POST GRADUATE DEGREE COURSE

M.TECH

IN

ARTIFICIAL INTELLIGENCE &MACHINE LEARNING

[W.E.F. 2021-22]

DEPARTMENT OF

COMPUTER SCIENCE AND SYSTEMS ENGINEERING

AU COLLEGE OF ENGINEERING (AUTONOMOUS)

ANDHRA UNIVERSITY

VISAKHAPATNAM-530 003

ANDHRA UNIVERSITY: VISAKHAPATNAM
M.Tech
Artificial Intelligence & Machine Learning
Course Structure and Scheme of Valuation w.e.f. 2021-2022

I-SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTAIML11	Mathematicas for Machine Learning	3	-	70	30	100	3
MTAIML12	Artificial Intelligence	3	-	70	30	100	3
MTAIML13	Elective-I	3	-	70	30	100	3
MTAIML14	Elective-II	3	-	70	30	100	3
MTCST15	Research Methodology &IPR	3	-	70	30	100	2
MTCST16	Organizational Behavior (Audit Course)	3	-	70	30	100	0
MTAIML17	Artificial Intelligence Lab	-	3	50	50	100	2
MTAIML18	Data mining Lab using Python	-	3	50	50	100	2
	Total	**18**	**6**	**520**	**280**	**800**	**18**

Elective-I: Data Mining/Cloud Computing/Evolutionary Computing
Elective II: Big Data Analytics/Internet of Things/Pattern Recognition

II-SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTAIML21	Machine Learning	3	-	70	30	100	3
MTAIML22	Soft Computing	3	-	70	30	100	3
MTAIML23	Elective-III 3	3	-	70	30	100	3
MTAIML24	Elective-IV	3	-	70	30	100	3
MTCST25	Entrepreneurship (Audit Course)	3	-	70	30	100	0
MTAIML26	Machine Learning Lab	-	3	50	50	100	2
MTAIML27	Soft Computing Lab	-	3	50	50	100	2
MTAIML28	Mini Project With Seminar	-	3	-	100	100	2
	Total	15	9	450	350	800	18

Elective-III: Computer Vision/Natural Language Processing/Recommender Systems
Elective-IV: Robotics and Intelligent Systems/Reinforcement Learning/NoSQL Databases

III-SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTAIMLR31	Elective-V	3	-	70	30	100	3
MTAIMLR32	Open Elective	3	-	70	30	100	3
MTAIMLR33	Dissertation-I / Industrial project		-	100	-	100	10
Total		6	-	240	60	300	16

Elective V : Deep Learning/Expert Systems/High Performance Computing
Open Elective :Business Analytics/Operations Research/Social Media Analytics

IVSEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTCSTAIR41	Dissertation - II	-	-	100	-	100	16
Total		**-**	**-**	**100**	**-**	**100**	**16**

M.TECH (CSE-AI&ML)

Programme Education Objectives (PEO)
PEO 1: To drive the students to achieve excellence in research and professional career.
PEO 2: To promote creative thinking and innovative mindset for solving societal problems.
PEO 3: To help exhibit adaptive and agile skills in the core area of Artificial Intelligence and Machine Learning to meet the technical and managerial challenges.
PEO 4: To demonstrate interpersonal skills, professional ethics to work in a team to make a positive impact on society and sustenance.

PROGRAM OUTCOMES (PO'S)

PO-1	Apply the knowledge of Machine learning, AI and other related subjects to developsoftware solutions .
PO-2	Able to assess the significance of a complex AI problem and analyse its characteristics
PO-3	Able to Compare the approaches applicable to solve a complex problem and identify an effective solution for the societal and environmental constraints.
PO-4	Able to grasp the essence of the latest research findings related to AI and Machine learning domain.
PO-5	Able to apply modern tools and algorithms for problem solving and validate the results through scientific approach.
PO-6	Acquire professional integrity and ethics, understand the participate in sustainable development of the society
PO-7	Able to work effectively as a multidisciplinaryteam .
PO-8	Able to create reports and make effective presentations .
PO-9	Be able to learn life-long learning skills in pace with the technological advancements

PROGRAM SPECIFIC OUTCOMES (PSO'S)

PSO-1	An ability to build AI systems capable of automated reasoning for solving complex problems in a wide range of application domains
PSO-2	Ability to apply ML algorithms for model building towards smart computing.
PSO-3	Ability to integrate multi-disciplinary approaches to design, develop, implement and evaluate solutions for various real world problems

MTAIML11	MATHEMATICAL FOR MACHINE LEARNING	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- Gain foundation in mathematical concepts related to Linear algebra necessary for ML.
- Understands the concepts related to Orthogonality and rotations.
- Learns different forms of matrix decompositions.
- Understands the concepts of differentiation for finding gradients and curvatures.
- Learns various optimization methods.

Course Outcomes:

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

- Attains the capability to solve linear equations and define mappings.
- Extract latent orthogonal features from the set of examples using PCA / SVD
- Estimate the gradients of matrices to apply back propagation and other techniques for parameter update.
- Capable of estimating the summary statistics of datasets and select appropriate model to fit the data.

MTAIML12	ARTIFICIAL INTELLIGENCE	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- Gain a historical perspective of Artificial Intelligence (AI) and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Experiment with a machine learning model for simulation and analysis.
- Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes:

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

- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.

- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.
- Develop intelligent algorithms for constraint satisfaction problems and design intelligent systems for Game Playing.
- Attain the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.
- Solve problems with uncertain information using Bayesian approaches.

MTAIML13	**ELECTIVE-I DATA MINING**	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Outcomes:

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

- Compare types of data, quality of data, suitable measures required to perform data analysis.
- Choose appropriate classification technique to perform classification, model building and evaluation.
- Make use of association rule mining techniques on categorical and continuous data
- Identify and apply clustering algorithm (with open-source tools), interpret, evaluate and report the result.
- Analyze and Compare anomaly detection techniques.

Course Outcomes:

By the end of the course, the student should be able to:

- understand the differences between OLTP and OLAP.
- The student learns how data cube technology supports summarization and querying high dimensional data.
- The student is introduced to similarity, distance, information gain and other performance and error metrics used for evaluation of mining results.
- The student is introduced to various approaches to association rule mining, supervised and unsupervised learning and the corresponding classification and clustering approaches involving decision trees, Bayesian approaches, model based and agglomerative approaches.

MTAIML13	**ELECTIVE-I CLOUD COMPUTING**	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- Broadly educate to know the impact of engineering on legal and societal issues involved.

Course Outcomes:

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

- Interpret the key dimensions of the challenge of Cloud Computing
- Examine the economics, financial, and technological implications for selecting cloud computing for own organization.
- Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications
- Evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas.
- Illustrate Virtualization for Data-Center Automation.

MTAIML14	ELECTIVE-II BIG DATA ANALYTICS	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

This course is aimed at enabling the students to

- Provide an overview of an exciting growing field of big data analytics.
- Introduce the tools required to manage and analyze big data like Hadoop, NoSQL, Map Reduce, HIVE, Cassandra, Spark.
- Teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- Optimize business decisions and create competitive advantage with Big Data analytics.

Course Outcomes:

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

- Illustrate on big data and its use cases from selected business domains.
- Interpret and summarize on NoSQL, Cassandra
- Analyze the HADOOP and Map Reduce technologies associated with big data analytics and explore on Big Data applications Using Hive.
- Make use of Apache Spark, RDDs etc. to work with datasets.
- Assess real time processing with Spark Streaming.

MTAIML14	ELECTIVE-II INTERNET OF THINGS	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- Vision and Introduction to Internet of Things (IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

Course Outcomes (COs):

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

- Explain in a concise manner how the general Internet as well as Internet of Things work.
- Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
- Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
- Develop prototype models for various applications using IoT technology.

MTAIML14	ELECTIVE-II PATTERN RECOGNITION	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

From the course the student will learn

- Concepts of Algorithms, Searching and Sorting techniques, Trees, Binary trees, representation, traversal.
- Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees.
- AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

Course Outcomes:

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

- Ability to write and analyze algorithms for algorithm correctness and

efficiency.

- Master a variety of advanced Abstract Data Type (ADT) and data structures and their Implementation.
- Demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of real-life.
- Design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees.
- Ability to compare various search trees and find solutions for IT related problems.

MTAIML15	RESEARCH METHODOLOGY AND IPR	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 2**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To provide students a comprehensive knowledge about IPR.
- The students will learn the procedure of obtaining Patents, Copyrights, Trademarks & Industrial Design.
- To enable the students to know about various IP rights its recognition and protection.
- To provide knowledge on various types of IP databases.

Course Outcomes:

On successful completion of this course student will be able to

- Distinguish and explain various forms of IPRs like trademark, copy right, Geo tagged etc.
- Know and identify the methods to fit one's own intellectual work in particular form of IPRs.
- Apply statutory provisions to protect a particular form of IPRs.
- Understand current and emerging issues relating to the intellectual property and its protection.

MTAIML16	ORGANIZATIONAL BEHAVIOR (AUDIT COURSE)	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 0**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To understand the basic concepts of organizational behavior, its foundations and importance.
- To enable students to have a basic perspective of Motivation and Motivation theories.
- To acquaint the students about group behavior in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

Course Outcomes:

- Identifying fundamental aspects of organizational dynamics.
- Evaluate main theories of motivation and formulating suitable motivational strategies.
- Analyze the behavior of individuals and groups in organizations.
- Understanding of Leadership theories and Leadership behavior.
- Apply relevant theories, concepts to address important Organizational Behavior questions.

MTAIML17	ARTIFICIAL INTELLIGENCE LAB	
Instruction: 3Periods/week,	Time: 3 Hours	**Credits: 2**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To apply the techniques in applications which involve perception, reasoning and learning.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

- Apply the basic principles of AI in problem solving using LISP/PROLOG/ PYTHON
- Implement different state space search algorithms for Game playing using LISP/PROLOG
- Develop an Expert System using JESS/PROLOG

MTAIML18	DATA MINING LAB USING PYTHON	
Instruction: 3Periods/week,	Time: 3 Hours	**Credits: 2**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To study the various data analysis techniques in PYTHON Programming language.
- To apply the various data mining techniques available for generating Knowledge such as association Analysis, Classification and Clustering to various standard datasets and own datasets.

Course Outcomes:

- Student will be able to write PYTHON programs to perform several data analytics operations on datasets.
- Ability to extract patterns by applying appropriate data mining techniques from different types of datasets.

MTAIML21	**MACHINE LEARNING**	
Instruction: 3Periods/week,	Time: 3 Hours	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Study 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

- Understand the distribution and diversity of Data.
- Extract features useful for building predictive models.
- Gain knowledge on Supervised and unsupervised Learning techniques.
- Analyze Statistical learning techniques and Logistic Regression
- Select appropriate Support Vector Machines and Perceptron Algorithm
- Compare the performance of different learning models.

MTAIML22	**SOFT COMPUTING**	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- Aims to provide comprehensive understanding of soft computing approaches for AI problem solving
- Develops in depth knowledge on concepts related to different types of neural networks.
- Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment

and reasoning with fuzzy quantities.

- Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems.
- Introduces the concepts related to Genetic algorithms for learning from examples.

Course Outcomes:

After completion of course, students would be able to:

- Build neural networks to extract patterns from data.
- Build fuzzy inference systems and develop fuzzy expert systems.
- Write genetic algorithms for learning the hyper parameters for data classification.

MTAIML23	ELECTIVE-III COMPUTER VISION	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objective:

To Recognize and describe both the theoretical and practical aspects of computing with images and to Connect issues from Computer Vision to Human Vision

Course Outcomes:

- Introduce computer vision including fundamentals of image formation.
- Enumerate the concepts of Feature detection and Matching.
- Discuss about Image Segmentation Techniques
- Discuss applications of Feature based alignment like pose estimation.
- Discuss different recognition techniques.

MTAIML23	ELECTIVE-III NATURAL LANGUAGE PROCESSING	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- 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:

After completion of this course

- Demonstrate a given text with basic Language features.
- To design an innovative application using NLP components
- Explain a rule-based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications.
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

MTAIML23	ELECTIVE-III RECOMMENDER SYSTEMS	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:
This course covers the basic concepts of recommender systems, including personalization algorithms, evaluation tools, and user experiences

Course Outcomes:

- Describe basic concepts behind recommender systems.
- Explain a variety of approaches for building recommender systems.
- Describe system evaluation methods from both algorithmic and users' perspectives.
- Describe applications of recommender systems in various domains

MTAIML24	ELECTIVE-IV ROBOTICS AND INTELLIGENT SYSTEMS	
Instruction: 3Periods/week	Time: 3 Hours	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objective:
To understand the use of robotics in building intelligent systems.

Course Outcomes:

- Enumerate the fundamentals of robotics and Artificial Intelligence (AI).
- Demonstrate how to set up a Robot.
- Discuss about the practical Robot Design Process.
- Discuss Object Recognition Using Neural Networks and Supervised Learning

MTAIML24	ELECTIVE-IV REINFORCEMENT LEARNING

Instruction: 3Periods/week,	Time: 3 Hours	Credits: 3
Internal: 30 Marks	External: 70 Marks	Total: 100 Marks

Course Objective:

To provide the fundamentals of Reinforcement learning.

Course Outcomes:

- Enumerate the elements of Reinforcement Learning
- Solve the n-armed Bandit problem.
- Compare different Finite Markov Decision Process
- Discuss about Monte Carlo Methods in solving real world problems.
- List the Applications and Case Studies of Reinforcement Learning

MTAIML24	ELECTIVE-IV NoSQL DATABASES	
Instruction: 3Periods/week,	Time: 3 Hours	Credits: 3
Internal: 30 Marks	External: 70 Marks	Total: 100 Marks

Course Objectives:

- Define NoSQL, its characteristics and history, and the primary benefits for using NoSQL data.
- To Define the major types of NoSQL databases including a primary use case and advantages/disadvantages of each type
- Create wide-column, document, key-value, graph and object-oriented databases, add content, and run queries 3.
- Describe the NoSQL data architecture patterns.
- Perform basic database administration tasks.
- Develop NoSQL desktop and cloud database solutions.

Course Outcomes:

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

- Enumerate different features of NOSQL Databases
- Compare different data models.
- Design a Key-Value Database for a real-world problem.
- Design a Document Database for a real-world problem.
- Design a Graph Database for a real-world problem.

MTAIML26	ENTREPRENEURSHIP	
Instruction: 3Periods/week,	Time: 3 Hours	Credits: 0
Internal: 30 Marks	External: 70 Marks	Total: 100 Marks

Course Objectives:

- To familiarize the students with the concepts of Management.
- To relate the concepts of Management with industrial organizations.
- To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.
- To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

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

- Understand the roles, skills, and functions of management.
- Distinguish the different types of business organizations.
- Identify the factors involved in Production Operations Management.
- Diagnose organizational problems and take suitable decisions.
- Establish good Human Resource Management practices.
- Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

MTAIML26	**MACHINE LEARNING LAB**	
Instruction: 3Periods/week,	Time: 3 Hours	**Credits: 2**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To learn how to apply machine learning algorithms in real world.
- To gain knowledge about appropriate machine learning algorithms suitable for the given problem.
- To understand and interpret results of different machine learning algorithms.

Course Outcomes:

On completion of this course, the student will be able to

- Implement machine learning algorithms to real world problems.
- Choose appropriate machine learning algorithm for a problem.
- Interpret the results of two different machine learning algorithms.

MTAIML27	**SOFT COMPUTING LAB**	
Instruction: 3Periods/week,	Time: 3 Hours	**Credits: 2**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

- To learn concepts of neural networks to solve real world problems.

- To understand and implement appropriate pre trained models.
- To gain knowledge about genetic algorithms.

Course Outcomes:

On completion of this course, the student will be able to

- Implement neural networks to solve real world problems.
- Choose appropriate pre-trained model to solve real time problem.
- Parameter tuning using Genetic algorithms.

MTAIML31	ELECTIVE-V DEEP LEARNING	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

The objective of this course is to cover the review of ML, fundamentals of feed forward neural networks, regularization methods and optimization in deep models as well as some advanced topics such as convolutional neural networks, recurrent neural networks, long short term memory cells.

Course Outcomes

After completion of course, students would be able to:

- Explore feed forward networks and Deep Neural networks.
- Mathematically understand the deep learning approaches and paradigms
- Complex feature extraction with CNN and RNNs
- Apply the deep learning techniques for various applications.

MTAIML31	ELECTIVE-V HIGH PERFORMANCE COMPUTING	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course Objectives:

The objective of the subject is to

- Introduce the basic concepts related to HPC architecture and parallel computing.
- Discuss various computational techniques for studying soft matter systems.
- Apply these concepts to examine complex bio molecular/materials systems that generally require large-scale HPC platform with hybrid CPU-GPU architectures.

Course Outcomes: After completion of this course

- Design, formulate, solve, and implement high performance versions of standard single threaded algorithms.
- Demonstrate the architectural features in the GPU and MIC hardware accelerators.

- Design programs to extract maximum performance in a multicore, shared memory execution environment processor.
- Analyze Symmetric and Distributed architectures.
- Develop and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.

MTAIML32	OPEN ELECTIVE BUSINESS ANALYTICS	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Course objectives:

- To introduce students to problem solving with Business Analytics and the use of spreadsheets for descriptive analytics, data queries and visualization
- To introduce students to statistical sampling, sampling distributions, confidence intervals and statistical inference
- To familiarize students with various types of regression including simple linear regression and multiple linear regression
- To introduce students to key concepts in statistical forecasting models for time series data.
- To familiarize students with predictive decision modeling, model analysis and developing spreadsheet applications including building linear optimization models on spreadsheets.

Course outcomes:

After completion of the course the student should be able to:

- Describe data and models used for Business Analytics and apply various descriptive analytic techniques to analyze data.
- Estimating population parameters, interval estimates, construct confidence intervals and perform hypothesis testing.
- Estimate and interpret the parameters of simple linear regression and multiple linear regressions.
- Apply forecasting models for various time series data including stationary time series, time series with linear trend and time series with seasonality.

MTAIML32	OPEN ELECTIVE OPERATIONS RESEARCH	
Instruction: 3Periods/week,	**Time: 3 Hours**	**Credits: 3**

Internal: 30 Marks	External: 70 Marks	Total: 100 Marks

Course Objectives:

- Formulate a real-world problem as a mathematical programming model.
- Implement and solve the model in EXCEL and LINDO
- Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
- Understand the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems.
- Solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of basic methods for, and challenges in integer programming.

Course Outcomes:

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

- Students will be able to describe characteristics and scope of OR.
- Students will be able to define and formulate mathematical problems.
- Students will be able to select optimal problems solving techniques for a given problem using LP.
- Students will be able to formulate and solve transportation, travelling salesman and transshipment problems.
- Students will be able to formulate and solve optimization problems related to job/ work assignments.
- Students will be able to demonstrate and solve simple models of Game theory.
- Students will be able to evaluate optimum solution using dynamic programming for different applications.
- Students will be able to choose / devise appropriate queuing model for practical application.
- Students will be able to solve different problems related to Network.

POST GRADUATE DEGREE COURSE

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IN

ARTIFICIAL INTELLIGENCE &MACHINE LEARNING

[W.E.F. 2021-22]

DEPARTMENT OF

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AU COLLEGE OF ENGINEERING (AUTONOMOUS)

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MTAIML28	Mini Project With Seminar	-	3	-	100	100	2
	Total	15	9	450	350	800	18

Elective-III: Computer Vision/Natural Language Processing/Recommender Systems
Elective-IV: Robotics and Intelligent Systems/Reinforcement Learning/NoSQL Databases

III-SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTAIMLR31	Elective-V	3	-	70	30	100	3
MTAIMLR32	Open Elective	3	-	70	30	100	3
MTAIMLR33	Dissertation-I / Industrial project		-	100	-	100	10
Total		6	-	240	60	300	16

Elective V : Deep Learning/Expert Systems/High Performance Computing
Open Elective :Business Analytics/Operations Research/Social Media Analytics

IVSEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTCSTAIR41	Dissertation - II	-	-	100	-	100	16
Total		**-**	**-**	**100**	**-**	**100**	**16**

Detailed Syllabus for M.Tech (AI&ML) First Semester
MTAIML11 MATHEMATICAL FOR MACHINE LEARNING

Instruction: 3Periods/week	**Time:3Hours**	**Credits:3**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

Course Objectives:

- Gain foundation in mathematical concepts related to Linear algebra necessary for ML
- Understands the concepts related to Orthogonality and rotations
- Learns different forms of matrix decompositions
- Understands the concepts of differentiation for finding gradients and curvatures
- Learns various optimization methods

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

- Attains the capability to solve linear equations and define mappings
- Extract latent orthogonal features from the set of examples using PCA / SVD
- Estimate the gradients of matrices to apply back propagation and other techniques for parameter update
- Capable of estimating the summary statistics of datasets and select appropriate model to fit the data

UNIT-I

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces

UNIT-II

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations

UNIT-III

Matrix Decompositions: Determinant and Trace, Eigen values and Eigen vectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny

UNIT-IV

Vector Calculus : Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series

UNIT-V

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform

UNIT-VI

Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization

Text Books:

1. “Mathematics for Machine Learning”, Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.

Reference Books:

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML12 ARTIFICIAL INTELLIGENCE

Instruction: 3Periods/week	**Time:3Hours**	**Credits:3**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

Course Objectives:

- Gain a historical perspective of Artificial Intelligence (AI) and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Experiment with a machine learning model for simulation and analysis.
- Explore the current scope, potential, limitations, and implications of intelligent systems.

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

- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
- Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
- Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
- Solve problems with uncertain information using Bayesian approaches.

UNIT-I:

Introduction to artificial intelligence: Introduction, history, intelligent systems, Turing Test, Role of Knowledge, AI applications, tic-tac-tie game playing, current trends in AI,

Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, AI problem solving as state space search, exhaustive searches, heuristic search techniques, Hill climbing , A* algorithms,

UNIT-II:

Logic and Theorem Proving concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic

UNIT-III:

Problem reduction and game playing: Introduction to problem reduction, AO* algorithm, constraint satisfaction algorithm, Cryptarithmetic Problem solving, Means Ends analysis, game playing, Min-Max algorithm for game playing, alpha-beta pruning, iterative-deepening, two-player perfect information games,

UNIT-IV

Representation of Knowledge with Rules: Production System, Forward versus Backward chaining, Rule Matching and chain control, Non-Monotonic reasoning, Truth maintenance systems,

UNIT-V:

Uncertain Reasoning: Probability theory: Introduction, probability theory, Bayes theorem, Bayesian belief networks, certainty factor theory, Dempster-Shafer theory, Statistical Inference

UNIT-VI:

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-VII:

Planning: Overview, Blocks world as example, components of planning system, Goal stack planning, Nonlinear planning, Hierarchical planning, Reactive Systems

Expert Systems: Representing and using Domain knowledge, examples of expert systems, Expert system Architectures, Components, Building an expert system, Expert system shells

Text Books:

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
3. Introduction To Artificial Intelligence And Expert Systems, 1st Edition, Patterson, Pearson India, 2015

Reference Books:

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar,PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3. Artificial Intelligence, SarojKaushik, 1st Edition, CENGAGE Learning, 2011

MTAIML13 ELECTIVE-I DATA MINING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Outcomes:

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

- **Compare** types of data, quality of data, suitable measures required to perform data analysis. (UNIT-I)
- **Choose** appropriate classification technique to perform classification, model building and evaluation (UNIT-II)
- **Make use of** association rule mining techniques on categorical and continuous data (UNIT III)
- **Identify and apply** clustering algorithm (with open source tools), interpret, evaluate and report the result (UNIT IV)
- **Analyze and Compare** anomaly detection techniques (UNI-V)

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

Unit III

Nearest Neighborhood classifier, Bayesian Classifier, Support vector Machines: Linear SVM, Separable and Non Separable case.

Unit IV:

Association Analysis: Problem Definition, Frequent Item-set generation, a priori Algorithm, rule generation, compact representation of frequent item sets, FP-Growth Algorithms.

Unit-V:

Handling Categorical, Continuous attributes, Concept hierarchy, Multi-dimensional Association Rules, Sequential pattern mining, Sub graph pattern mining algorithms

Unit V*I*:

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 VII:

Anomaly Detection: Characteristics of Anomaly Detection Problems and Methods, Statistical Approaches, Proximity-based Approaches, Clustering-based Approaches and Reconstruction-based Approaches

Text Books:

1. Introduction to Data Mining: Pang-Ning Tan; Michael Steinbach; AnujKarpatne; Vipin Kumar, 2nd edition.
2. Data Mining, Concepts and Techniques, 2nd edition, Jiawei Han, MichelineKamber, Elsevier, 2006.

Reference Books:

1. Fundamentals of data warehouses, 2nd edition,Jarke, Lenzerini, Vassiliou, Vassiliadis, Springer.

Suggested NPTEL Course and other Useful Websites:

1. https://nptel.ac.in/courses/106105174/
2. http://cse20-iiith.vlabs.ac.in/

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML13 ELECTIVE-I CLOUD COMPUTING

Instruction: 3Periods/week	**Time:3Hours**	**Credits:3**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- Broadly educate to know the impact of engineering on legal and societal issues involved.

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

- Interpret the key dimensions of the challenge of Cloud Computing
- Examine the economics, financial, and technological implications for selecting cloud computing for own organization.
- Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications
- Evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas.
- Illustrate Virtualization for Data-Center Automation.

UNIT I:

Introduction: Network centric computing, Network centric content, peer-to –peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. **Parallel and Distributed Systems:** Introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, model concurrency with Petri Nets.

UNIT II:

Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing,

UNIT-III

Cloud Computing : Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, The Map Reduce Program model, HPC on cloud, biological research.

UNIT IV:

Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades,

UNIT-V

Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT VI:

Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2), **Cloud Security:** Cloud security risks, security – a top concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT VII:

Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Installing Simple Notification Service on Ubuntu 10.04, Installing Hadoop on Eclipse, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), **Google:** Google App Engine, Google Web Toolkit (Text Book 2), **Microsoft:** Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book2).

Text Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter,TMH

Reference book:

1. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi,TMH

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML13 ELECTIVE-I EVOLUTIONARY COMPUTING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Syllabus:

1. Problems to Be Solved: Optimisation, Modelling, and Simulation Problems, Search Problems, Optimisation Versus Constraint Satisfaction, The Famous NP Problems.

   Evolutionary Computing: The Main Evolutionary Computing Metaphor, The Inspiration from Biology, Evolutionary Computing: Why?
2. Evolutionary Algorithm: Components of Evolutionary Algorithms, An Evolutionary Cycle by Hand, Example Applications, The Operation of an Evolutionary Algorithm, Natural Versus Artificial Evolution, Evolutionary Computing, Global Optimisation, and Other Search Algorithms.

   Representation, Mutation, and Recombination: Representation and the Roles of Variation Operators, Binary Representation, Integer Representation, Real-Valued or Floating-Point Representation, Permutation Representation, Tree Representation.
3. Fitness, Selection, and Population Management: Population Management Models, Parent Selection, Survivor Selection, Selection Pressure, Multimodal Problems, Selection, and the Need for Diversity.

   Popular Evolutionary Algorithm Variants: Genetic Algorithms, Evolution Strategies, Evolutionary Programming, Genetic Programming, Learning Classifier Systems, Differential Evolution, Particle Swarm Optimisation, Estimation of Distribution Algorithms.
4. Parameters and Parameter Tuning: Evolutionary Algorithm Parameters, EAs and EA Instances, Designing Evolutionary Algorithms, The Tuning Problem, Algorithm Quality: Performance and Robustness, Tuning Methods.

   Parameter Control: Introduction, Examples of Changing Parameters, Classification of Control Techniques, Examples of Varying EA Parameters,
5. Working with Evolutionary Algorithms: What Do You Want an EA to Do?, Performance Measures, Test Problems for Experimental Comparisons, Example Applications.

   Hybridisation with Other Techniques: Memetic Algorithms, Motivation for Hybridising EAs, Structure of a Memetic Algorithm, Adaptive Memetic Algorithms, Design Issues for Memetic Algorithms, Example Application: Multistage Memetic Timetabling.
6. Nonstationary and Noisy Function Optimisation: Characterisation of Nonstationary Problems, The Effect of Different Sources of Uncertainty, Algorithmic Approaches

   Multi-objective Evolutionary Algorithms: Multi-objective Optimisation Problems, Dominance and Pareto Optimality, EA Approaches to Multi-objective Optimisation, Example Application: Distributed Coevolution of Job Shop Schedules.
7. Constraint Handling: Two Main Types of Constraint Handling, Approaches to Handling Constraints, Example Application: Graph Three-Colouring

Interactive Evolutionary Algorithms: Characteristics of Interactive Evolution, Algorithmic Approaches to the Challenges of IEAs, Interactive Evolution as Design vs. Optimisation, Example Application: Automatic Elicitation of User Preferences.

Text book:

Introduction to Evolutionary Computing, A.E. Eiben , J.E. Smith, © Springer-Verlag Berlin Heidelberg 2015

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML14 ELECTIVE-II BIG DATA ANALYTICS

Instruction: 3Periods/week	**Time:3Hours**	**Credits:3**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

Course Objectives:

This course is aimed at enabling the students to

- Provide an overview of an exciting growing field of big data analytics.
- Introduce the tools required to manage and analyze big data like Hadoop, NoSQL, Map Reduce, HIVE, Cassandra, Spark.
- Teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- Optimize business decisions and create competitive advantage with Big Data analytics

Course Outcomes:

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

- Illustrate on big data and its use cases from selected business domains.
- Interpret and summarize on NoSQL, Cassandra
- Analyze the HADOOP and Map Reduce technologies associated with big data analytics and explore on Big Data applications Using Hive.
- Make use of Apache Spark, RDDs etc. to work with datasets.
- Assess real time processing with Spark Streaming.

UNIT I:

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT II:

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer- peer replication, sharding and replication, consistency, relaxing consistency, version stamps, Working with Cassandra ,Table creation, loading and reading data.

UNIT III:

Data formats, analyzing data with Hadoop, scaling out, Architecture of Hadoop distributed file system (HDFS), fault tolerance ,with data replication, High availability, Data locality , Map Reduce Architecture, Process flow, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization.

UNIT-IV:

Introduction to Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, Logical joins, Window functions, Optimization, Table partitioning, Bucketing, Indexing, Join strategies.

UNIT V:

Apache spark- Advantages over Hadoop, lazy evaluation, In memory processing, DAG, Spark context, Spark Session, RDD, Transformations- Narrow and Wide, Actions, Data frames ,RDD to Data frames, Catalyst optimizer, Data Frame Transformations, Working with Dates and Timestamps, Working with Nulls in Data,

UNIT-VI

Working with Complex Types, Working with JSON, Grouping, Window Functions, Joins, Data Sources, Broadcast Variables, Accumulators, Deploying Spark- On-Premises Cluster Deployments, Cluster Managers- Standalone Mode, Spark on YARN , Spark Logs, The Spark UI- Spark UI History Server, Debugging and Spark First Aid

UNIT VII:

Spark-Performance Tuning, Stream Processing Fundamentals, Event-Time and State full Processing - Event Time, State full Processing, Windows on Event Time- Tumbling Windows, Handling Late Data with Watermarks, Dropping Duplicates in a Stream, Structured Streaming Basics - Core Concepts, Structured Streaming in Action, Transformations on Streams, Input and Output.

Text Books:

1. Big Data, Big Analytics: Emerging, Michael Minnelli, Michelle Chambers, and AmbigaDhiraj
2. SPARK: The Definitive Guide, Bill Chambers &MateiZaharia, O'Reilley, 2018Edition
3. Business Intelligence and Analytic Trends for Today's Businesses", Wiley,2013
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World Polyglot Persistence", Addison-Wesley Professional,2012
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley,2012

Reference Books:

1. "Hadoop Operations", O'Reilley, Eric Sammer,2012
2. "Programming Hive", O'Reilley, E. Capriolo, D. Wampler, and J. Rutherglen,2012
3. "HBase: The Definitive Guide", O'Reilley, Lars George,2011
4. "Cassandra: The Definitive Guide", O'Reilley, Eben Hewitt,2010
5. "Programming Pig", O'Reilley, Alan Gates,2011

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML14 ELECTIVE-II INTERNET OF THINGS

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:

- Vision and Introduction to Internet of Things(IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

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

- Explain in a concise manner how the general Internet as well as Internet of Things work.
- Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
- Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
- Develop prototype models for various applications using IoT technology.

UNIT I:

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

UNIT II:

Business Models for Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High- level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

UNIT III:

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

UNIT IV:

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT V:

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology,Sensing the World.

Text Books:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press,2015

Reference Books:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally,Wiley
Getting Started with the Internet of Things,CunoPfister , Oreilly

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML14 ELECTIVE-II PATTERN RECOGNITION

Instruction: 3Periods/week	**Time:3Hours**	**Credits:3**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

Course Objectives: From the course the student will learn

- Concepts of Algorithms, Searching and Sorting techniques, Trees, Binary trees, representation, traversal.
- Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Searchtrees.
- AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of searchtrees.

Course Outcomes:

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

- Ability to write and analyze algorithms for algorithm correctness and efficiency
- Master a variety of advanced Abstract Data Type (ADT) and data structures and their Implementation
- Demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of reallife
- Design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees
- Ability to compare various search trees and find solutions for IT related problems

UNIT I:

Introduction: Overview of Pattern Recognition- Relations of PR with other Systems, PR Applications, Different Approaches to Pattern Recognition- Statistical Approach to PR, Syntactic Approach to PR, Neural Approach to PR, Examples of PR Approaches. Other Approaches to PR.

UNIT II:

Structure of PR System: Abstract Representation of PR Mappings, Structure of PR System, Patterns and Feature s, Feature Extraction Examples, Object Description and Classification, Figure Recognition, Numerical Results and Analysis. Feature Vector and Feature Space, training and Learning in PR System.

UNIT III:

Statistical Pattern Recognition: Introduction, Gaussian Case and Class Dependency, Discriminate Function, Examples, Classifier Performance

UNIT IV:

Training: Parametric Estimation and Supervised Learning, Maximum Likely Hood Estimation, Bayesian Parameter Estimation Approach , Parzen Windows, Direct Classification Using Training set., Unsupervised Learning and Clustering, Clustering for Unsupervised Learning and Classification

UNIT V:

Syntactic Pattern Recognition: Overview of Syntactic Pattern Recognition, Grammar Based Approaches and Applications, Examples of String Generation as Pattern Description, 2-D line Drawing Description Grammar, Character Description using PDL, Object Description using Projected Cylinder Models, Block World Description Models, Heuristic Generation of Grammars

UNIT VI:

Recognition of Syntactic Description: Recognition by Matching, Recognition by Parsing, CYK Parsing Algorithm, Augmented Transition Nets in Parsing, Graph Based structure representation, Structured Strategy to Compare Attributed Graphs.

UNIT VII:

Neural Pattern Recognition: Introduction to Neural Networks,, Neural Network Structure for PR Applications, Physical Neural Networks, ANN Model, NN Based PR Association, Matrix Approaches and Examples

UNIT VIII:

Feed Forward Neural Networks: Training by Back Propagation, Hope field Approach to Neural Computing, Other related Neural Approaches and Extensions

Text Book:

1. Pattern Recognition- Statistical, Structural and Neural Approaches, Rober.J. Shelkoff, John Wiley & Sons, NY1992,ISBN0-471-52974-5

Reference Book:

1. Neural Networks for pattern recognition, Christopher M.Bishop Oxford UniversityPress.
2. Pattern Classification, Richard O.Duda ,Wiley IndiaEdition

Common for M.Tech (CST, IT, CN&IS, AI&ML)

Instruction: 3Periods/week	**Time:3Hours**	**Credits:2**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis,interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 ndEdition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Detailed Syllabus for M.Tech (AI&ML) First Semester
MTAIML16 ORGANIZATIONAL BEHAVIOR (AUDIT COURSE)

Common for M.Tech (CST, IT, CN&IS, AI&ML)

Instruction: 3Periods/week	**Time:3Hours**	**Credits:0**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

UNIT-I Organizational Behavior: Concept of Organization - Concept of Organizational Behavior - Nature of Organizational Behavior - Role of Organizational behavior - Disciplines contributing to Organizational Behavior.

UNIT-II Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation: Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and McGregor's Theory X and Theory Y.

UNIT –III Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

UNIT-IV Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

UNIT-V Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication : Downward, Upward and Horizontal communication.

UNIT-VI Organizational conflicts: Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Inter organizational conflict - Conflict management.

UNIT –VII Organizational Change: Nature - Factors in Organizational change -Planned change: Process of planned change - Resistance to change: Factors in resistance to change - Overcoming resistance to change.

Text Books:

1.L.M.Prasad: Organizational Behavior, Sultan Chand & Sons, New Delhi -110002
2.K. Aswathappa: Organizational Behavior, Himalaya Publishing House, New Delhi

Reference Books:

1. Stephen Robbins: Organizational Behavior, Pearsons Education, New Delhi.

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML17 ARTIFICIAL INTELLIGENCE LAB

Instruction: 3Periods/week **Time:3Hours** **Credits:2**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To apply the techniques in applications which involve perception, reasoning and learning.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

- Apply the basic principles of AI in problem solving using LISP/PROLOG/ PYTHON
- Implement different state space search algorithms for Game playing using LISP/PROLOG
- Develop an Expert System using JESS/PROLOG

List of Experiments

1. Implementation of DFS for water jug problem using LISP/PROLOG/PYTHON
2. Implementation of BFS for tic-tac-toe problem using LISP/PROLOG/Java
3. Implementation of TSP using heuristic approach using Java/LISP/Prolog
4. Implementation of Simulated Annealing Algorithm using LISP/PROLOG/ PYTHON
5. Implementation of Hill-climbing to solve 8- Puzzle Problem using PYTHON/JAVA
6. Implementation of Monkey Banana Problem using LISP/PROLOG/ PYTHON
7. Implementation of A* Algorithm using LISP/PROLOG/ PYTHON
8. Implementation of AO* Algorithm using LISP/PROLOG/ PYTHON
9. Implementation of Min-Max Game playing algorithm using LISP/PROLOG/ PYTHON
10. Implementation Expert System with forward chaining using JESS/CLIPS
11. Implementation Expert System with backward chaining using RVD/PROLOG

Detailed Syllabus for M.Tech (AI&ML) First Semester

MTAIML18 DATA MINING LAB USING PYTHON

Instruction: 3Periods/week **Time:3Hours** **Credits:2**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Scope: Lab experiments using R / Python on benchmark datasets

1. Demonstration of pre-processing on some datasets.
2. Demonstration of Data visualization
3. Demonstration of Data dimensionality reduction techniques
4. Demonstration of Classification process using different classifiers
5. Demonstration of Clustering using different clustering methods
6. Demonstration of Association rule extraction using various association algorithms.

II-SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTAIML21	Machine Learning	3	-	70	30	100	3
MTAIML22	Soft Computing	3	-	70	30	100	3
MTAIML23	Elective-III 3	3	-	70	30	100	3
MTAIML24	Elective-IV	3	-	70	30	100	3
MTCST25	Entrepreneurship (Audit Course)	3	-	70	30	100	0
MTAIML26	Machine Learning Lab	-	3	50	50	100	2
MTAIML27	Soft Computing Lab	-	3	50	50	100	2
MTAIML28	Mini Project With Seminar	-	3	-	100	100	2
	Total	15	9	450	350	800	18

Elective-III: Computer Vision/Natural Language Processing/Recommender Systems
Elective-IV: Robotics and Intelligent Systems/Reinforcement Learning/NoSQL Databases

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML21 MACHINE LEARNING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Study 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

- Understand the distribution and diversity of Data
- Extract features useful for building predictive models.
- Gain knowledge on Supervised and unsupervised Learning techniques
- Analyze Statistical learning techniques and Logistic Regression
- Select appropriate Support Vector Machines and Perceptron Algorithm
- Compare the performance of different learning models

UNIT I:

Introduction to Machine Learning, Applications of Machine learning,

Supervisory Learning: Learning classes from examples, Vapnik-Charvonenkis (VC) Dimension, Probably Approximately Correct(PAC) Learning, noise, learning multiple classes, regression, model selection and generalization, dimensions of supervised machine learning algorithms

UNIT II:

Bayesian Decision Theory: Classification, losses and risks, discriminant functions, utility theory, value of information,

Parametric Methods: Maximum likelihood estimation, evaluating an estimator with bias and variance, Bayes' estimator, parametric classification, regression, tuning model complexity: bias vs variance dilemma, model selection procedures

UNIT III:

Multivariate methods: Multivariate data, parameter estimation, missing value imputation, univariate normal distribution and classification, discrete features, regression, Dimensionality Reduction: Subset selection, PCA, Factor Analysis, multi-dimensional scaling, LDA

UNIT IV:

Clustering: Mixture densities, K-means clustering, Expectation Maximization algorithm, mixtures of Latent Variable Models, Supervised learning after clustering, Hierarchical clustering, choosing number of clusters

UNIT V:

Non-parametric methods: Non-parametric methods density estimation, generalisation to multivariate data, nonparametric classification, condensed nearest neighbors, non-parametric regression: smoothing models, choosing smoothing parameters

UNIT VI:

Decision trees and Linear Discrimination: Univariate classification and regression trees, rule extraction from trees, Multivariate trees,

Generalizing linear model, two class and multi-class geometry of linear discriminant, pairwise separation, gradient descent, logistic discrimination for binary and multi-class problems, discrimination by regression, Support vector machines, optimal separating hyperplane, kernel functions for non-separable spaces, SVM for regression.

UNIT VII:

Hidden Markov Models: Discrete Markov processes, Hidden Markov Models, Three basic problems of HMM, Evaluation problem, finding the state sequence, Learning model parameters, continuous observations, Model selection in HMM

Assessing and comparing classification Algorithms: Cross-validation and resampling methods, measuring error, interval estimation, hypothesis testing

Text Book:

1. Introduction to Machine Learning by Ethem Alpaydin, Prentice-Hall of India, 2006

Reference books:

1. Applied Machine Learning, M.Gopal, McGraw Hill Education, 2019
2. Machine Learning: The art and Science of Algorithms that make sense of Data, Peter Flach, Cambridge University Press,2012
3. Machine Learning, Tom Mitchell , McGraw Hill, 1997

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML22 SOFT COMPUTING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:

- Aims to provide comprehensive understanding of Soft computing approaches for AI problem solving
- Develops in depth knowledge on concepts related to different types of neural networks
- Provides in depth knowledge on concepts related to Fuzzy logic, membership value assignment and reasoning with fuzzy quanities
- Helps to understand the development of Fuzzy Inference systems and Fuzzy expert systems
- Introduces the concepts related to Genetic algorithms for learning from examples

Course Outcomes

After completion of course, students would be able to:

- Build neural networks to extract patterns from data
- Build fuzzy inference systems and develop fuzzy expert systems
- Write genetic algorithms for learning the hyper parameters for data classification

UNIT-I:

Introduction to Soft computing, Artificial Neural Network: An Introduction, Evolution of Neural Networks, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, McCulloch–Pitts Neuron, Linear Separability, Hebb Network.

UNIT-II:

Supervised Learning Network, Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons, Back-Propagation Network, Radial Basis Function Network, Time Delay Neural Network, Associative Memory Networks, Hopfield Networks

UNIT-III :

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Tolerance and Equivalence Relations, Noninteractive Fuzzy Sets, Membership Function, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments, Methods of Membership Value Assignments, Defuzzification

UNIT-IV:

Fuzzy Arithmetic and Fuzzy Measures, Measures of Fuzziness, Fuzzy Rule Base and Approximate Reasoning, Fuzzy Propositions, Formation of Rules, Decomposition of Rules (Compound Rules), Aggregation of Fuzzy Rules, Fuzzy Reasoning (Approximate Reasoning), Fuzzy Inference Systems (FIS), Overview of Fuzzy Expert System

UNTI-V :

Genetic Algorithm, Introduction, Biological Background, Genetic Algorithm and Search Space, Basic Terminologies in Genetic Algorithm, General Genetic Algorithm, Operators, Stopping

Condition for Genetic Algorithm Flow, Constraints, Problem Solving Using Genetic Algorithm, The Schema Theorem, Classification of Genetic Algorithm, Advantages and Limitations of Genetic Algorithm, Applications of Genetic Algorithm.

Text Books:

1. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 3ed, Wiley India.
2. Fakhreddine O. Karray, Clarence W. De Silva, Soft Computing and Intelligent Systems Design: Theory, Tools and Applications, 1e, Pearson.

References:

1. Fundamentals of Neural Networks – Laurene Fauseett, Prentice Hall India, New Delhi, 1994.
2. Timothy J. Ross,Fuzzy Logic with Engineering Applications, 3 ed, Wiley India
3. E – Neuro Fuzzy and Soft computing – Jang J.S.R., Sun C.T and Mizutami, Prentice hall New Jersey, 1998

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML23 ELECTIVE-III COMPUTER VISION

Instruction: 3Periods/week Time:3Hours Credits:3
Internal: 30Marks External:70Marks Total: 100Marks

Course Objective:
To Recognize and describe both the theoretical and practical aspects of computing with images and to Connect issues from Computer Vision to Human Vision

Course Outcomes:
- Provide an introduction to computer vision including fundamentals of image formation
- Enumerate the concepts of Feature detection and Matching
- Discuss about Image Segmentation Techniques
- Discuss applications of Feature based alignment like pose estimation
- Discuss different recognition techniques.

UNIT-I
Introduction: What is computer vision, A brief history, Image Formation, Geometric primitives and transformations, Photometric image formation, The digital camera.

UNIT-II
Feature detection and matching: Points and patches, Feature detectors, Feature descriptors, Feature matching, Feature tracking, Application: Performance-driven animation, Edges, Application: Edge editing and enhancement, Lines, Application: Rectangle detection.

UNIT-III
Segmentation: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts and energy-based methods, Application: Medical image segmentation.

UNIT-IV
Feature-based alignment: 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration, Calibration patterns, Vanishing points, Application: Single view metrology, Rotational motion, Radial distortion.

UNIT-V
Recognition: Objectdetection,Face detection, Pedestrian detection, Face recognition,Eigenfaces, Active appearance and 3D shape models, Application: Personal photo collections, Instance recognition, Category recognition, Context and scene understanding.

Text Books:
1. RichardSzeliski,"ComputerVision:Algorithmsand Applications",Springer,2010.
2. Rafael C. Gonzalez "Digital Image Processing", Pearson Education; Fourth edition (2018)

Reference Books:
1. Forsyth/Ponce,"ComputerVision:AModernApproach",PearsonEducationIndia;2nd edition(2015)
2. S.Nagabhushana,"ComputerVisionandImageProcessing",NewAgeInternationalPvtLtd;First dition(2005)

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML23 ELECTIVE-III NATURAL LANGUAGE PROCESSING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- 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:

After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT I:

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II:

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III:

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

UNIT IV:

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic,

Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V:

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication,2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

1. Language Processing with Java and LingPipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher,2015.
2. Natural Language Processing with Java, 2nd Edition, Richard M Reese, OReilly Media,2015.
3. Handbook of Natural Language Processing, Second, NitinIndurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rd Edition, TanveerSiddiqui, U.S. Tiwary, Oxford University Press,2008.

MTAIML23 ELECTIVE-III RECOMMENDER SYSTEMS

Instruction: 3Periods/week **Time:3Hours** **Credits:3**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:
This course covers the basic concepts of recommender systems, including personalization algorithms, evaluation tools, and user experiences

Course Outcomes:

- Describe basic concepts behind recommender systems
- Explain a variety of approaches for building recommender systems
- Describe system evaluation methods from both algorithmic and users' perspectives
- Describe applications of recommender systems in various domains

1. **Collabarative recommendations**: User-based nearest neighbor recommendation, Item -based nearest neighbor recommendation, About ratings, Model-based and Preprocessing-based approaches, Recent practical approaches and Systems.
2. **Content- based recommendation:** Content representation and content similarity, Similarity-based retrieval, Other text classification methods.
3**. Knoledge-based recommendation**: Introduction ,Knowledge representation and reasoning, Interacting with constraint--based recommenders, Interacting with case-based recommenders, Example applications.
4. **Hybrid recommendation approaches:** Opportunities for hybridization , Monolithic hybridization design, Parallelized hybridization design, Pipelined hybridization design.
5**. Evaluating recommender systems:** Introduction , General properties of evaluation research, Popular evaluation designs, Evaluation on historical datasets, Alternate evaluation designs.
6. **Attacks on collaborative recommender systems**: A first example, Attack dimensions , Attack types, Evaluation of effectiveness and countermeasures, Countermeasures, Privacy aspects - distributed collaborative filtering.
7. **Online consumer decision making**: Introduction , Context effects, Primacy/recency effects, Further effects, Personality and social psychology. Recommender systems and the next-generation web: Trust aware recommender systems, Folksonomies and more, Ontological filtering, Extracting semantics from the web.

Text Book:
1. Recommender Systems: An Introduction by Dietmar Jannach, Markus Zanker, Alexander Felfernig, Gerhard Friedrich, Cambridge University Press.

Reference Book:
1. Recommender Systems: The Textbook by Charu C. Aggarwal, Springer Publications.

MTAIML24 ELECTIVE-IV ROBOTICS AND INTELLIGENT SYSTEMS

Instruction: 3Periods/week Time:3Hours Credits:3
Internal: 30Marks External:70Marks Total: 100Marks

Course Objective:
To understand the use of robotics in building intelligent systems.

Course Outcomes:
- Enumerate the fundamentals of robotics and Artificial Inteligence (AI).
- Demonstrate how to setting up a Robot.
- Discuss about the practical Robot Design Process.
- Discuss Object Recognition Using Neural Networks and Supervised Learning

UNIT-I:
Foundation for Advanced Robotics and AI: The basic principle of robotics and AI, What is AI and what is it not, The example problem, Artificial intelligence and advanced robotics techniques, Introducing the robot and our development environment, Software components (ROS, Python, and Linux), Robot control systems and a decision-making framework, The robot control system – a control loop with soft real-time control

UNIT-II:
Setting Up Your Robot: Technical requirements, What is a robot, Robot anatomy, Subsumption architecture, Software setup, Hardware, Assembling the tracks,Mounting the tracks, Arm base assembly, Wiring.

UNIT-III:
A Concept for a Practical Robot Design Process, A systems engineering-based approach to robotics, Use cases, The problem –put away the toys, Project goals, Decomposing hardware needs, Breaking down software needs.

UNIT-IV:
Object Recognition Using Neural Networks and Supervised Learning: Technical requirements, The image recognition process, The image recognition training and deployment process – step by step, The convolution neural network process, Build the toy/not toy detector

UNIT-V:
Picking up the Toys: Technical requirements, Task analysis, Summary of robot arm learning process, Teaching the robot arm, Version one – action state reinforcement learning, Adaptive learning rate, Q-learning implementation,Google's SAC-X, Amazon Robotics Challenge

Text Books:
1. Francis X. Govers, Artificial Intelligence forRobotics: Build intelligent robots that perform human tasks usingAI techniques, PACKT
2. J. J. Craig, Introduction to Robotics, Addison Wesley Publishers, 2005

Reference Books:
1. M. Negnevitsky, Artificial Intelligence, A guide to intelligent systems Addison-Wesley, 2005

MTAIML24 ELECTIVE-IV REINFORCEMENT LEARNING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objective:

To provide the fundamentals of Reinforcement learning.

Course Outcomes:

- Enumerate the elements of Reinforcement Learning
- Solve the n-armed Bandit problem
- Compare different Finite Markov Decision Process
- Discuss about Monte Carlo Methods in solving real world problems
- List the Applications and Case Studies of Reinforcement Learning

UNIT-I

The Reinforcement Learning Problem: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, Summary, History of Reinforcement Learning.

UNIT-II

Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits)

UNIT-III

Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes,

Value Functions, Optimal Value Functions, Optimality and Approximation.

UNIT-IV

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns

UNIT-V

Applications and Case Studies: TD-Gammon, Samuel's Checkers Player, TheAcrobot, Elevator Dispatching, Dynamic Channel Allocation, Job-Shop Scheduling.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction",2nd Edition,The MIT Press,2018

2. Marco Wiering , Martijn van Otterlo Reinforcement Learning: State-of-the-Art (Adaptation, Learning, and Optimization (12)) 2012th Edition

Reference Books:

1. Vincent François-Lavet , Peter Henderson , Riashat Islam, An Introduction to Deep Reinforcement Learning (Foundations and Trends(r) in Machine Learning) , 2019

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML24 ELECTIVE-IV NoSQL DATABASES

Instruction: 3Periods/week **Time:3Hours** **Credits:3**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

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

- Enumerate different features of NOSQL Databases
- Compare different data models
- Design a Key-Value Database for a real world problem
- Design a Document Database for a real world problem
- Design a Graph Database for a real world problem

UNIT-I:

Introduction to NoSQL. The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters,The Emergence of NoSQL.

Aggregate Data Models, Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases.

UNIT-II :

More Details on Data Models, Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access, Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication, Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums

UNIT-III :

Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, When Not to Use, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets

UNIT-IV:

Document Databases, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure

UNIT-V :

Column-Family Stores, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters. **Graph Databases**, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services Recommendation Engines

Text Books:

1. Sadalage, P. & Fowler, M., NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. (1st Ed.). Upper Saddle River, NJ: Pearson Education, In, 2012.

Reference Books:

1. Gauravvaish, Getting started with NoSQL , PACKT publishing, ISBN: 978184969488
2. Redmond, E. & Wilson, J., Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement (1st Ed.), 2012
3. Raleigh, NC: The Pragmatic Programmers, LLC. ISBN-13: 978- 1934356920 ISBN-10: 1934356921

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML25 ENTREPRENEURSHIP (AUDIT COURSE)

Instruction: 3Periods/week **Time:3Hours** **Credits:0**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Unit-I

Basic Concepts of Management: Management:-Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management.

Unit-II

Forms of Business Organizations: Introduction, Types of Business organizations**: Private Sector**-Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations**; Public sector**-Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Unit-III

ProductionandoperationsManagement: Plantlocation-Factorstobeconsidered in the selection of Plant location; Break - even analysis- Significance andmanagerialapplications;ImportanceofProductionPlanningandControlanditsFunctions;Human Resource Management and Functions of Human Resource Manager (in brief);Functions of Marketing; Methods of Raising Finance.

Unit-IV

Entrepreneurship: Definition, Characteristics and Skills ,Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Unit-V

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ;Steps for starting a small enterprise -Incentives for Small Scale Industries by Government.

Text Books:

1. Sharma,S.C,andBanga,T.R.,IndustrialOrganization&EngineeringEconomics, KhannaPublishers,Delhi,2000.
2. Vasant Desai,The Dynamics of Entrepreneurial Development and Management (PlanningforfutureSustainablegrowth),HImalayanPublishingHouse,2018.

Reference Books:

1. Aryasri , A.R., Management Science,McGraw HIll Education (India Private Limited , NewDelhi2014.
2. Sheela,P.,andJagadeswaraRao,K.,Entrepreneurship,ShreePublishingHouse,Guntur,

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML26 MACHINE LEARNING LAB

Instruction: 3Periods/week **Time:3Hours** **Credits:2**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

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

- Implement machine learning algorithms to real world problems
- Choose appropriate machine learning algorithm for a problem
- Interpret the results of two different machine learning algorithms

List of Experiments:

1. Implement **Principal Component Analysis (PCA)** on an unsupervised dataset using NumPy.
2. Implement and demonstrate the **Singular Value Decomposition (SVD**) on a given set of training data samples. Read the training data from a .CSV file and use NumPy.
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm** to output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Write a program to implement the **naïveBayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your classifier.
7. Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using **k-Means algorithm**. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement **k-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.
11. Create the following **plots** using Matplotlib, Pandas Visualization, Seaborn on iris dataset, wine reviews datasets.

a) Scatter Plot
b) Line chart
c) Histogram
d) Heatmap

Text Books:

1. Hands–On Machine Learning with Scikit–Learn and TensorFlow 2e: Concepts, Tools, and Techniques to Build Intelligent Systems, AurelienGeron, 2019.

References:

1. https://scikit-learn.org/stable/tutorial/index.html
2. https://archive.ics.uci.edu/ml/index.php
3. https://towardsdatascience.com/pca-and-svd-explained-with-numpy-5d13b0d2a4d8
https://towardsdatascience.com/introduction-to-data-visualization-in-python-89a54c97fbed

Detailed Syllabus for M.Tech (AI&ML) Second Semester

MTAIML27 SOFT COMPUTING LAB

Instruction: 3Periods/week	**Time:3Hours**	**Credits:2**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

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

- Implement neural networks to solve real world problems
- Choose appropriate pre-trained model to solve real time problem
- Parameter tuning using Genetic algorithms
- Implement Fuzzy Inference

Software Packages required:

- Open source tools for building neural network models, fuzzy logic and genetic algorithms

List of Experiments:

1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
2. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
3. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
4. Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset.
5. Design a neural network for predicting house prices using Boston Housing Price dataset.
6. Implement fuzzy inference for image segmentation.
7. Implement the house price prediction problem with fuzzy reasoning
8. Implement the Fuzzy C-Means algorithm for clustering
9. Implement the basic concepts of genetic algorithms for learning
10. Implement genetic algorithms for hyper parameter tuning in neural networks for classifying IMDB dataset.

Text Books:

1. Ivan Gridin, “Learning Gentic Algorithms with Python”, BPB publishers, 2021
2. Rajasekaran and Pai, “Neural Networks, Fuzzy Logic and Evolutionary Algorithms: Synthesis and Applications, PHI, 2017

III-SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTAIMLR31	Elective-V	3	-	70	30	100	3
MTAIMLR32	Open Elective	3	-	70	30	100	3
MTAIMLR33	Dissertation-I / Industrial project		-	100	-	100	10
Total		**6**	**-**	**240**	**60**	**300**	**16**

Elective V : Deep Learning/Expert Systems/High Performance Computing
Open Elective : Business Analytics/Operations Research/Social Media Analytics

Detailed Syllabus for M.Tech (AI&ML) Third Semester
MTAIML31 ELECTIVE-V DEEP LEARNING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**
Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:
The objective of this course is to cover the review of ML, fundamentals of feed forward neural networks, regularization methods and optimization in deep models as well as some advanced topics such as convolutional neural networks, recurrent neural networks, long short term memory cells.

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

- Explore feed forward networks and Deep Neural networks
- Mathematically understand the deep learning approaches and paradigms
- Complex feature extraction with CNN and RNNs
- Apply the deep learning techniques for various applications

1. **Machine Learning Basics:**
Learning Algorithms, Capacity, Overfitting, and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised and Unsupervised Learning algorithms, Stochastic Gradient Descent, Building a ML algorithm, Challenges and Motivation to Deep learning

2. **Deep forward Networks**:
Learning XOR, Gradient -based Learning, Hidden Units, Architecture Design, Back-propagation and other Differentiation algorithms

3. **Regularization for Deep Learning**:
Parameter Norm Penalties, Norm Penalties as constrained Optimization, Regularization and under -constrained problems, dataset Augmentation, Noise robustness, semi-supervised learning, multitask learning, Early stopping, parameter tying and setting, sparse presentations, bagging and other ensemble methods, dropout

4. **Optimization for Training Deep Models**:
Difference between learning and pure optimization, Challenges in NN optimization, Basic algorithms, parameter Initialization strategies, Algorithms with adaptive learning rates,

5. **Convolutional Networks:**
Convolution operation**,** Motivation, pooling, convolution and pooling as an infinitely strong prior, variants of basic convolution function, structured outputs, data types, efficient convolution algorithms, random or unsupervised features

6. **Sequence Modeling: Recurrent and recursive nets:**
Unfolding computational graphs, recurrent neural networks, bidirectional RNNs, Encoder-decoder Sequence-to-sequence Architectures, Deep recurrent networks, recursive neural networks, challenge of long-term dependencies, echo state networks, leaky units and other strategies for multiple time scales, Long Short -term Memory (LSTM) and other gated RNNs

7. **Practical methodology and applications:**
Performance metrics, default baseline models, determining whether to gather more data, selecting hyperparameters, debugging strategies, multi-digit number recognition, large scale deep learning,

applications in computer vision and NLP

Text Book:

1. "Deep Learning", Ian Goodfellow, YoshuaBengio and Aaron Courville, published by MIT Press,UK, 2017 Series
2. Deep Learning with Keras: The Textbook by Antonio Gulli and Sujit Pal, PacktPublishing Ltd, Birmingham, UK, April 2017

Reference Book:

1. Deep Learning with TensorFlow, The Textbook by Giancarlo Zaccone, Md. Rezaul Karim, and Ahmed Menshawy, Packt Publishing Ltd, Birmingham, UK, April 2017.

Detailed Syllabus for M.Tech (AI&ML) Third Semester

MTAIML31 ELECTIVE-V EXPERT SYSTEMS

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

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1. Introduction: Introduction to Expert System, Definitions, Importance of Expert System, Characteristic features of Expert System, Applications of Expert System, Different categories of Expert Systems, Rule Based System Architecture, Neural Network Architecture

2. Knowledge Representations: Components of Knowledge in Expert system, OAV Triplets, Semantic Networks, Frams Representation via Logic Statements, Production Systems, Clause, Properties Rule properties, Rule Conversions, Multiple Conclusions, Neural Networks via Rule Based System

3. Knowledge Acqusition: Introduction Knowledge Acquisition and domain Expert, Selectio of the domain, Selection of the Knowledge Engineers, Selection of the Expert, Meetings an Plans, Organization of Meetings, Documentation, Multiple domain Experts, Knowledge Acquisition – An Example, Knowledge Acquisition using Rule induction, Generating Rules from Trees, ID3 algorithm for Rule Generation

4. Design of Expert System: Introduction, Selecting the appropriate Problem, Stages in the Developing Expert System, Errors in Development stages, Software Engineering and Expert Systems, The Expert System Life Cycle, Expert System Design Examples- Certainty factors, Decision tress

5. Inference Engine: Inference Engine, Insight of Inference Engine, Search Strategies, Forward Chaining Algorithm, Algorithms for forward Chaining- Baseline Version, Backward Chaining Algorithm, Algorithms for Back word Chaining-Baseline Version, Mixed Modes of Chaining, Work sheets for Forward and Back word Chaining.

6. Reasoning Under Uncertainity: Uncertainty, Types of Error, Error and Induction, Classic Probability, Temporal Reasoning and MorcovChines, TMS, Fuzzy Logic and Natural Languages computations, Probabilistic Reasoning, probabilistic Networks, Bayesian Networks. Use of Probability and Fuzzy logic in Expert System, Rule Induction by Machine Learning

7. Software Tools and Architectures: Overview of Expert System Tools, Expert System Shells, Multiple Paradigm Environments, Abstract architectures, Potential Implementation Problems, Selecting a Software Tool, Implementation Mechanism of tools, Black Board Architecture, Reasoning under uncertainty and Truth Maintenance Systems Case-study :A case-study on Financial planning Expert System, Sale Expert system, DENDRAL andMYCIN

Text Books:

1. Expert System principals and Programming-Giarratano.Rilev.2003
2. Introducion to Expert SystemsV-JamesP.Iginizo.Mc.Graw-Hill.inc
3. Introduction to Expert Systems Peter Jackson, Addison Wesley

Detailed Syllabus for M.Tech (AI&ML) Third Semester

MTAIML31 ELECTIVE-V HIGH PERFORMANCE COMPUTING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course Objectives:
The objective of the subject is to

- Introduce the basic concepts related to HPC architecture and parallel computing
- Discuss various computational techniques for studying soft matter systems.
- Apply these concepts to examine complex biomolecular/materials systems that generally require large-scale HPC platform with hybrid CPU-GPU architectures

Course Outcomes: After completion of this course

- Design, formulate, solve and implement high performance versions of standard single threaded algorithms.
- Demonstrate the architectural features in the GPU and MIC hardware accelerators.
- Design programs to extract maximum performance in a multicore, shared memory execution environment processor.
- Analyze Symmetric and Distributed architectures.
- Develop and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.

UNIT I:
Graphics Processing Units-Introduction to Heterogeneous Parallel Computing, GPU architecture, Thread hierarchy, GPU Memory Hierarchy.

UNIT II:
GPGPU Programming-Vector Addition, Matrix Multiplication algorithms. 1D, 2D, and 3D Stencil Operations, Image Processing algorithms – Image Blur, Gray scaling. Histogramming, Convolution, Scan, Reduction techniques.

UNIT III:
Many Integrated Cores-Introduction to Many Integrated Cores. MIC, Xeon Phi architecture. Thread hierarchy. Memory Hierarchy, .Memory Bandwidth and performance considerations.

UNIT IV:
Shared Memory Parallel Programming- Symmetric and Distributed architectures, OpenMP Introduction. Thread creation, Parallel regions. Worksharing, Synchronization.

UNIT V:
Message Passing Interface-MPI Introduction, Collective communication, Data grouping for communication.

Text Books:
1. Programming Massively Parallel Processors A Hands-on Approach, 3e Wen-Mei W Hwu, David B Kirk, MorgannKaufmann,2013.
2. Using OpenMP, Scientific and Engineering edition, Barbara Chapman, Gabriele Jost, Ruud vander Pas, MIT Press,2008.

Reference Books:

1. Intel Xeon Phi Coprocessor Architecture and Tools, RezaurRahman, Apress Open,2013.
2. Using MPI, Gropp, Lusk, Skjellum, The MIT press,2014.
3. High Performance Computing: Programming and Applications, John Levesque, CRC Press, 2010.

Detailed Syllabus for M.Tech (AI&ML) Third Semester

MTAIML32 OPEN ELECTIVE HIGH PERFORMANCE COMPUTING

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

Course objectives

1. to introduce students to problem solving with Business Analytics and the use of spreadsheets for descriptive analytics, data queries and visualization
2. to introduce students to statistical sampling, sampling distributions, confidence intervals and statistical inference
3. To familiarize students with various types of regression including simple linear regression and multiple linear regression
4. To introduce students to key concepts in statistical forecasting models for time series data
5. To familiarize students with predictive decision modeling, model analysis and developing spreadsheet applications including building linear optimization models on spreadsheets.

Course outcomes

After completion of the course the student should be able to:

1. Describe data and models used for Business Analytics and apply various descriptive analytic techniques to analyze data
2. Estimating population parameters, interval estimates, construct confidence intervals and perform hypothesis testing
3. Estimate and interpret the parameters of simple linear regression and multiple lineaR regressions
4. Apply forecasting models for various time series data including stationary time series, time series with linear trend and time series with seasonality

Syllabus:

1. Foundations of Business Analytics: Evolution of Business Analytics, Scope, data and models for Business Analytics, problem solving with Business Analytics, Analytics on spreadsheets, Excel functions for Database queries, Add-ons for Business Analytics. Descriptive Analytics: Data visualization, creating charts in MS Excel, Data Queries, Tables, sorting and filtering, Data summarization with statistics, Data exploration using Pivot tables

2. Statistical Sampling: methods, estimating population parameters, sampling error, sampling distributions, interval estimates, confidence intervals, using confidence intervals for decision making, prediction intervals Statistical Inference: Hypothesis testing, one-sample Hypothesis testing, two-tailed test of Hypothesis for mean, two-sample Hypothesis testing, Analysis of variance, chi-square test for independence

3. Trendiness and Regression: Modeling Relationships and trends in data, Simple linear regression, least squares regression, regression on analysis of variance, testing hypothesis for regression coefficients, Confidence intervals for regression coefficients, Residual analysis and regression assumptions, Multiple linear regression, building regression models, regression with categorical independent variables with two or more levels, regression with nonlinear terms, advanced techniques for regression modeling

4. Forecasting Techniques: Qualitative and judgmental forecasting, statistical forecasting models, forecasting models for stationery time series, forecasting models for time series with linear trend, forecasting models for time series with seasonality, selecting appropriate time-series-

based forecasting models, regression forecasting with casual variables, practice of forecasting

5. Spreadsheet modeling and Analysis: Strategies for predictive decision modelling, Implementing models on spreadsheet, spreadsheet applications in Business analytics, Model assumptions, complexity and realism, developing user-friendly applications, analyzing uncertainty and model assumptions, model analysis using analytics solver platform

6. Linear Optimization & amp; Applications: Building Linear Optimization Models on spreadsheets, solving Linear Optimization models, Graphical interpretation of linear optimization, Using optimization models of prediction and insight, Types of constraints in optimization models, process selection models,
Blending Models, Portfolio Investment models

Text Book

1. "Business Analytics: Methods, Models, and Decisions" James R. Evans, Pearson Publications, Second edition

Reference Book

1. "Business Analytics: The Science of Data-Driven Decision Making", U.Dinesh Kumar, Wiley Publications

Detailed Syllabus for M.Tech (AI&ML) Third Semester

MTAIML32 OPEN ELECTIVE OPERATIONS RESEARCH

Instruction: 3Periods/week **Time:3Hours** **Credits:3**

Internal: 30Marks **External:70Marks** **Total: 100Marks**

UNIT I: Overview of Operations Research, Types of OR Models , Phases of Operations Research– OR Techniques, Introduction to Linear Programming, Formulation of Linear Programming Problem, Graphical Solution; Graphical Sensitivity Analysis

UNIT II: Standard Form of LPP, Basic Feasible Solutions , Unrestricted Variables, Simplex Algorithm , Artificial Variables, Big M Me th od , Two Phase Simplex Method, Degeneracy, Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal And Dual Problems And Their Relations, Dual Simplex Method

UNIT III: Transportation Problem as LPP, Initial Solutions, North West Corner Rule, Lowest Cost Method, Vogels Approximation Method, Optimum Solutions of TPP, Degeneracy in Transportation, Transportation Algorithms

UNIT IV: Assignment Problem , Assignment Problem as LPP, Hungarian Method, Travelling Salesman Problem, Solutions Of TSP, Sequencing Problems, N-Jobs Two Machine Problems, N-Jobs K Machines Problems, Two-Jobs M- Machine Problems, Crew Scheduling Problems

UNITV: Network Representation of A Project, CPM and PERT , Critical Path Calculations, Time – Cost Optimizations, PERT Analysis and Probability Considerations, Resource Analysis in Network Scheduling.

UNIT VI: Replacement Problems-Individual And Group Replacement Policy, Reliability & System Failure Problems, Inventory-Factors Effecting Inventory-EOQ, Inventory Problems With and Without Shortages, Inventory Problems With Price Breakups, Multi Item Deterministic Problems. Probabilistic Inventory Problems

UNIT VII: Game Theory : Two Person Zero Sum Games , Mixed Strategy Games and Their Algorithms.

Text Books:

1. Operations Research, KantiSwaroop, P.K. Gupta, Man Mohan, Sulthan Chand& Sons Education

2. Operations Research–An Introduction, HandyATaha–PearsonEducation.

Detailed Syllabus for M.Tech (AI&ML) Third Semester

MTAIML32 OPEN ELECTIVE SOCIAL MEDIA ANALYTICS

Instruction: 3Periods/week	**Time:3Hours**	**Credits:3**
Internal: 30Marks	**External:70Marks**	**Total: 100Marks**

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1. **Introduction:** Analyzing social web, tools used, Basics of network structure, representing social networks, different network structures and properties, describing nodes and edges with centrality, describing networks, degree distribution, density, connectivity, centralization

2. **Network Visualization**: graph layoutgrid layout, visualizating network features, scale issues
   Tie strength: measuring tie strength, tie strength and network structure, tie strength and network propagation

3. **Trust**: defining trust, naunces of trust, measuring trust, trust in social media, inferring trust, network-based inference, and similarity based trust inference
   Understanding Structure through user attributes and behavior: Analyzing attributes and behavior, analyzing content, identifying user roles

4. **Building Networks**: Modeling networks, Sampling methods, egocentric network analysis
   Entity Resolution and Link Prediction: Link prediction, Entity resolution, Incorporating network data, case study for link prediction and entity resolution

5. **Propagation in Networks:** Epidemic models, Threshold models, firefighter problem, stochastic models, applications of epidemic models to social media
   Community-Maintained Resources: Supporting technologies for community- maintained resources, Wikies, message boards, repositories, user motivations

6. **Location-based Social Interaction:** Location technology, mobile location sharing, location-based social media analysis, privacy and location -based social media
   Social Information Filtering: Social sharing and social filtering, automated recommender systems, case study of trusty based movie recommendations

7. **Social Media in Public Sector**: Analyzing public-sector social media, case studies of congressional use of twitter, predicting elections and astroturfing
   Privacy: Privacy policies and settings, aggregation and data mining, deanonymization, inferring data, data ownership and maintaining privacy online, respecting privacy in social media analysis

Text Book:

1. "Analyzing the Social Web", Jennifer Golbeck Morgan Kaufmann publishers, 2013