIT - IV

Introduction to Automatic Speech Recognition: Template Matching. Stochastic Modeling. Practical Techniques for Improving Speech Recognition and Performance, Automatic Speech Recognition for Large Vocabularies. Speaker Recognition and other Para-linguistic Technologies. Human Auditory System. Digital Coding of Speech.

UNIT - V

Phonetics Synthesis by Rule: Introduction Automatic Speech Recognition, Discriminative training for speech recognition, Speech recognition applications, Speech synthesis, voice conversion, Speaker recognition

TEXT BOOKS:

1. Digital Speech Processing: Synthesis, and Recognition by Sadaoki Furui, CRC Press.
2. Speech Synthesis and Recognition by Wendy Holmes, CRC Press.
3. Audio Signal Processing and Coding by Andreas Spanias, Ted Painter and Venkatraman Atti, Willey.

BIG DATA ANALYTICS (Professional Elective - III)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. The purpose of this course is to provide the students with the knowledge of Big data Analytics principles and techniques.
2. This course is also designed to give an exposure of the frontiers of Big data Analytics

Courses Outcomes

1. Ability to explain the foundations, definitions, and challenges of Big Data and various Analytical tools.
2. Ability to program using HADOOP and Map reduce, NOSQL
3. Ability to understand the importance of Big Data in Social Media and Mining.

UNIT - I

Getting an Overview of Big Data: What is Big Data? History of Data Management – Evolution of Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics, Careers in Big Data, Future of Big Data

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

UNIT - II

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: The MapReduce Framework, Techniques to Optimize MapReduce Jobs, Uses of MapReduce, Role of HBase in Big Data Processing

UNIT - III

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics, Points to Consider during Analysis, Developing an Analytic Team, Understanding Text Analytics

Analytical Approaches and Tools to Analyze Data: Analytical Approaches, History of Analytical Tools. Introduction to Popular Analytical Tools, Comparing Various Analytical Tools, Installing R

UNIT - IV

Data Visualization-I: Introducing Data Visualization, Techniques Used for Visual Data Representation, Types of Data Visualization, Applications of Data Visualization, Visualizing Big Data, Tools Used in Data Visualization, Tableau Products

Data Visualization with Tableau (Data Visualization-II): Introduction to Tableau Software, Tableau Desktop Workspace, Data Analytics in Tableau Public, Using Visual Controls in Tableau Public

UNIT - V

Social Media Analytics and Text Mining: Introducing Social Media, Introducing Key Elements of Social Media, Introducing Text Mining, Understanding Text Mining Process, Sentiment Analysis, Performing Social Media Analytics and Opinion
Mining on Tweets

Mobile Analytics: Introducing Mobile Analytics, Introducing Mobile Analytics Tools, Performing Mobile Analytics, Challenges of Mobile Analytics

TEXT BOOKS:

1. Big data, blackbook, dreamtech press,2015
2. Big Data Analytics, SeemaAcharya, Subhashini Chellappan, Wiley 2015.
3. Simon Walkowiak, Big Data Analytics with R, Packt Publishing, ISBN: 9781786466457

REFERENCES:

1. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Michael Minelli, Michehe Chambers, 1st Edition, Ambiga Dhiraj, Wiley CIO Series, 2013.
2. Hadoop: The Definitive Guide, Tom White, 3rd Edition, O"Reilly Media, 2012.
3. Big Data Analytics: Disruptive Technologies for Changing the Game, Arvind Sathi, 1st Edition, IBM Corporation, 2012.

FUNCTIONAL PROGRAMMING (Professional Elective - III)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. Understand the concepts and terms used to describe languages that support the imperative, functional, object-oriented, and logic programming paradigms.
2. Solve problems using the functional paradigm.
3. Solve problems using the object-oriented paradigm.
4. Solve problems using the logic programming paradigm.

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

1. Write programs in a functional style.
2. Reason formally about functional programs.
3. Use polymorphism and higher-order functions.
4. Reason about the time and space complexity of programs.

UNIT - I

Functional Programming: Introduction, Differences between Functional Programming and Object-Oriented Programming, concepts of functional programming, Functional Programming in Python: Introduction to Python, Built-in Functions, Dictionary Methods, String Methods, LIST/ARRAY Methods, Tuple Methods, Set Methods

UNIT - II

Python Exceptions, File Handling, Tuple Methods, Defining Iteration, Conditional Iterations, Random Module, Math Module, CMath Module, Python File I/O

UNIT - III

Python Sending Mail, Python CSV, Python OOP Concepts, Python Iterators, Python Generators, Python Decorators, Python Database Connections

UNIT - IV

Introduction to Haskell and Laziness, Structure, Modularity, Maintainability, Polymorphism, higher order functions, strings & characters, lazy evaluation, Data Types using Patterns

UNIT - V

LISP Programming: Basic LISP Programming, Data Types, Functions, Editing, Loading, Compiling LISP Programs, Control Structures: Recursions and Conditionals, LISTS, SETS, Structural Recursion with LISTS, Symbols

TEXT BOOKS:

1. The Haskell School of Expression: Learning Functional Programming through Multimedia, Paul Hudak.
2. Functional Programming in Python, David Mertz, O'Reilly Media.
3. LISP, Patrick Henry Winston, Bertbold Klaus Paul Horn, Pearson Education

ENTERPRISE CLOUD CONCEPTS (Professional Elective - III)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes:

1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

UNIT - I

Understanding Cloud Computing: Origins and influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

UNIT - II

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology.

Cloud Computing Mechanisms:

Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication.

UNIT - III

Cloud Management Mechanisms: Remote Administration System, Resource Management System, SLA Management System, Billing Management System, Case Study Example

Cloud Computing Architecture

Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture, Case Study Example

UNIT - IV

Cloud-Enabled Smart Enterprises: Introduction, Revisiting the Enterprise Journey, Service-Oriented Enterprises, Cloud Enterprises, Smart Enterprises, The Enabling Mechanisms of Smart Enterprises

Cloud-Inspired Enterprise Transformations: Introduction, The Cloud Scheme for Enterprise Success, Elucidating the Evolving Cloud Idea, Implications of the Cloud on Enterprise Strategy, Establishing a Cloud-Incorporated Business Strategy

UNIT - V

Transitioning to Cloud-Centric Enterprises: The Tuning Methodology, Contract Management in the Cloud

Cloud-Instigated IT Transformations

Introduction, Explaining Cloud Infrastructures, A Briefing on Next-Generation Services, Service Infrastructures, Cloud Infrastructures, Cloud Infrastructure Solutions, Clouds for Business Continuity, The Relevance of Private Clouds, The Emergence of Enterprise Clouds

TEXT BOOKS:

1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham, Cloud Computing: Concepts, Technology & Architecture 1st Edition,
2. Pethuru Raj, Cloud Enterprise Architecture, CRC Press

REFERENCES:

1. James Bond,The Enterprise Cloud, O'Reilly Media, Inc.

REINFORCEMENT LEARNING (Professional Elective - IV)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on fundamentals of reinforcement learning and the methods used to create agents that can solve a variety of complex tasks.

Course Outcomes

1. Understand basics of RL
2. Understand RL Framework and Markov Decision Process
3. Analyzing ning through the use of Dynamic Programming and Monte Carlo
4. Understand TD(0) algorithm, TD(λ) algorithm

UNIT - I

Basics of probability and linear algebra, Definition of a stochastic multi-armed bandit, Definition of regret, Achieving sublinear regret, UCB algorithm, KL-UCB, Thompson Sampling.

UNIT - II

Markov Decision Problem, policy, and value function, Reward models (infinite discounted, total, finite horizon, and average), Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration

UNIT - III

The Reinforcement Learning problem, prediction and control problems, Model-based algorithm, Monte Carlo methods for prediction, and Online implementation of Monte Carlo policy evaluation

UNIT - IV

Bootstrapping; TD(0) algorithm; Convergence of Monte Carlo and batch TD(0) algorithms; Model-free control: Q-learning, Sarsa, Expected Sarsa.

UNIT - V

n-step returns; TD(λ) algorithm; Need for generalization in practice; Linear function approximation and geometric view; Linear TD(λ). Tile coding; Control with function approximation; Policy search; Policy gradient methods; Experience replay; Fitted Q Iteration; Case studies.

TEXT BOOKS:

1. “Reinforcement learning: An introduction,” First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020
2. “Statistical reinforcement learning: modern machine learning approaches,” First Edition, Sugiyama, Masashi. CRC Press 2015

REFERENCES:

1. “Bandit algorithms,” First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020
2. “Reinforcement Learning Algorithms: Analysis and Applications,” Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021
3. Alexander Zai and Brandon Brown “Deep Reinforcement Learning in Action,” First Edition, Manning Publications 2020

MACHINE TRANSLATION (Professional Elective - IV)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To teach students machine translation approaches.
2. To evaluate the performance of machine translation Systems.
3. To develop translation models for Indian Languages.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand machine translation approaches.
2. Apply and assess manual and automatic evaluation methods for machine translation.
3. Build machine translation model using existing tools for machine translation.

UNIT - I

Introduction to Machine Translation, MT Approaches: vauquois Triangle, Three major paradigms of Machine Translation, MT Evaluation

UNIT - II

Learning Bilingual word Mappings:

A Combinatorial Argument, Deeper look at one- one alignment, Heuristic based Computation of the V_E *V_F Table, Iterative Computation of the V_E *V_F Table, EM: Study of progress in Parameter values

UNIT - III

Phrase based Machine Translation:

Need for phrase alignment, An example to illustrate phrase alignment technique, Phrase table, Mathematics of Phrase based SMT, Decoding, Moses.

UNIT - IV

Rule based Machine Translation (RBMT):

Two kinds of RBMT: Interlingua and Transfer, Universal networking Language (UNL), UNL expressions as binary predicates, Interlingua and Word Knowledge, Translation using Interlingua, Details of english to UNL Conversion: with illustration, Transfer based MT.

UNIT - V

Example based Machine Translation:

Essential steps of EBMT, EBMTs working, EBMT and case based reasoning, Text similarity computation, EBMT and Translation Memory, EBMT and SMT.

TEXT BOOK:

1. Pushpak Bhattacharyya, Machine Translation, CRC Press

REFERENCES:

1. Statistical Machine Translation by Philipp Koehn, Cambridge University Press.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
3. Linguistic Fundamentals for Natural Language Processing by Emily Bender, Morgan & Claypool.

CYBER SECURITY (Professional Elective - IV)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course objectives:

1. To understand various types of cyber-attacks and cyber-crimes
2. To learn threats and risks within context of the cyber security
3. To have an overview of the cyber laws & concepts of cyber forensics
4. To study the defensive techniques against these attacks

Course Outcomes:

1. Analyze and evaluate the cyber security needs of an organization.
2. Understand Cyber Security Regulations and Roles of International Law
3. Design and develop a security architecture for an organization.
4. Understand fundamental concepts of data privacy attacks

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc

Cybercrime: Examples and Mini-Cases

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. **Mini-Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

DEEP LEARNING LAB (Lab - III)

M.Tech AI I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. To Build The Foundation Of Deep Learning.
2. To Understand How To Build The Neural Network.
3. To enable students to develop successful machine learning concepts.

Course Outcomes:

1. Upon the Successful Completion of the Course, the Students would be able to:
2. Learn The Fundamental Principles Of Deep Learning.
3. Identify The Deep Learning Algorithms For Various Types of Learning Tasks in various domains.
4. Implement Deep Learning Algorithms And Solve Real-world problems.

LIST OF EXPERIMENTS:

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Applying the Convolution Neural Network on computer vision problems
4. Image classification on MNIST dataset (CNN model with Fully connected layer)
5. Applying the Deep Learning Models in the field of Natural Language Processing
6. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes
7. Applying the Autoencoder algorithms for encoding the real-world data
8. Applying Generative Adversial Networks for image generation and unsupervised tasks.

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C, M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.H., and Van Loan C.F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Extensive Reading:

- http://www.deeplearning.net
- https://www.deeplearningbook.org/
- https://developers.google.com/machine-learning/crash-course/ml-intro
- www.cs.toronto.edu/~fritz/absps/imagenet.pdf
- http://neuralnetworksanddeeplearning.com/

BIG DATA ANALYTICS LAB (Professional Elective - III Lab)

M.Tech AI I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. The purpose of this course is to provide the students with the knowledge of Big data Analytics principles and techniques.
2. This course is also designed to give an exposure of the frontiers of Big data Analytics

Course Outcomes:

1. Use Excel as a Analytical tool and visualization tool.
2. Ability to program using HADOOP and Map reduce
3. Ability to perform data analytics using ML in R.
4. Use cassandra to perform social media analytics

List of Experiments:

1. Implement a simple map-reduce job that builds an inverted index on the set of input documents (Hadoop)
2. Process big data in HBase
3. Store and retrieve data in Pig
4. Perform Social media analysis using cassandra
5. Buyer event analytics using Cassandra on suitable product sales data.
6. Using Power Pivot (Excel) Perform the following on any dataset
   a) Big Data Analytics
   b) Big Data Charting
7. Use R-Project to carry out statistical analysis of big data
8. Use R-Project for data visualization of social media data

TEXT BOOKS:

1. Big Data Analytics, SeemaAcharya, Subhashini Chellappan, Wiley 2015.
2. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Michael Minelli, Michehe Chambers, 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Hadoop: The Definitive Guide, Tom White, 3rd Edition, O"Reilly Media, 2012.
4. Big Data Analytics: Disruptive Technologies for Changing the Game, Arvind Sathi, 1st Edition, IBM Corporation, 2012.

REFERENCES:

1. Big Data and Business Analytics, Jay Liebowitz, Auerbach Publications, CRC press (2013)
2. Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop, Tom Plunkett, Mark Hornick, McGraw-Hill/Osborne Media (2013), Oracle press.
3. Professional Hadoop Solutions, Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Wiley, ISBN: 9788126551071, 2015.
4. Understanding Big data, Chris Eaton, Dirk deroos et al., McGraw Hill, 2012.
5. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007.
6. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, 1st Edition, Wiley and SAS Business Series, 2012.

FUNCTIONAL PROGRAMMING LAB (Professional Elective - III Lab)

M.Tech AI I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. To be able to introduce core programming basics and program design with functions using functional programming languages.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.

Course Outcomes:

1. Students should be able to understand the basic concepts of scripting and the contributions of Functional Programming Languages.
2. Ability to explore python especially the object-oriented concepts, and the built in objects of Python.

List of Programs:

1. Write a program to demonstrate different number data types in Python.
2. Write a program to perform different Arithmetic Operations on numbers in Python.
3. Write a program to create, concatenate and print a string and accessing sub-string from a given string.
4. Write a python script to print the current date in the following format “Sun May 29 02:26:23 IST 2017”
5. Write a program to create, append, and remove lists in python.
6. Write a program to demonstrate working with tuples in python.
7. Write a program to demonstrate working with dictionaries in python.
8. Write a python program to find largest of three numbers.
9. Write a Python program to convert temperatures to and from Celsius, Fahrenheit. [Formula : c/5 = f-32/9]
10. Write a recursive function, (defun nth (pos list) ???), that returns the n'th item from a list. Assume the list has at least n items. (nth 1 aList) is to return the first item in aList.
11. Write simple lisp functions such as the following. Take into account lists which are too short.
    - (remove-first '(a b c ...)) -> (b c ...) --- remove the first item from the list.
    - (remove-second '(a b c ...)) -> (a c ...) -- remove the second item from the list.
    - (insert-as-second 'b '(a c ...)) -> (a b c ...) --- insert as the second element.
12. Write a Lisp macro mycase that translates the following macro call. Assume the input will be error free. The input lists can be any length. You must document your solution.
    (mycase (C1 C2 ... Cn) (P1 P2 ... Pn))
    translates to the following
    (mycond (C1 P1) (C2 P2) ... (Cn Pn))
13. Write a Lisp macro mycase that translates the following macro call as shown. Assume the input will be error free. The input lists can be any length. Use standard Lisp functionals. If you need support functions, your answer should have only non-recursive support functions.
    (mycase (C1 C2 ... Cn) (P1 P2 ... Pn))
    translates to the following
    (mycond (C1 (P1 P2 ... Pn)) (C2 (P2 ... Pn)) ... (Cn (Pn)))
14. Assume the following forms have been typed into the Lisp interpreter and evaluated.

    ```
    ( defun a ( x ) ( values (list x) x ) )
    ( setq a '( a b ) )
    ( defun b ( x ) `( x ,x ) )
    (setq b ( cdr a ) )
    ```

(setq c (car a))
(setq d c)
(setq e ((lambda (x) (list x)) d))

15. What will the following forms evaluate to?
    (cons c (car a))
    (cons e b)
    (eval a)
    (let ((a b) (y a)) (append a y))
    (multiple-value-list (a a))
    (b c)
    (set (car a) (cdr a))
    (setf (car a) (cdr a))

TEXT BOOKS:

1. The Haskell School of Expression: Learning Functional Programming through Multimedia, Paul Hudak.
2. Functional Programming in Python, David Mertz, O'Reilly Media.

ENTERPRISE CLOUD CONCEPTS LAB (Professional Elective - III Lab)

M.Tech AI I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives: Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes:

1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

List of Experiments:

1. Install Virtualbox/VMware Workstation with different flavors of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java..
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
6. Install Hadoop single node cluster and run simple applications like word count.

E-Resources:

1. https://www.iitk.ac.in/nt/faq/vbox.htm
2. https://www.google.com/urlsa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjqrNG0za73AhXZt1YBHZ21DWEQFnoECAMQAQ&url=http%3A%2F%2Fwww.cs.columbia.edu%2F~sedwards%2Fclasses%2F2015%2F1102-fall%2Flinuxvm.pdf&usg=AOvVaw3xZPuF5xVgk-AQnBRsTtHz
3. https://www.cloudsimtutorials.online/cloudsim/
4. https://edwardsamuel.wordpress.com/2014/10/25/tutorial-creating-openstack-instance-in-trystack/
5. https://www.edureka.co/blog/install-hadoop-single-node-hadoop-cluster

BLOCKCHAIN TECHNOLOGY (Professional Elective - V)

M.Tech AI II Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisites:

1. Knowledge in information security and applied cryptography.
2. Knowledge in distributed databases.

Course Objectives:

1. To learn the fundamentals of BlockChain and various types of block chain and consensus mechanism.
2. To understand public block chain system, Private block chain system and consortium blockchain.
3. Able to know the security issues of blockchain technology.

Course Outcomes: Able to work in the field of block chain technologies.

UNIT-I

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain,The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. **Cryptocurrency – Bitcoin, Altcoin and Token:** Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT-II

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT-III

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Why We Need Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Why We Need Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT-IV

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT-V

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities. Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

TEXT BOOKS:

1. "Block chain Technology", Chandramouli Subramanian, Asha A.George, Abhilash K A and Meena Karthikeyan, Universities Press.

REFERENCES:

1. Blockchain Blueprint for Economy, Melanie Swan, SPD O'reilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson Addition Wesley.

NATURE INSPIRED COMPUTING (Professional Elective - IV)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on significance of intelligence, genetic algorithms Ant Colony algorithms

Course Outcomes:

1. Familiar with Genetic algorithm and its applications.
2. Compare different Ant Colony Optimization algorithmic models.
3. Compare different Artificial Bee Colony Optimization algorithmic models.
4. Illustrate Particle swam optimization algorithm with an example.

UNIT - I:

Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organization, swarm and evolutionary algorithms. Optimisation problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

UNIT - II:

Genetic algorithms - Mathematical foundation, Genetic problem solving, crossover and mutation. genetic algorithms and Markov process, applications of genetic algorithms

UNIT - III:

Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimisation, variations of ACO, case studies.

UNIT - IV:

Particle Swarm algorithms - particles moves, particle swarm optimisation, variable length PSO, applications of PSO, case studies. Artificial Bee Colony algorithms - ABC basics, ABC in optimisation, multi-dimensional bee colony algorithms, applications of bee algorithms, case studies.

UNIT - V:

Selected nature inspired techniques - Hill climbing, simulated annealing, Gaussian adaptation, Cuckoo search, Firey algorithm, SDA algorithm, bat algorithm, case studies. Other nature inspired techniques - Social spider algorithm, Cultural algorithms, Harmony search algorithm, Intelligent water drops algorithm, Artificial immune system, Flower pollination algorithm, case studies.

TEXT BOOKS:

1. Albert Y.Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
2. Floreano, D. and C. Mattiussi -"Bio-Inspired Artificial Intelligence: Theories, methods, and Technologies" IT Press, 2008

REFERENCES:

1. Leandro Nunes de Castro - " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi, 2005
3. Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hall of India, New Delhi, 2020

CONVERSATIONAL AI (Professional Elective - V)

M.Tech AI II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To be familiar with the basic knowledge about conversational systems.
2. To understand the different techniques of natural language processing

UNIT - I

Introducing Dialogue Systems: What's a Dialogue System? A Brief History Of Dialogue Systems, Present-Day Dialogue Systems, Modeling Conversation Dialogue Systems, Designing and Developing Dialogue Systems

UNIT - II

Rule-Based Dialogue Systems: Architecture, Methods, and Tools: A Typical Dialogue Systems Architecture, Designing a Dialogue System, Tools for Developing Dialogue Systems, Rule-Based Techniques in Dialogue Systems Participating in the Alexa Prize

UNIT - III

Statistical Data-Driven Dialogue Systems: Motivating the Statistical Data-Driven Approach, Dialogue Components in the Statistical Data-Driven Approach, Reinforcement Learning (RL), Representing Dialogue as a Markov Decision Process, From MDPs to POMDPs, Dialogue State Tracking, Dialogue Policy, Problems and Issues with Reinforcement Learning in POMDPs

UNIT - IV

Evaluating Dialogue Systems: How to Conduct the Evaluation, Evaluating Task-Oriented Dialogue Systems, Evaluating Open-Domain Dialogue Systems, Evaluation Frameworks- PARADISE, Quality of Experience (QoE), Interaction Quality, Best Way to Evaluate Dialogue Systems.

UNIT - V

End-to-End Neural Dialogue Systems: Neural Network Approaches to Dialogue Modeling, A Neural Conversational Model, Introduction to the Technology of Neural Dialogue, Retrieval-Based Response Generation, Task-Oriented Neural Dialogue Systems, Open-Domain Neural Dialogue Systems, Some Issues and Current Solutions, Dialogue Systems: Datasets, Competitions, Tasks, and Challenges.

TEXT BOOKS:

1. Michael McTear, “Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots”, Second Edition, Moran and Claypool Publishers, 2020.

REFERENCE:

1. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”, O’REILLY, 2016.

IPR (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To explain the art of interpretation and documentation of research work
2. To explain various forms of intellectual property rights
3. To discuss leading International regulations regarding Intellectual Property Rights

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand types of Intellectual Property
2. Analyze trademarks and its functionality
3. Illustrate law of copy rights and law of patents

UNIT- I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT - II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT - III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT - IV

Trade Secrets: Trade secret law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT - V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

FAULT TOLERANCE SYSTEMS (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To know the different advantages and limits of fault avoidance and fault tolerance techniques.
2. To impart the knowledge about different types of redundancy and its application for the design of computer system being able to function correctly even under presence of faults and data errors.
3. To understand the relevant factors in evaluating alternative system designs for a specific set of requirements.
4. To understand the subtle failure modes of "fault-tolerant" distributed systems.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Become familiar with general and state of the art techniques used in design and analysis of fault tolerant digital systems.
2. Be familiar with making system fault tolerant, modeling and testing, and benchmarking to evaluate and compare systems.

UNIT - I

Introduction to Fault Tolerant Computing: Basic concepts and overview of the course; Faults and their manifestations, Fault/error modeling, Reliability, availability and maintainability analysis, System evaluation, performance reliability tradeoffs.

UNIT - II

System level fault diagnosis: Hardware and software redundancy techniques. Fault tolerant system design methods, Mobile computing and Mobile communication environment, Fault injection methods.

UNIT - III

Software fault tolerance: Design and test of defect free integrated circuits, fault modeling, built in self-test, data compression, error correcting codes, simulation software/hardware, fault tolerant system design, CAD tools for design for testability.

UNIT - IV

Information Redundancy and Error Correcting Codes: Software Problem. Software Reliability Models and Robust Coding Techniques, Reliability in Computer Networks Time redundancy. Re execution in SMT, CMP Architectures, Fault Tolerant Distributed Systems, Data replication.

UNIT - V

Case Studies in FTC: ROC, HP Non-Stop Server. Case studies of fault tolerant systems and current research issues.

TEXT BOOK:

1. Fault Tolerant Computer System Design by D. K. Pradhan, Prentice Hall.

REFERENCES:

1. Fault Tolerant Systems by I. Koren, Morgan Kauffman.
2. Software Fault Tolerance Techniques and Implementation by L. L. Pullum, Artech House Computer Security Series.
3. Reliability of Computer Systems and Networks: Fault Tolerance Analysis and Design by M. L. Shooman, Wiley.

INTRUSION DETECTION SYSTEMS (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Computer Networks, Computer Programming

Course Objectives:

1. Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to determine the best tool or approach to reduce risk from intrusion.
2. Identify and describe the parts of all intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share.

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

1. Possess a fundamental knowledge of Cyber Security.
2. Understand what vulnerability is and how to address most common vulnerabilities.
3. Know basic and fundamental risk management principles as it relates to Cyber Security and Mobile Computing.
4. Have the knowledge needed to practice safer computing and safeguard your information using Digital Forensics.
5. Understand basic technical controls in use today, such as firewalls and Intrusion Detection systems.
6. Understand legal perspectives of Cyber Crimes and Cyber Security.

UNIT - I

The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's -Overview of Intrusion Detection and Intrusion Prevention, Network and Host-based IDS

UNIT - II

Classes of attacks - Network layer: scans, denial of service, penetration Application layer: software exploits, code injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/sop Hesitated groups-Automated: Drones, Worms, Viruses

UNIT - III

A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS

UNIT - IV

Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)-Host-based Anomaly Detectors-Software Vulnerabilities-State transition, Immunology, Payload Anomaly Detection

UNIT - V

Attack trees and Correlation of alerts- Autopsy of Worms and Botnets-Malware detection -Obfuscation, polymorphism- Document vectors.

Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero-day detection-Insider Threat issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception-Future: Collaborative Security

TEXT BOOKS:

1. Peter Szor, The Art of Computer Virus Research and Defense, Symantec Press ISBN 0-321-

30545-3.
2. Markus Jakobsson and Zulfikar Ramzan, Crimeware, Understanding New Attacks and Defenses.

REFERENCE BOOKS:

1. Saiful Hasan, Intrusion Detection System, Kindle Edition.
2. Ankit Fadia, Intrusion Alert: An Ethical Hacking Guide to Intrusion Detection.

Online Websites/Materials:

1. https://www.intechopen.com/books/intrusion-detection-systems/

Online Courses:

1. https://www.sans.org/course/intrusion-detection-in-depth
2. https://www.cybrary.it/skill-certification-course/ids-ips-certification-training-course

DIGITAL FORENSICS (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Cybercrime and Information Warfare, Computer Networks

Course Objectives:

1. provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
4. E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

Course Outcomes: On completion of the course the student should be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

UNIT - I

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber criminalistics area, holistic approach to cyber-forensics

UNIT - II

Cyber Crime Scene Analysis:
Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT - III

Evidence Management & Presentation:
Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT - IV

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT - V

Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

TEXT BOOKS:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

REFERENCES:

1. William Oettinger, Learn Computer Forensics: A beginner's guide to searching, analyzing, and securing digital evidence, Packt Publishing; 1st edition (30 April 2020), ISBN: 1838648178.
2. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge.

OPTIMIZATION TECHNIQUES (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisite: Mathematics –I, Mathematics –II

Course Objectives:

1. To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2. Constrained and unconstrained optimization techniques for solving and optimizing electrical and electronic engineering circuits design problems in real world situations.
3. To explain the concept of Dynamic programming and its applications to project implementation.

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

1. explain the need of optimization of engineering systems.
2. understand optimization of electrical and electronics engineering problems.
3. apply classical optimization techniques, linear programming, simplex algorithm, transportation problem.
4. apply unconstrained optimization and constrained non-linear programming and dynamic programming.
5. Formulate optimization problems.

UNIT - I

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surface - classification of Optimization problems.

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT - II

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT - III

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints: Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints: Kuhn – Tucker conditions.

Single Variable Nonlinear Unconstrained Optimization: Elimination methods: Uni Model function-its importance, Fibonacci method & Golden section method.

UNIT - IV

Multi variable nonlinear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hooke - Jeeves, Rosenbrock's search methods. Gradient methods: Gradient of function & its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT - V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. Optimization Techniques & Applications by S.S.Rao, New Age International.
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

REFERENCES:

1. George Bernard Dantzig, Mukund Narain Thapa, “Linear programming”, Springer series in Operations Research 3rd edition, 2003.
2. H. A. Taha, “Operations Research: An Introduction”, 8th Edition, Pearson/Prentice Hall, 2007.
3. Optimization Techniques by Belegundu & Chandrupatla, Pearson Asia.
4. Optimization Techniques Theory and Practice by M.C. Joshi, K.M. Moudgalya, Narosa Publications

CYBER PHYSICAL SYSTEMS (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: To learn about design of cyber-physical systems

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand the core principles behind CPS
2. Identify Security mechanisms of Cyber physical systems
3. Understand Synchronization in Distributed Cyber-Physical Systems

UNIT - I

Symbolic Synthesis for Cyber-Physical Systems

Introduction and Motivation, Basic Techniques - Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques: Construction of Symbolic Models, Continuous-Time Controllers, Software Tools

UNIT - II

Security of Cyber-Physical Systems

Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches

UNIT - III

Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time-Triggered Architecture, Related Technology, Advanced Techniques

UNIT - IV

Real-Time Scheduling for Cyber-Physical Systems

Introduction and Motivation, Basic Techniques - Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/Multicore Scheduling, Accommodating Variability and Uncertainty

UNIT - V

Model Integration in Cyber-Physical Systems

Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Advanced Techniques, ForSpec, The Syntax of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

TEXT BOOKS:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015

GRAPH ANALYTICS (Open Elective)

M.Tech AI I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To explore the concept of Graphs and related algorithms.
2. To learn new ways to model, store, retrieve and analyze graph-structured data.
3. To be aware of advanced concepts in graph analytic techniques and its applications.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand Large-scale Graph and its Characteristics
2. Analyze Breadth-First Search Algorithm
3. Illustrate Recent Advances in Scalable Network Generation

UNIT - I

Introduction and Application of Large-scale Graph: Characteristics, Complex Data Sources - Social Networks, Simulations, Bioinformatics; Categories- Social, Endorsement, Location, Co-occurrence graphs; Graph Data structures, Parallel, Multicore and Graph Algorithms

UNIT - II Algorithms: Search and Paths

A Work-Efficient Parallel Breadth-First Search Algorithm (or How To Cope With the Nondeterminism of Reducers), Multi-Objective Shortest Paths

UNIT - III Algorithms: Structure

Multicore Algorithms for Graph Connectivity Problems, Distributed Memory Parallel Algorithms for Massive Graphs, Massive-Scale Distributed Triangle Computation and Applications

UNIT - IV Models

Recent Advances in Scalable Network Generation, Computational Models for Cascades in Massive Graphs, Executing Dynamic Data-Graph Computations Deterministically Using Chromatic Scheduling.

UNIT - V Frameworks and Software

Graph Data Science Using Neo4j, A Cloud-Based Approach to Big Graphs, Interactive Graph Analytics at Scale in Arkouda

TEXT BOOKS:

1. David A. Bader, Massive Graph Analytics, CRC Press

REFERENCES:

1. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications", (Structural Analysis in the Social Sciences), Cambridge University Press, 1995.
2. Matthew O. Jackson, “Social and Economic Networks”, Princeton University Press, 2010.
3. Tanja Falkowski, "Community Analysis in Dynamic Social Networks", (Dissertation), University Magdeburg, 2009.