



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**COURSE STRUCTURE & SYLLABUS M.Tech CSE for  
CYBER SECURITY PROGRAMME**

*(Applicable for batches admitted from 2019-2020)*



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**



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<b>M. Tech. (NN) I SEMESTER</b>							
S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN1101	<b>Program Core-1</b> Artificial Neural Networks	PC	3	0	0	3
2	MTNN1102	<b>Program Core-2</b> Advanced Data Structures	PC	3	0	0	3
3	MTNN1103	<b>Program Elective-1</b> 1. Machine Learning 2. Intelligent Systems 3. Expert Systems	PE	3	0	0	3
4	MTNN1104	<b>Program Elective-2</b> 1. Data Warehouse and Data Mining 2. Recommender Systems 3. Pattern Recognition	PE	3	0	0	3
5	MTNN1105	<b>Research Methodology and IPR</b>	CC			0	2
6	MTNN1106	<b>Laboratory-1</b> Advanced Data Structures Lab	LB	0	0	4	2
7	MTNN1107	<b>Laboratory-2</b> Neural Networks Lab	LB	0	0	4	2
8	MTNN1108	<b>Audit Course-1*</b>	AC	2	0	0	0
<b>Total Credits</b>							18

<b>M. Tech. (NN) II SEMESTER</b>							
S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN1201	<b>Program Core-3</b> Soft Computing	PC	3	0	0	3
2	MTNN1202	<b>Program Core-4</b> Deep Learning	PC	3	0	0	3
3	MTNN1203	<b>Program Elective-3</b> 1. Computer Vision 2. Big Data Analytics 3. Remote Sensing	PE	3	0	0	3
4	MTNN1204	<b>Program Elective-4</b> 1. Cognitive Systems 2. Knowledge Discovery 3. Natural Language Processing	PE	3	0	0	3
5	MTNN1205	<b>Laboratory-3</b> Soft Computing Lab	LB	0	0	4	2
6	MTNN1206	<b>Laboratory-4</b> Deep Learning lab	LB	0	0	4	2
7	MTNN1207	<b>Mini Project with Seminar</b>	MP	2	0	0	2
8	MTNN1208	<b>Audit Course-2 *</b>	AC	2	0	0	0
<b>Total Credits</b>							18



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*\*Student has to choose any one audit course listed below.*

**Audit Course 1 & 2:**

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

<b>M. Tech. (NN) III SEMESTER</b>							
S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN2101	<b>Program Elective-5</b> 1. Reinforcement Learning 2. Bio-Informatics 3. Speech Processing 4. MOOCS-I(NPTEL/SWAYAM-Any 12 Weeks Program)	PE	3	0	0	3
2	MTNN2102	<b>Open Elective</b> 1. MOOCS-II(NPTEL/SWAYAM-Any 12WeeksProgram-Interdisciplinary Course but not from the Parent Department) 2. Courses offered by other departments in the college	OE	3	0	0	3
3	MTNN2103	<b>Dissertation-I/Industrial Project #</b>	PJ	0	0	20	10
<b>Total Credits</b>							16

*#Students going for Industrial Project/Thesis will complete these courses through MOOCs*

Open Electives offered to Other Departments

1. Python Programming
2. Artificial Intelligence
3. Machine Learning
4. Deep Learning

<b>M. Tech. (NN) IV SEMESTER</b>							
S.No	Course Code	Courses	Category	L	T	P	C
1	MTNN2201	<b>Dissertation-II</b>	PJ	0	0	32	16
<b>Total Credits</b>							16



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Artificial Neural Networks</b>				

**Course Objective:**

- The main objective of this course is to provide the student with the basic understanding of neural networks fundamentals,
- Program the related algorithms and Design the required and related systems

**Course Outcomes:**

- Demonstrate ANN structure and activation Functions
- Define foundations and learning mechanisms and state-space concepts
- Identify structure and learning of perceptions
- Explain Feed forward, multi-layer feed forward networks and Back propagation algorithms
- Analyze Radial Basis Function Networks, Theor Regularization and RBF networks

**UNIT-I:** Introduction and ANN Structure, Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

**UNIT-II:** Mathematical Foundations and Learning mechanisms.Re-visiting vector and matrix algebra, State-space concepts, Concepts of optimization, Error-correction learning. Memory-based learning, Hebbian learning. Competitive learning.

**UNIT-III:** Single layer perceptrons, Structure and learning of perceptrons, Pattern classifier, introduction and Bayes' classifiers, Perceptron as a pattern classifier, Perceptron convergence. Limitations of a perceptrons.

**UNIT-IV:** Feed forward ANN, Structures of Multi-layer feed forward networks. Back propagation algorithm, Back propagation - training and convergence, Functional approximation with back propagation. Practical and design issues of back propagation learning.

**UNIT-V:** Radial Basis Function Networks, Pattern separability and interpolation, Regularization Theor Regularization and RBF networks.RBF network design and training. Approximation properties of RBF.

**Text Books:**

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

**Reference Books:**

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Advanced Data Structures</b>				

**Course Objectives:**

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Student should be able to come up with analysis of efficiency and proofs of correctness.

**Course Outcomes:**

- After completion of course, students would be able to:
- Understand the implementation of symbol table using hashing techniques.
- Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
- Develop algorithms for text processing applications.
- Identify suitable data structures and develop algorithms for computational geometry problems.

**UNIT-I: Dictionaries:** Definition, Dictionary Abstract Data Type, and Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

**UNIT-II: Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.

**UNIT-III: Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.

**UNIT-IV: Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

**UNIT-V: Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees. Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

**Text Books:**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Machine Learning</b>				

**Course Objectives:**

- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).
- Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).
- Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

**Course Outcomes:**

After the completion of the course, student will be able to

- Explain the definition and usage of the term 'the internet of things' in different contexts.
- Demonstrate on various network protocols used in IoT.
- Analyze on various key wireless technologies used in IoT systems, such as WiFi, 6LoWPAN, Bluetooth and ZigBee.
- Illustrate on the role of big data, cloud computing and data analytics in IoT system.
- Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software.

**UNIT-I: Introduction-**Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

**UNIT-II: Supervised Learning-** Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metrics for assessing classification.

**UNIT-III: Statistical Learning-** Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning a probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

**UNIT-IV: Support Vector Machines (SVM)-** Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines. **Learning with Neural Networks:** Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

**UNIT-V: Decision Tree Learning:** Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.



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**Textbooks:**

1. Applied Machine Learning, M.Gopal, Mc Graw Hill Education
2. Machine Learning, Tom Mitchell, c Graw Hill

**References**

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, O'Reilly
2. Machine Learning, The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge press



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<b>Intelligent Systems</b>				

**Course Objectives:**

- Understand the fine structure or deeper origin of knowledge
- Generate intelligent behavior on the basis of statistical evidence.

**Course Outcomes:**

After completion of course, students would be:

- Demonstrate Data representation and Logical operations.
- Analyze backward reasoning and solving problems by reduction.
- Identify Tools for representation of Lisp programming.
- Explain the architecture of real time expert systems.
- Define Quantitative simulation and Petri Nets.

**UNIT I: Knowledge Representation:**

Data and knowledge: Data representation and data items in traditional databases, Data representation and data items in relational databases. Rules: Logical operations, Syntax and semantics of rules, Data log rule sets, The dependence graph of data log rule sets, Objects, Solving problems by reasoning: The structure of the knowledge base, The reasoning algorithm, Conflict resolution, Explanation of the reasoning.

**Unit II: Rule Based Systems:**

Forward reasoning: The method of forward reasoning, A simple case study of forward reasoning, Backward reasoning: Solving problems by reduction, The method of backward reasoning, A simple case study of backward reasoning, Bidirectional reasoning. Contradiction freeness: The notion of contradiction freeness, Testing contradiction freeness, The search problem of contradiction freeness. Completeness: The notion of completeness, Testing Completeness, The search problem of completeness. Decomposition of knowledge bases: Strict decomposition, Heuristic decomposition

**UNIT III: Tools for Representation and Reasoning:**

The Lisp programming language: The fundamental data types in Lisp, Expressions and their evaluation, some useful Lisp primitives, some simple examples in Lisp, The Prolog programming language: The elements of Prolog programs, The execution of Prolog programs, Built-in predicates, and Some simple examples in Prolog. Expert system shells: Components of an expert system shell, Basic functions and services in an expert system shell

**UNIT IV: Real-Time Expert Systems:**

The architecture of real-time expert systems: The real-time subsystem, The intelligent subsystem Synchronization and communication between real-time and intelligent subsystems: Synchronization and communication primitives, Priority handling and time-out. Data exchange between the real-time and the intelligent subsystems: Loose data exchange, the blackboard architecture. Software engineering of real-time expert systems: The software lifecycle of real time expert systems, Special steps and tool, An Example of A Real-Time expert System.

**UNIT V: Qualitative Reasoning and Petri Nets:**

Sign and interval calculus, Qualitative simulation: Constraint type qualitative differential equations, The solution of QDEs: the qualitative simulation algorithm: Initial data for the simulation, Steps of the simulation algorithm, Simulation results. Qualitative physics, Signed directed graph (SDG) models, The Notion of Petri nets, The firing of transitions, Special cases and extensions, The state-space of Petri nets





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The use of Petri nets for intelligent control, The analysis of Petri nets: Analysis Problems for Petri Nets, Analysis techniques.

**Text Books:**

1. Intelligent Control Systems-An Introduction with Examples by Katalin M. Hangos, Rozália Lakner , Miklós Gerzson, Kluwer Academic Publishers.
2. Intelligent Systems and Control: Principles and Applications Paperback – 12 Nov 2009 by Laxmidhar Behera, Indrani Kar by OXFORD.

**References Books:**

1. Intelligent Systems and Technologies Methods and Applications by Springer publications.
2. Intelligent Systems - Modeling, Optimization and Control, by Yung C. Shin and Chengying Xu, CRC Press, Taylor & Francis Group, 2009.



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<b>Expert Systems</b>				

**Course Objectives:**

- In this course the student will learn the methodology used to transfer the knowledge of a human expert into an intelligent program that can be used to solve problems.

**Course Outcomes:**

After completing this course, the student should be able to:

- Apply the methodology to transfer human knowledge into an expert system
- Apply knowledge representation
- Design a knowledge base and Implement a rule-based expert system
- Evaluate Expert System tools
- Apply CLIPS for the implementation of an expert system

**UNIT-I:** Introduction what is AI? The Foundations of AI, What is an AI Technique?-Tic-Tac-Toe. Problems, Problem Spaces and Search Defining the problem as a state space search, Production systems, Problem characteristics, production system characteristics, Issues in the design of search programs.

**UNIT-II:** Heuristic Search Techniques Generate-and-test, Hill climbing, Simulated Annealing, Best-First search, A\* algorithm, AO\* algorithm, Constraint satisfaction, Means-Ends Analysis.

**UNIT-III:** First-Order Logic Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, Representing Change in the world, deducing hidden properties of the world. Interface in First-Order Logic Inference rules involving Quantifiers, An Example proof, Generalized Modus Ponens, Forward and Backward Chaining, Completeness, Resolution, Completeness of Resolution.

**UNIT-IV:** Slot-and-Filler Structures Semantic Nets, Frames, And Conceptual Dependency. Game Playing Overview, The Mini-max Search Procedure, Adding Alpha-Beta Cutoffs, Additional Refinements, Iterative Deepening.

**UNIT-V:** Natural Language Processing Introduction, Syntactic processing, Semantic analysis. Expert Systems Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.



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**Text Books:**

1. Rich, Elaine and Knight, Kevin, Artificial Intelligence, Tata McGraw-Hill publications, 2nd Edition, 2006
2. Russell, Stuart and Norvig, Peter, Artificial Intelligence A Modern Approach, Pearson Education

**Reference Books:**

1. Eugene Charniak and Drew McDermott, Introduction to Artificial Intelligence, Addison Wesley, Pearson Education, 2005
2. George F Luger, Artificial Intelligence Structures and Strategies for Complex Problem Solving, Pearson Education Ltd., 2nd Edition, 2002.
3. Dan W Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall of India, 2001.



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Data Warehousing and Data Mining</b>				

**Course Objectives:**

- This course will introduce the concepts of data ware house and data mining, which gives a complete description about the principles
- Student able to understand architectures, applications, design and implementation of data mining and data ware housing concepts.

**Course Outcomes:**

- Understand the functionality of the various data mining and data warehousing component
- Appreciate the strengths and limitations of various data mining and data warehousing models
- Explain the analyzing techniques of various data
- Describe different methodologies used in data mining and data ware housing
- Compare different approaches of data ware housing and data mining with various technologies

**UNIT-I: Data Warehousing**-Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

**UNIT-II: Business Analysis**-Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet.

**UNIT-III: Data Mining**-Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

**UNIT-IV: Association Rule Mining And Classification** -Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

**UNIT-V: Clustering And Trends In Data Mining**-Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Hierarchical Methods – Density-Based Methods –Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data Constraint-Based Cluster Analysis – Outlier Analysis – Data Mining Applications.

**Text Books:**

1. Alex Berson and Stephen J.Smith, “Data Warehousing, Data Mining and OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.



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**Reference Books:**

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to DataMining”, PersonEducation,2007.
2. K.P. Soman, Shyam Diwakar and V. Aja, “Insight into Data Mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, 2006.
4. Daniel T.Larose, “Data Mining Methods and Models”, Wiley-Interscience, 2006.



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Recommender Systems</b>				

**Course Objectives:**

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
- To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

**Course Outcomes:**

- Design recommendation system for a particular application domain.
- Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity
- Explain User-based recommendation, knowledge-based recommender system
- Define Opportunities for hybridization, Monolithic hybridization
- Identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization

**UNIT-I: Introduction:** Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

**UNIT-II: Content-based Filtering:** High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

**UNIT-III: Collaborative Filtering:** User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems. **Types of Recommender Systems:** Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems

**UNIT-IV: Hybrid Approaches:** opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations of hybridization strategies

**UNIT-V: Evaluating Recommender System:** Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

**Text Books:**

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.

**Reference Books:**

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pattern Recognition</b>				



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**Course Objectives:**

- To implement pattern recognition and machine learning theories
- To design and implement certain important pattern recognition techniques
- To apply the pattern recognition theories to applications of interest
- To implement the entropy minimization, clustering transformation and feature ordering

**Course Outcomes:**

- Design systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns that are analyzed using, e.g., hidden Markov models (HMM)
- Analyze classification problems probabilistically and estimate classifier performance,
- Understand and analyze methods for automatic training of classification systems,
- Apply Maximum-likelihood parameter estimation in relatively complex probabilistic models, such as mixture density models and hidden Markov models
- Understand the principles of Bayesian parameter estimation and apply them in relatively simple probabilistic models

**UNIT- I: Introduction** - Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Examples of Automatic Pattern recognition systems, Simple pattern recognition model, Decision and Distance Functions - Linear and generalized decision functions, Pattern space and weight space, Geometrical properties, implementations of decision functions, Minimum-distance pattern classifications.

**UNIT-II: Probability**-Probability of events, Random variables, Joint distributions and densities, Movements of random variables, Estimation of parameter from samples, Statistical Decision Making - Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations. Baye's classifier for normal patterns.

**UNIT-III: Non Parametric Decision Making** - Introduction, histogram, kernel and window estimation, nearest neighbor classification techniques. Adaptive decision boundaries, adaptive discriminate functions, Minimum squared error

Discriminate functions, choosing a decision making techniques. Clustering and Partitioning - Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single-linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering-Forg's algorithm, K-means's algorithm, Isodata algorithm.

**UNIT-IV: Pattern Preprocessing and Feature Selection:** Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection.

**UNIT-V: Syntactic Pattern Recognition & Application Of Pattern Recognition:** Introduction, concepts from formal language theory, formulation of syntactic pattern recognition problem, syntactic pattern description, recognition grammars, automata as pattern recognizers, Application of pattern recognition techniques in bio-metric, facial recognition, IRIS scan, Finger prints, etc.,

**Text Books:**

1. Gose. Johnsonbaugh. Jost. "Pattern recognition and Image Analysis",PHI.
- Tou. Rafael. Gonzalez. "Pattern Recognition Principle", Pearson Education

**Reference Book:**

1. Richard Duda, Hart., David Stork, "Pattern Classification", John Wiley.



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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>Advanced Data Structures Lab</b>				

**Course Objectives:**

From the course the student will learn

- Knowing about oops concepts for a specific problem.
- Various advanced data structures concepts like arrays, stacks, queues, linked lists, graphs and trees.

**Course Outcomes:**

- Identify classes, objects, members of a class and relationships among them needed for a specific problem.
- Examine algorithms performance using Prior analysis and asymptotic notations.
- Organize and apply to solve the complex problems using advanced data structures (like arrays, stacks, queues, linked lists, graphs and trees.)
- Apply and analyze functions of Dictionary

### **List of Experiments**

**Experiment 1:**

Implement Multi stacks.

**Experiment 2:**

Implement Double Ended Queue (Dequeues) & Circular Queues.

**Experiment 3:**

Implement various Recursive operations on Binary Search Tree.

**Experiment 4:**

Implement various Non-Recursive operations on Binary Search Tree.

**Experiment 5:**

Implement BFS for a Graph

**Experiment 6:**

Implement DFS for a Graph.

**Experiment 7:**

Implement Merge & Heap Sort of given elements.

**Experiment 8:**

Implement Quick Sort of given elements.

**Experiment 9:**

Implement various operations on AVL trees.

**Experiment 10:**

Implement B Tree operations.



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**Experiment 11:**

Implementation of Binary trees Traversals Techniques.

**Experiment 12:**

Implement Krushkal's algorithm to generate a min-cost spanning tree.

**Experiment 13:**

Implement Prim's algorithm to generate a min-cost spanning tree.

**Experiment 14:**

Implement functions of Dictionary using Hashing.



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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>Neural Networks Lab</b>				

**Course Objectives:**

- This course will serve as a comprehensive introduction to various topics in machine learning. At the end of the course
- The students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

**Course Outcomes:**

- Create a custom feed-forward network.
- Design Constructing Layers
- Setting Transfer Functions, Each layer has its own transfer function
- Define which is set through the net. Layers{i}.transferFcn property
- Discriminative Learning models: Logistic Regression, Perceptrons, Artificial Neural Networks, Support Vector Machines.

*Note: The experiments need to be implemented using MATLAB.*

## List of Experiments

**Sample Problem Statement:** Create a custom feed-forward network .It consists of the following sections:

1. Network Layers
  - Constructing Layers
  - Connecting Layers
  - Setting Transfer Functions
2. Weights and Biases
3. Training Functions & Parameters
  - The difference between train and adapt
  - Performance Functions
  - Train Parameters
4. Conclusion

### 1. Network Layers

- **Constructing Layers**  
assume you have an empty network object named `net' in your workspace  
`>> net = network`

Define properties of input layer  
`>> net.numInputs = 1`

Define the number of neurons in the input layer. This should of course be equal to the dimensionality of data set. The appropriate property to set is net.

`inputs{i}.size`, where i is the index of the input layers.

So to make a network which has 2 dimensional points as inputs, type:

```
>> net.inputs{1}.size = 2;
```



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`net.numLayers` represents the total number of layers in the network, and `net.layers{i}.size`, which sets the number of neurons in the  $i^{\text{th}}$  layer. To build our example network, we define 2 extra layers (a hidden layer with 3 neurons and an output layer with 1 neuron), using:

```
>> net.numLayers = 2;  
>> net.layers{1}.size = 3;  
>> net.layers{2}.size = 1;
```

- **Connecting Layers**

```
>> net.inputConnect(1) = 1;  
>> net.layerConnect(2, 1) = 1;  
>> net.outputConnect(2) = 1;  
>> net.targetConnect(2) = 1;
```

- **Setting Transfer Functions**

Each layer has its own transfer function which is set through the `net.layers{i}.transferFcn` property. So to make the first layer use sigmoid transfer functions, and the second layer use linear transfer functions,

```
>> net.targetConnect(2) = 1;  
>> net.layers{2}.transferFcn = 'purel'
```

## 2. Weights and Biases

Define which layers have biases by setting the elements of `net.biasConnect` to either 0 or 1, where `net.biasConnect(i) = 1` means layer  $i$  has biases attached to it.

To attach biases to each layer in network use

```
>> net.biasConnect = [ 1 ; 1];
```

- Initialisation procedure for the weights

*reset all weights and biases by using*

```
>> net = init(net);
```

- Each layer of weights and biases use their own initialisation routine to initialise.

```
>> net.initFcn = 'initlay';
```

- The initialisation for each set of weights and biases separately.

```
>> net.layers{i}.initFcn = 'initnw';
```

```
>> net.layers{i}.initFcn = 'initwb';
```

## 3. Weights and Biases

Define which layers have biases by setting the elements of `net.biasConnect` to either 0 or 1, where `net.biasConnect(i) = 1` means layer  $i$  has biases attached to it.

To attach biases to each layer in network use

```
>> net.biasConnect = [ 1 ; 1];
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- Initialisation procedure for the weights

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>> net = init(net);
```

- Each layer of weights and biases use their own initialisation routine to initialise.

```
>> net.initFcn = 'initlay';
```

- The initialisation for each set of weights and biases separately.

```
>> net.layers{i}.initFcn = 'initnw';
```



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```
>> net.layers{i}.initFcn = 'initwb';
```

- Define the initialisation for the input weights,  
>> *net.inputWeights{1,1}.initFcn = 'rands';*
- Define the initialisation for each set of biases  
>> *net.biases{i}.initFcn = 'rands';*
- Define the initialisation for weight matrices  
>> *net.layerWeights{i,j}.initFcn = 'rands';*

where *net.layerWeights{i,j}* denotes the weights from layer j to layer i.

## 2. Training Functions & Parameters

- The difference between train and adapt  
When using adapt, both incremental and batch training can be used. Which one is actually used depends on the format of your training set. If it consists of two matrices of input and target vectors  
>> P = [ 0.3 0.2 0.54 0.6 ; 1.2 2.0 1.4 1.5]  
P is input vector and T is Target vector  
>> T = [ 0 1 1 0 ]
- Performance Functions  
The performance function is set with means square error  
>> net.performFcn = 'mse';
- Train Parameters  
Train network using a Gradient Descent w/ Momentum algorithm  
>> net.trainFcn = 'traingdm';
- set the parameters  
>> net.trainParam.lr = 0.1;  
>> net.trainParam.mc = 0.9;  
lr is the learning rate, and mc is the the momentum term  
Two other useful parameters are net.trainParam.epochs, which is the maximum number of times the complete data set may be used for training, and net.trainParam.show, which is the time between status reports of the training function.  
>> net.trainParam.epochs = 1000;  
>> net.trainParam.show=100;



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Soft Computing</b>				

**Course Objectives:**

- Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- Introduce students to artificial neural networks and fuzzy theory from an engineering perspective

**Course Outcomes:**

- Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- Reveal different applications of these models to solve engineering and other problems.

**UNIT-I: Fuzzy Set Theory:** Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Surgeon Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

**UNIT-II: Optimization:** Derivative based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton’s Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing and Random Search – Downhill Simplex Search.

**UNIT-III: Artificial Intelligence:** Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Propositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning under Uncertainty Basic knowledge Representation Issues Knowledge acquisition, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent directed Search Production System and Learning.

**UNIT-IV: Neuro Fuzzy Modeling:** Adaptive Neuro-Fuzzy Inference Systems, Architecture – Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

**UNIT-V: Applications Of Computational Intelligence:** Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.

**Text Books:**

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
- 2.N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2006.

**References:**



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1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Deep Learning</b>				

**Course Objectives:**

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

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Apply such deep learning mechanisms to various learning problems.
- Learn deep Turing machines, the open issues in deep learning, and have a grasp of the current research directions.

**Course Outcomes:**

After the completion of the course, student will be able to

- Demonstrate the basic concepts fundamental learning techniques and layers.
- Discuss the Neural Network training, various random models.
- Explain different types of deep learning network models.
- Classify the Probabilistic Neural Networks.
- Implement tools on Deep Learning techniques.

**UNIT-I: Introduction:** Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques. **Feed forward neural network:** Artificial Neural Network, activation function, multi-layer neural network

**UNIT-II: Training Neural Network:** Risk minimization, loss function, back propagation, regularization, model selection, and optimization. **Deep Neural Networks:** Difficulty of training deep neural networks, Greedy layer wise training.

**UNIT-III: Deep Learning:** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolution Neural Network, Recurrent Neural Network, and Deep Belief Network.

**UNIT-IV: Probabilistic Neural Network:** Hopfield Net, Boltzmann machine, RBMs, Sigmoid net, Auto encoders.

**UNIT-V: Applications:** Object recognition, sparse coding, computer vision, natural language processing. **Introduction to Deep Learning Tools:** Tensor Flow, Caffe, Theano, Torch.





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**Text Books:**

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

**Reference Books:**

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004
4. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
5. Pattern Recognition and Machine Learning, Christopher Bishop, 2007



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Computer Vision</b>				

**Course Objectives:**

- Be familiar with both the theoretical and practical aspects of computing with images
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks.

**Course Outcomes:**

- Developed the practical skills necessary to build computer vision applications
- Gain and exposure to object and scene recognition and categorization from images
- Identify Regularization theory, Optical computation
- Explain Deformable curves and surfaces, Snakes and active contours, Level set representations
- Demonstrate object recognition methods, Shape correspondence and shape matching, Principal Component analysis

**UNIT –I: Image Formation Models:** Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems

**UNIT- II: Image Processing and Feature Extraction:** Image representations (continuous and discrete), Edge detection

**UNIT- III: Motion Estimation:** Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion

**UNIT- IV: Shape Representation and Segmentation:** Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, and Multi resolution analysis

**UNIT- V: Object recognition:** Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component analysis, Shape priors for recognition

**Text Books:**

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall
2. Robot Vision, by B. K. P. Horn, McGraw-Hill.

**Reference Books:**

1. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.

<b>I Year - II Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Big Data Analytics</b>				



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**Course Objectives:**

- Optimize business decisions and create competitive advantage with Big Data analytics
- Introducing Java concepts required for developing map reduce programs
- Derive business benefit from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
- To introduce programming tools PIG & HIVE in Hadoop ecosystem.

**Course Outcomes:**

- Demonstrate Java Collections for various data structures and Generic types.
- Construct Hadoop Cluster with the building blocks and configure it.
- Illustrate Map Reduce framework applications to process huge amounts of data.
- Explain the Hadoop IO techniques, data integrity & compression for developing distributed systems such as serialization frameworks.
- Prepare Pig Latin scripts to process Big Data in Hadoop.
- Apply Hive to process Big Data in Hadoop.

**UNIT-I:** Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

**UNIT-II:** Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) – Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

**UNIT-III:** Writing Map Reduce Programs: A Weather Dataset, Understanding Hadoop API for MapReduce Framework (Old and New), Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Partitioner

**UNIT-IV:** Hadoop I/O: The Writable Interface, Writable Comparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, Bytes Writable, Null Writable, Object Writable and Generic Writable, Writable collections, Implementing a Custom Writable: Implementing a Raw Comparator for speed, Custom comparators

**UNIT-V:** Pig: Hadoop Programming Made Easier Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin  
Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data



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**Text Books:**

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3<sup>rd</sup> Edition, O'reilly
3. Hadoop in Action by Chuck Lam, MANNING Publ.
4. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk, Bruce Brown, Rafael Coss

**Reference Books:**

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, Srinath Perera, Thilina Gunarathne



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Remote Sensing</b>				

**Course Objectives:**

- To provide an opportunity for individuals to learn Remote Sensing and Geo information Science for the benefit of their professional career
- This basic course in Remote Sensing and Geo information Science will allow graduates to build their knowledge and practical expertise in RS and GIS technologies with independent study and project experience at the certificate level

**Course Outcomes:**

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

- Select the type of remote sensing technique / data for required purpose
- Identify the earth surface features from satellite images
- Analyze the energy interactions in the atmosphere and earth surface features
- Perform corrections and process digital satellite data Mapping of course outcomes with program outcomes

**UNIT-I: Physics of Remote Sensing:** Sources of Energy, Active and Passive Radiation, Electromagnetic Radiation - Reflectance, Transmission, Absorption, Thermal Emissions, Interaction with Atmosphere, Atmospheric windows, Spectral reflectance of Earth's surface features, Multi concept of Remote Sensing.

**UNIT-II: Platforms:** Various types of platforms, different types of aircraft, manned and unmanned spacecrafts used for data acquisition - characteristics of different types of platforms - airborne and space borne.

**UNIT-III: Data Acquisition Systems:** Optical, Thermal and Microwave; Resolutions - spatial, spectral, radiometric and temporal, signal to noise ratio.

**UNIT-IV: Image Processing:** Data Products and Their Characteristics, Digital image formation, digital image display mechanism, image histograms, look up table data, Pre-processing – Atmospheric, Radiometric, Geometric Corrections - Basic Principles of Visual Interpretation, Equipment for Visual Interpretation, Ground Truth, Ground Truth Equipment.

**UNIT-V Image enhancements:** Linear and non-linear Contrast enhancement techniques, density slicing, pseudo colour images, spatial enhancement techniques (convolution filtering), spectral enhancement techniques, Image algebra. Applications of Remote sensing in various Engineering and Science domains such as Agriculture, Forest, Soil, Geology, LU/LC, Water Resources, Urban etc



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**Textbooks:**

1. James B. Campbell & Randolph H. Wynne., Introduction to Remote Sensing, The Guilford Press, 2011.
2. Charles Elach&Jakob van Zyl., Introduction to the physics and techniques of Remote Sensing, John Wiley & Sons publications, 2006.
3. Lille sand T.M & Kiefer R.W., Remote Sensing and Image Interpretation, John Wiely and Sons, 2008.
4. ChritianMatzler., Thermal microwave radiation: Applications for remote sensing, The institution of Engineering and Technology, London, 2006.
5. Rees, W. G., Physical principles of Remote Sensing, Cambridge University Press, 2001Paul Curran P.J., Principles of Remote Sensing, ELBS Publications, 1985.

**References:**

1. Fundamentals of Remote Sensing by George Joseph, Third Edition



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Cognitive Systems</b>				

**Course Objectives:**

- The purpose of this course is to give students at the bachelor's program in cognitive science a broad understanding of the field of cognitive science from an interdisciplinary perspective.
- The course discusses models of cognition that are based on empirical studies of human and artificial intelligence.

**Course Outcomes:**

- Identify knowledge from computing, linguistics, psychology
- Define philosophy can combine to give us an understanding of thinking.
- Analyze how the other courses in the program contribute to cognitive science.
- Explain basis for specialization in the master degree.
- Identify reflect critically on issues that are central to cognitive science

**UNIT--I:** Introduction to Knowledge Based Artificial Intelligence (KBAI) and Cognitive Systems. Where Knowledge-Based AI fits into AI as whole, Cognitive systems: what are they? Cognitive Science and Cognition, AI and cognition: how are they connected?

**UNIT- II:** Fundamentals: Semantic Networks, Generate & Test, Means-Ends Analysis, Problem Reduction, Production Systems

**UNIT-III:** Kinematics of Robot Manipulator: Introduction, General Mathematical Preliminaries on Vectors& Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation H Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation. (SLE: Geometrical Approach to Inverse Kinematics.)

**UNIT-IV:** Visuospatial Reasoning Constraint Propagation, Visuospatial Reasoning UNIT- Design & Creativity Configuration, Diagnosis, Design, Creativity Met cognition Learning by Correcting Mistakes, Meta-Reasoning, AI Ethics Module II (Cognitive Systems)Introduction: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Concepts about Basic Control System, ,Control Loops of Robotic Systems, Different Types of Controllers Proportional, Integral, Differential, PID controllers. (SLE: Types of Drive Systems and their Relative Merits)



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**UNIT-V: Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.**

**Text Books:**

1. Chris Forsythe et al. , Cognitive Systems: Human Cognitive Models in Systems Design, Kindle Edition
2. G. F. Markus. The Algebraic Mind - Integrating Connectionism & Cognitive Science , MIT Press.
3. Fu, Lee and Gonzalez, Robotics, control vision and intelligence. McGraw Hill . 4. John J. Craig, Introduction to Robotics, Addison Wesley

**References:**

1. Henrik Christensen, Cognitive Systems (Cognitive Systems Monographs), Springer
2. Yoram Koren, Robotics for Engineers, McGraw Hill International, 1st edition, 1985.
3. Groover, Weiss, Nagel, Industrial Robotics, McGraw Hill International, 2nd edition, 2012. 4. Robotic Engineering -An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009





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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Knowledge Discovery</b>				

**Course Objectives:**

- To learn the latest development of knowledge discovery and data mining concepts and techniques.
- Theories and algorithms for data mining and knowledge discovery will be introduced
- Relevant applications in specific domains such as medicine and health care will be covered.

**Course Outcomes:**

- Identify and distinguish data mining applications from other IT applications
- Describe data mining algorithms, Web usage mining
- Describe applicability of data mining
- Analyze data mining algorithms and techniques
- Explain Web terminology and characteristics, Web content mining,

**UNIT-I :** Introduction to Data mining, types of Data, Data Quality, Data Processing, Measures of Similarity and Dissimilarity, Exploring Data: Data Set, Summary Statistics, Visualization, OLAP and multi dimensional data analysis.

**UNIT-II: Classification:** Basic Concepts, Decision Trees and model evaluation: General approach for solving a classification problem, Decision Tree induction, Model over fitting: due to presence of noise, due to lack of representation samples, Evaluating the performance of classifier. Nearest Neighborhood classifier, Bayesian Classifier, Support vector Machines: Linear SVM, Separable and Non Separable case.

**UNIT-III: Association Analysis:** Problem Definition, Frequent Item-set generation, rule generation, compact representation of frequent item sets, FP-Growth Algorithms. Handling Categorical, Continuous attributes, Concept hierarchy, Sequential, Sub graph patterns

**UNIT-IV: Clustering:** Over view, K-means, Agglomerative Hierarchical clustering, DBSCAN, Cluster evaluation: overview, Unsupervised Cluster Evaluation using cohesion and separation, using proximity matrix, Scalable Clustering algorithm

**UNIT-V: Web data mining:** Introduction, Web terminology and characteristics, Web content mining, Web usage mining, web structure mining, Search Engines Characteristics, Functionality, Architecture, Ranking of WebPages, Enterprise search

**Text Books:**

1. Introduction to Data Mining: Pang-Ning tan, Michael Steinbach, Vipinkumar, Addison-Wesley.
2. Introduction to Data Mining with Case Studies: GK Gupta; Prentice Hall.

**Reference Books:**

1. Data Mining: Introductory and Advanced Topics, Margaret H Dunham, Pearson, 2008.
2. Fundamentals of data warehouses, 2/e ,Jarke, Lenzerini, Vassiliou, Vassiliadis, Springer.
3. Data Mining Theory and Practice, Soman, Diwakar, Ajay, PHI, 2006.
4. Data Mining , Concepts and Techniques, 2/e, Jiawei Han, MichelineKamber, Elsevier, 2006.

<b>I Year - II Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Natural Language Processing</b>				

**Course Objectives:**



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- Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
- Teach them to recognize the significance of pragmatics for natural language understanding.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

**Course Outcomes:**

- Explain approaches to syntax and semantics in NLP.
- Demonstrate approaches to discourse, generation, dialogue and summarization within NLP.
- Explain current methods for statistical approaches to machine translation.
- Identify machine learning techniques used in NLP, including hidden Markov models and probabilistic
- Explain context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP

**UNIT-I: Introduction:** NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

**UNIT-II: N-gram Language Models:** The role of language models, Simple Ngram models. Estimating parameters and smoothing. Evaluating language models. **Part of Speech Tagging and Sequence Labeling:** Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields

**UNIT-III: Syntactic parsing:** Grammar formalisms and tree banks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs.

**UNIT-IV: Semantic Analysis:** Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

**UNIT- V: Information Extraction (IE) and Machine Translation (MT):** Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase based translation, and synchronous grammars. Dialogues: Turns and utterances, grounding, dialogue acts and structures Natural Language Generation: Introduction to language generation, architecture, discourse planning (text schemata, rhetorical relations).



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**Text Books:**

1. D. Jurafsky & J. H. Martin – “Speech and Language Processing – An introduction to Language processing, Computational Linguistics, and Speech Recognition”, Pearson Education

**References:**

1. Allen, James. 1995. – “Natural Language Understanding”. Benjamin/ Cummings, 2ed.
2. Bharathi, A., Vineet Chaitanya and Rajeev Sangal. 1995. Natural Language Processing- “A Pananian Perspective”. Prentice Hill India, Eastern Economy Edition.
3. Eugene Charniak: “Statistical Language Learning”, MIT Press, 1993.
4. Manning, Christopher and Heinrich Schutze. 1999. “Foundations of Statistical Natural Language Processing”. MIT Press.



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<b>I Year - II Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>Soft Computing Lab</b>				

**Course Objectives:**

- From the course the student will learn
- Describe supervised and unsupervised learning differences.
- Describe the data science life cycle.
- Use machine Take data science into production.
- Introducing data science, with a focus on the job outlook and market requirements.
- Hands-on Applied Statistics Concepts using Python.
- Graphics and Data Visualization Libraries in Python.
- Machine Learning algorithms, Models and Case Studies with Python.

**Course Outcomes:**

- Use Deep Learning techniques to build concise representations of the meanings of words in all significant languages
- Use machine learning methods to solve the real-world problems.
- Develop a feed forward, convolution and recurrent neural networks.
- Experiment with AI and data visualization techniques
- Examine map reduce, Naive Byes and K-Means Clustering.

**Experiment 1**

To solve the real-world problems using the following machine learning methods:

a) Linear Regression b) Logistic Regression

**Experiment 2**

Implement Support Vector Machines

**Experiment 3**

Implement K-Means Clustering & PCA

**Experiment 4**

Implementation of map reduce

**Experiment 5**

Implementation of Naive Bayes

**Experiment 6**

Exploratory Data Analysis for Classification using Pandas and Matplotlib

**Experiment 7**

Implement a program for Bias, Variance, and Cross Validation

**Experiment 8**

Implementation of feed forward neural networks

**Experiment 9**

Implementation of convolution neural networks



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**Experiment 10**

Implementation of recurrent neural networks

**Experiment 11**

Write a program to simulate a perception network for pattern classification and function approximation.

**Experiment 12**

Solve optimal relay coordination as a linear programming problem using Genetic Algorithm.

**Experiment 13**

Solve optimal relay coordination as a non-Linear programming problem using Genetic algorithm.

**Experiment 14**

Solve economic load dispatch problem using Genetic algorithm



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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>Deep Learning Lab</b>				

**Course Objectives:**

From the course the student will learn

- Describe supervised and unsupervised learning differences.
- Describe the data science life cycle.
- Use machine Take data science into production.
- Introducing data science, with a focus on the job outlook and market Requirements.
- Hands-on Applied Statistics Concepts using Python.
- Graphics and Data Visualization Libraries in Python.
- Machine Learning algorithms, Models and Case Studies with Python.

**Course Outcomes:**

- Use Deep Learning techniques to build concise representations of the meanings of words in all significant languages
- Use Voice Recognition application using
- Develop a feed forward, convolution and recurrent neural networks.
- Experiment with AI and data visualization techniques
- Examine Object Recognition application

Get Familiarity with popular deep learning frame works such as Tensor Flow, PyTorch, Keras, etc.. For applications like

**Experiment 1**

Implement Face Recognition application using any one of frame works

**Experiment 2**

Implement Voice Recognition application using any one of frame works

**Experiment 3**

Implement Object Recognition application using any one of frame works

**Experiment 4**

Implement Object Counting application using any one of frame works

**Experiment 5**

Implement Sentiment Analysis application using any one of frame works

**Experiment 6**

Implement Detection of Fake News application using any one of frame works, etc....



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Reinforcement Learning</b>				

**Course Objectives:**

- There have been many recent advances in the field of reinforcement learning.
- To provide exposure to these advances and facilitate in depth discussions on chosen topics.
- Student has to done the introduction to reinforcement learning course.

**Course Outcomes:**

- Gain Knowledge about advances in reinforcement learning and case studies
- Define Bayesian approach to data-efficient reinforcement learning with off-line data
- Demonstrate Inverse reinforcement learning and human supervision
- Describe deep Q network, deep actor critic
- Explain hierarchical frame works, option discovery

**UNIT-I: Introduction-** Recent Advances in Reinforcement Learning Atari Game Player, Alpha Go, and other case studies.

**UNIT-II: Model Based RL-** Bayesian Approaches to Reinforcement Learning; Data-efficient Reinforcement Learning; Learning with off-line data; Learning with incompletely specified models; RL and planning.

**UNIT-III: Human in the Loop RL-** Learning with human supervision; imitation learning; inverse reinforcement learning; learning from demonstration.

**UNIT-IV: Representation Learning for RL-** Deep Q network; Deep Actor-Critic; Representation and policy transfer in RL

**UNIT-V: Hierarchical RL-** Hierarchical frameworks; Option discovery; safe state abstractions; hierarchies for transfer.

**Text Books:**

1. Richard S. Sutton and Andrew G. Barto. Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2017. [Draft copies available now]
2. Neuro Dynamic Programming. Dimitri Bertsekas and John G. Tsitsiklis. Athena Scientific. 1996

**Reference Books:**

1. Reinforcement Learning: An Introduction, 2e, Richard S. Sutton and Andrew G. Barto



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Bioinformatics</b>				

**Course Objectives:**

- The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
- Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.

**Course Outcomes:**

- Demonstrate mastery of the core concepts of Bioinformatics, including computational biology, database design
- Explain Gene Prediction and Regularity element Prediction
- Illustrate protein structure prediction and protein classification
- Describe genome mapping, functional genomics

**UNIT-I:** Introduction to Bioinformatics and Biological Databases, Sequence alignment, Pair wise Sequence alignment, multiple sequence alignment, database Similarities.

**UNIT-II: Molecular phylogenetics-** Basics, gene phylogeny Vs Systems Phylogeny, Tree construction methods and programs, advanced Statistical approaches, profiles and Hidden markow models.

**UNIT-III: Gene and promoter prediction-**Gene Prediction, promoter and regulatory element prediction, RNA structure prediction, protein motives and domain prediction

**UNIT-IV: Structural Bioinformatics-** Basics, Protein structure Visualization, comparison, classification, protein secondary structure prediction, protein tertiary structure prediction.

**UNIT-V: Genomics and Proteomics-** Genome Mapping, Assembly, comparison, functional genomics, proteomics.

**Text Books:**

1. Essential Bioinformatics: Jin Xiong 2006, Cambridge University Press.

**Reference Books:**

1. "Bioinformatics: A Biologist's Guide to Biocomputing and the Internet" , 1e,  
Eaton pub co,2000





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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Speech Processing</b>				

**Course Objectives:**

- Student Focuses on methods for recording speech and other vocal signals, for processing and modifying such recordings, and for synthesizing artificial speech.
- Addition to class discussion and short, hands-on exercises, each student develops, executes, and presents a hands-on term project.

**Course Outcomes:**

- Explain and apply knowledge of landmark findings and theories in cognitive science.
- Design, interpret, and evaluate simple behavioral and neuro scientific experiments.
- Interpret and appreciate formal and computational approaches in cognitive science.
- Describe Articulator synthesis, Formant synthesis, LPC synthesis.
- To analyze a speech signal in terms of its frequency content.

**UNIT I:** Introduction-Production of speech, sound perception, speech Analysis, speech coding, speech Enhancement, speech Synthesis, speech and speaker Recognition, Signals and Linear Systems: Simple signal, Filtering and convolution, Frequency Analysis: Fourier Transform, spectra and Correlation, Laplace Transform: Poles and Zeros, Discrete –Time Signal and Systems: Sampling, Frequency Transforms of Discrete-Time Signals, Decimation and Interpolation Filter: Band pass Filter, Digital Filters, Difference Equations and Interpolation Speech analysis: Introduction, Short-Time speech Analysis: Windowing, Spectra of Windows: Wide-and Narrow – Band Spectrograms, Time-domain Parameters: Signal Analysis in the Time Domain, Short –Time Average Energy and Magnitude, Short –Time Average Zero-Crossing Rate ( ZCR), short-Time Autocorrelation Function , Frequency–Domain (Spectral) Parameters: Filter–Bank Analysis, Short-Time Fourier Transform Analysis, Spectral Displays, Formant Estimation and Tracking .

**UNIT II: Speech Production And Acoustic Phonetics-**Anatomy and Physiology of the speech Organs: the Lungs and the Thorax, Larynx and Vocal Folds(cords), Vocal Tract, Articulatory phonetics: Manner of Atriculatory, Structure of the Syllable, Voicing, Place of the Articulation, Phonemes in Other Language, Articulatory Models, Acoustic Phonetics : Spectrograms, Vowels, Diphthongs, glides and Liquids, Nasals, Fricatives, stops (Plosives), Variants of Normal Speech.

**UNIT III: Linear Predictive Coding (Lpc) Analysis-** Basic Principles of LPC, Least –Squares Autocorrelation Method, Least –Squares Covariance Method, Computation Considerations, Spectral Estimation Via LPC, Updating the LPC Model Sample by Sample, Window Considerations, Cepstral Analysis: Mathematical details of Cepstral analysis, Applications for the spectrum, Mel- Scale Cestrum, F0 Pitch estimation: Time domain F0 estimation methods, short-time Spectral methods

**UNIT IV: Speech synthesis-** Introduction, Principles of speech synthesis: Types of stored speech units to concatenate, Memory size, Synthesis method, Limited text voice response system, unrestricted- text TTS systems. Synthesizer methods: Articulator synthesis, Formant synthesis, LPC synthesis.

**UNIT V:** Introduction- Van Curability in speech signals, segmenting speech into smaller units, Performance evaluation, Database for speech recognition, pattern recognition methods, pre=processing, parametric representation: parameters used in speech recognition, feature extraction, Evaluation of similarity of speech patterns: frame-based distance measures, Making ASR decisions, HMMs

**Speaker recognition:** Introduction, Verification Vs. Recognition, Recognition techniques: Model evaluation, text dependence, statical Vs. dynamic features, stochastic models, vector quantization, similarity and distance measures, cepstral analysis, Features that distinguish the Speakers measures of



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the effectiveness of features, techniques to choose features, spectral features, prosodic features

**Text Books:**

1 Speech Communication Douglas O' Shaughnessy, Universities Press

**Reference Books:**

1. Fundamentals of Speech Recognition, Lawrence Rabiner, Biing-Hwang Juang, Pearson Education
2. Speech and Language processing, Daniel Jurafsky, James H. Martin, Pearson Education

**Open Electives offered to Other Departments**

- |                                   |                            |
|-----------------------------------|----------------------------|
| <b>1. Python Programming</b>      | <b>3. Machine Learning</b> |
| <b>2. Artificial Intelligence</b> | <b>4. Deep Learning</b>    |



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Python Programming</b>				

**Course Objectives:**

- Knowledge and understanding of the different concepts of Python.
- Using the GUI Programming and Testing in real-time applications.
- Using package Python modules for reusability.

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

- Understand and comprehend the basics of python programming.
- Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
- Explain the use of the built-in data structures list, sets, tuples and dictionary.
- Make use of functions and its applications.
- Identify real-world applications using oops, files and exception handling provided by python.

**Syllabus:**

**UNIT–I: Introduction-** History of Python, Python Language, Features of Python, Applications of Python, Using the REPL (Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

**UNIT–II: Types, Operators and Expressions-**Types - Integers, Strings, Booleans; Operators-Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations, Control Flow- if, if-elif-else, for, while, break, continue, pass.

**UNIT–III: Data Structures-**Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions.

**UNIT–IV: Functions-** Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables, Modules: Creating modules, import statement, from.. import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

**UNIT–V: Object Oriented Programming OOP in Python-**Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Datahiding, Brief Tour of the Standard Library - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics, Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.



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**Text Books:**

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson

**Reference Books:**

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press
2. Think Python, Allen Downey, Green Tea Press
3. Core Python Programming, W. Chun, Pearson



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Artificial Intelligence</b>				

**Course objectives:**

- To learn the difference between optimal reasoning Vs human like reasoning
- To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
- To learn different knowledge representation techniques
- To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

**Course Outcomes:**

- Formulate an efficient problem space for a problem expressed in English.
- Select a search algorithm for a problem and characterize its time and space complexities.
- Experiment with knowledge using the appropriate techniques for Problem reduction
- Apply AI techniques to solve problems of Game Playing, Expert Systems, Machine Learning and Natural Language Processing

**Syllabus:**

**UNIT-I: Introduction to artificial intelligence:** Introduction ,history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of ai languages, current trends in AI

**UNIT-II: Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening a\*, constraint satisfaction

**Problem reduction and game playing:** Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games

**UNIT-III: Logic concepts:** Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic

**UNIT-IV: Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames

**Advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web

**UNIT-V: Expert system and applications:** Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools



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**Text Books:**

1. Artificial Intelligence, 1<sup>st</sup> edition, Saroj Kaushik, CENGAGE Learning, 2011
2. Artificial intelligence, A modern Approach , 2<sup>nd</sup> edition, Stuart Russel, Peter Norvig, PEA, 2009
3. Artificial Intelligence, 3<sup>rd</sup> edition, Rich, Kevin Knight, Shiva Shankar B Nair, TMH,2017
4. Introduction to Artificial Intelligence, 1<sup>st</sup> edition, Patterson, PHI, 2015

**Reference Books:**

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5<sup>th</sup> ed, George F Lugar, PEA, 2008
2. Introduction to Artificial Intelligence, 1<sup>st</sup> edition, Ertel, Wolf Gang, Springer,2011
3. Artificial Intelligence, 1<sup>st</sup> edition, A new Synthesis, Nils J Nilsson, Elsevier, 1998



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Machine Learning</b>				

**Course Objectives:**

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.
- Demonstrate how to perform evaluation of learning algorithms and model selection.

**Course Outcomes:**

After the completion of the course, student will be able to

- Domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- Demonstrate on Supervised and Computational Learning
- Analyze on Statistics in learning techniques and Logistic Regression
- Illustrate on Support Vector Machines and Perceptron Algorithm
- Design a Multilayer Perceptron Networks and classification of decision tree

**Syllabus:**

**Unit-I: Introduction-**Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

**Unit-II: Supervised Learning-** Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metrics for assessing classification.

**Unit-III: Statistical Learning-** Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

**Unit-IV: Support Vector Machines (SVM)-** Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines.

**Learning with Neural Networks:** Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

**Unit -V: Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. Decision Tree Learning:** Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.



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**Textbooks:**

1. Artificial Intelligence, 1<sup>st</sup> edition, Saroj Kaushik, CENGAGE Learning, 2011
2. Machine Learning: A Probabilistic Perspective, 1<sup>st</sup> edition, Kevin Murphy, MIT Press, 2012
3. The Elements of Statistical Learning, 2<sup>nd</sup> edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 2009 (freely available online)

**Reference Books:**

1. Pattern Recognition and Machine Learning, 1<sup>st</sup> edition, Christopher Bishop, Springer, 2007
2. Programming Collective Intelligence: Building Smart Web 2.0 Applications - 1<sup>st</sup> edition, Toby Segaran, 2007
3. Building Machine Learning Systems with Python, 1<sup>st</sup> edition, Willi Richert, Luis Pedro Coelho, 2013





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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Deep Learning</b>				

**Course Objectives:**

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

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Apply such deep learning mechanisms to various learning problems.
- Learn deep Turing machines, the open issues in deep learning, and have a grasp of the current research directions.

**Course Outcomes:**

After the completion of the course, student will be able to

- Demonstrate the basic concepts fundamental learning techniques and layers.
- Discuss the Neural Network training, various random models.
- Explain different types of deep learning network models.
- Classify the Probabilistic Neural Networks.
- Implement tools on Deep Learning techniques.

**UNIT-I: Introduction:** Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

**Feed forward neural network:** Artificial Neural Network, activation function, multi-layer neural network

**UNIT-II: Training Neural Network:** Risk minimization, loss function, back propagation, regularization, model selection, and optimization.

**Deep Neural Networks:** Difficulty of training deep neural networks, Greedy layer wise training.

**UNIT-III: Deep Learning:** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolution Neural Network, Recurrent Neural Network, Deep Belief Network.

**UNIT-IV: Probabilistic Neural Network:** Hopfield Net, Boltzmann machine, RBMs, Sigmoid net, Auto encoders.

**UNIT V: Applications:** Object recognition, sparse coding, computer vision, natural language processing.

**Introduction to Deep Learning Tools:** TensorFlow, Caffe, Theano, Torch.

**Text Books:**

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.



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**Reference Books:**

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004
4. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
5. Pattern Recognition and Machine Learning, Christopher Bishop, 2007



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**AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING**

**Course objectives:**

Students will be able to:

Understand that how to improve your writing skills and level of readability

Learn about what to write in each section

Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

<b>Syllabus</b>		
<b>Units</b>	<b>CONTENTS</b>	<b>Hours</b>
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

**Suggested Studies:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011



**AUDIT 1 and 2: DISASTER MANAGEMENT**

**Course Objectives:** -Students will be able to:

learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

<b>Syllabus</b>		
<b>Units</b>	<b>CONTENTS</b>	<b>Hours</b>
1	<b>Introduction</b> Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	<b>Repercussions Of Disasters And Hazards:</b> Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	<b>Disaster Prone Areas In India</b> Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	<b>Disaster Preparedness And Management</b> Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	<b>Risk Assessment</b> Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	<b>Disaster Mitigation</b> Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4



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**KAKINADA – 533 003, Andhra Pradesh, India**

**Suggested Readings:**

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep & Deep Publication Pvt. Ltd., New Delhi.

**AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE**

**Course Objectives**

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

**Syllabus**

Unit	Content	Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	4
2	Order Introduction of roots Technical information about Sanskrit Literature	4
3	Technical concepts of Engineering-Electrical,	4
4	Technical concepts of Engineering - Mechanical.	4
5	Technical concepts of Engineering - Architecture.	4
6	Technical concepts of Engineering – Mathematics.	4

**Suggested reading**

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

**Course Output**

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students



**AUDIT 1 and 2: VALUE EDUCATION**

**Course Objectives**

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

**Syllabus**

<b>Unit</b>	<b>Content</b>	<b>Hours</b>
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements	4
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature ,Discipline	4
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking.	4
4	Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	4
5	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women.	4
6	All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	4

**Suggested reading**

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

**Course outcomes**

- Students will be able to
- 1.Knowledge of self-development
  - 2.Learn the importance of Human values
  - 3.Developing the overall personality



**AUDIT 1 and 2: CONSTITUTION OF INDIA**

**Course Objectives:**

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

<b>Syllabus</b>		
<b>Units</b>	<b>Content</b>	<b>Hours</b>
<b>1</b>	<b>History of Making of the Indian Constitution:</b> History Drafting Committee, ( Composition & Working)	4
<b>2</b>	<b>Philosophy of the Indian Constitution:</b> Preamble Salient Features	4
<b>3</b>	<b>Contours of Constitutional Rights &amp; Duties:</b> Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4
<b>4</b>	<b>Organs of Governance:</b> Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4
<b>5</b>	<b>Local Administration:</b> District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4



<b>6</b>	<b>Election Commission:</b> Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4
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**Suggested reading**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

**Course Outcomes:**

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.





**AUDIT 1 and 2: PEDAGOGY STUDIES**

**Course Objectives:**

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

<b>Syllabus</b>		
<b>Units</b>	<b>Content</b>	<b>Hours</b>
1	<b>Introduction and Methodology:</b> Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	4
3	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	4
4	Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
5	Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
6	<b>Research gaps and future directions</b> Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	4



### **Suggested reading**

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, *Compare*, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. [www.pratham.org/images/resource%20working%20paper%202.pdf](http://www.pratham.org/images/resource%20working%20paper%202.pdf).

### **Course Outcomes:**

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?



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**AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA**

**Course Objectives**

1. To achieve overall health of body and mind
2. To overcome stress

**Syllabus**

<b>Unit</b>	<b>Content</b>	<b>Hours</b>
1	Definitions of Eight parts of yog. ( Ashtanga )	5
2	Yam and Niyam. Do`s and Don`t`s in life. Ahinsa, satya, astheya, bramhacharya and aparigraha	5
3	Yam and Niyam. Do`s and Don`t`s in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	5
4	Asan and Pranayam Various yog poses and their benefits for mind & body	5
5	Regularization of breathing techniques and its effects-Types of pranayam	4

**Suggested reading**

1. ‘Yogic Asanas for Group Training-Part-I’ : Janardan Swami YogabhyasiMandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

**Course Outcomes:**

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency



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**AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE  
ENLIGHTENMENT SKILLS**

**Course Objectives**

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

**Syllabus**

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue)	4
2	Neetisatakam-Holistic development of personality Verses- 52,53,59 (don't's) Verses- 71,73,75,78 (do's)	4
3	Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,	4
4	Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	4
5	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18	4
6	Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	4

**Suggested reading**

1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

**Course Outcomes**

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students