JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
UNVERSITY COLLAGE OF ENGINEERING VIZIANAGARAM

PROGRAMME STRUCTURE & SYLLABUS

Master of Technology (M.Tech) in Data Science

(Applicable for batches admitted from 2020-2021)

DEPARTMENT OF INFORMATION TECHNOLOGY

I SEMESTER – M.Tech

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS1101	**Program Core-1** Essential for Machine Learning	PC	3	0	0	3
2	MTDS1102	**Program Core-2** Data Science Methodologies and Programming	PC	3	0	0	3
3	MTDS1103	**Program Elective-1** 1. Data Mining 2. Artificial Intelligence 3. Predictive Analytics	PE	3	0	0	3
4	MTDS1104	**Program Elective-2** 1. Internet of Everything 2. Social Media Analytics 3. Big Data Analytics	PE	3	0	0	3
5	MTDS1105	**Research Methodology and IPR**	AC	2	0	0	2
6	MTDS1106	**Laboratory-1** Data Science Programming Lab	LB	0	0	4	2
7	MTDS1107	**Laboartory-2** Advanced Computing Lab	LB	0	0	4	2
8	MTDS1108	**Audit Course-1***	AC	2	0	0	0
Total Credits							18

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

II SEMESTER – M.Tech

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS1201	**Program Core-3** Advanced Machine Learning Techniques	PC	3	0	0	3
2	MTDS1202	**Program Core-4** Deep Learning	PC	3	0	0	3
3	MTDS1203	**Program Elective-3** 1. Natural Language Processing 2. Data Structures and Algorithms 3. Cloud Computing	PE	3	0	0	3
4	MTDS1204	**Program Elective-4** 1. Image Video Analytics 2. Principles of Data Security 3. Recommender Systems	PE	3	0	0	3
5	MTDS1205	**Laboratory-3** Machine Learning Lab	LB	0	0	4	2
6	MTDS1206	**Laboartory-4** Deep Learning Lab	LB	0	0	4	2
7	MTDS1207	**Mini Project with Seminar**	MP	2	0	0	2
8	MTDS1208	**Audit Course-2***	AC	2	0	0	0
Total Credits							18

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

Audit Course 1 & 2:

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

III SEMESTER – M.Tech

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS2101	**Program Elective-5** MOOCs-1 through NPTEL/SWAYAM 12 Week Program related to the programme which is not listed in the course structure 1.Statistical Learning 2.Advance Database Systems	PE	3	0	0	3
2	MTDS2102	**Open Elective** 1. MOOCs-2 through NPTEL/SWAYAM - Any 12 week course on Engineering/ Management/ Mathematics offered by other than parent department 2. Course offered by other departments in the college	OE	3	0	0	3
3	MTDS2103	**Dissertation-I/Industrial Project**	PJ	0	0	20	10
Total Credits							16

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

IV- SEMESTER – M.Tech

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS2201	**Dissertation-II**	PJ	0	0	32	16
Total Credits							16

Open Electives offered by the Department of Information Technology for other Departments students

1. Python Programming
2. Principles of Cyber Security
3. Internet of Things
4. Machine Learning
5. Deep Learning
6. NoSQL Databases

I Year - I Semester M.Tech	ESSENTIAL FOR MACHINE LEARNING(MTDS1101)	L	T	P	C
		3	0	0	3

Course Objectives:

- Provide you with knowledge of various tools of machine learning are having a rich mathematical theory.
- This will help the student's to develop new algorithms of machine/deep learning using python, it is necessary to have knowledge of all such mathematical concepts.
- This course will focus on topics from matrix algebra, calculus, optimization, and probability theory those are having strong linkage with machine learning.
- Applications of these topics will be introduced in ML with help of some real-life examples.

Course Outcomes:

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

- Explain how to implement matrix algebra, calculus, optimization, and probability theory which can be further will be used in machine learning algorithms.
- Understand the key concepts machine learning are having a rich mathematical theory.

UNIT-I:

CALCULUS

Calculus: Derivatives and Integrals, Introduction to Derivatives, Mathematical Definition of Derivatives, Derivatives of Linear and Nonlinear Functions, Derivative Rules, Partial Derivatives and Gradients, Integrals and the Area Under the Curve, Example, Riemann Sum, Mathematical Definition,

Hands-On Project: Gradient Descent- Cost function, Derivative of the Cost Function, Implementing Gradient Descent.

UNIT-II:

STATISTICS AND PROBABILITY

Introduction, Descriptive Statistics: Mean, Variance and Standard Deviation, Covariance and Correlation, Covariance Matrix, random Variables, Random Variable: Definitions and Notation, Discrete and Continuous Random Variables, Probability Distributions: Probability Mass Functions, Probability Density Functions, Joint Probability, Marginal Probability, Conditional Probability, Expectation and Variance of Random Variables: Cumulative Distribution Functions, Expectation and Variance of Random Variables,

Hands-On Project: The Central Limit Theorem.

UNIT-III:

LINEAR ALGEBRA

Scalars and Vectors: What are Vectors? Geometric and Coordinate Vectors, Vector Spaces, Special Vectors, Operations and Manipulations on Vectors: Scalar Multiplication, Vector Addition, Transposition, Norms: Definitions, Common Vector Norms, Norm Representations, The Dot Product: Definition, Geometric interpretation: Projections, Properties,

Hands-on Project: Regularization.

UNIT-IV:

MATRICES AND TENSORS

Introduction: Matrix Notation, Shapes, Indexing, Main Diagonal, Tensors, Frobenius Norm, Operations and Manipulations on Matrices: Addition and Scalar Multiplication, Transposition, Matrix Product: Matrices with Vectors, Matrices Product. Transpose of a Matrix Product, Special Matrices: Square Matrices, Diagonal Matrices, Identity Matrices, Inverse Matrices, Orthogonal Matrices, Symmetric Matrices, And Triangular Matrices.

Hands-on Project: Image Classifier.

Systems of Linear Equations

System of linear equations: Row Picture, Column Picture, Number of Solutions, Representation of Linear Equations With Matrices, System Shape: Overdetermined Systems of Equations, Underdetermined Systems of Equations, Projections: Solving Systems of Equations, Projections to Approximate Unsolvable Systems, Projections Onto a Line, Projections Onto a Plane.

Hands-on Project: Linear Regression Using Least Squares Approximation

UNIT-V:

EIGENVECTORS, EIGENVALUES, AND EIGENDECOMPOSITION

Eigenvectors and Eigenvalues, Change of Basis, Linear Combinations of the Basis Vectors, The Change of Basis Matrix, Example: Changing the Basis of a Vector, Linear Transformations in Different Bases: Transformations, Transformation Matrix in Another Basis, Interpretation, Eigen decomposition: First Step: Change of Basis,

Eigenvectors and Eigenvalues, Diagonalization, Eigen decomposition of Symmetric Matrices

Hands-On Project: Principal Component Analysis

SINGULAR VALUE DECOMPOSITION

Non-square Matrices: Different Input and Output Spaces, Specifying the Bases, Expression of the SVD: Notation, Singular Vectors and Singular Values, Finding the Singular Vectors and the Singular Values, Summary, Geometry of the SVD: Two-Dimensional Example, Comparison with Eigen decomposition, Three-Dimensional Example, Summary, Low-Rank Matrix Approximation: Full SVD, Thin SVD and Truncated SVD, Decomposition into Rank One Matrices.

Hands-On Project: Image Compression

TEXT BOOKS

1. Hadrien Jean, Essential Math for Data Science: Take Control of Your Data with Fundamental Calculus, Linear Algebra, Probability, and Statistics. Haliotis Publishng , 2020.
2. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong., Mathematics for Machine Learning, Cambridge University Press, 2020.
3. Gilbert Strang, Linear Algebra and Learning from Data. Wellesley Publishers, 2019.
4. Otto Bretscher, Linear Algebra with Applications (Fifth Edition). Pearson Education, 2013.

I Year - I Semester M.Tech	DATA SCIENCE METHODOLOGIES AND PROGRAMMING (MTDS1102)	L	T	P	C
		3	0	0	3

Course Objectives:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Produce Python code to statistically analyze a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

Course Outcomes:

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

- Explain how data is collected, managed and stored for data science.
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
- Implement data collection and management scripts using Python Pandas.

UNIT I:

PYTHON Basics and Programming Concepts: Introducing Python, Types and Operations - Numbers, Strings, Lists, Tuples, Dictionaries, Files, Numeric Types, Dynamic Typing; Statements and Syntax - Assignments, Expressions, Statements, Loops, iterations, comprehensions; Functions - Function Basics, Scopes, Arguments, Advanced Functions; Modules - Module Coding Basics, Module Packages, Advanced Module Topics; Classes and OOP - Class, Operator Overloading, Class Designing; Exceptions and Tools - Exception Basics, Exception Coding Details, Exception Objects, Designing With Exceptions, Parallel System Tools

UNIT II:

GUI Programming: Graphical User Interface - Python gui development options, Adding Widgets, GUI Coding Techniques, Customizing Widgets; Internet Programming - Network Scripting, Client-Side scripting, Pymailgui client, server-side scripting, Pymailcgi server; Tools and Techniques - databases and persistence, data structures, text and language, python/c integration

UNIT III:

Pandas and NumPy: Numpy Basics - Fast Element wise array functions, Multidimensional Array, Data Processing using arrays, file i/o with arrays; Pandas - Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing

UNIT IV:

Data Preprocessing: Data Loading, Storage, and File Formats - Reading and Writing data in text format, binary data formats, interacting with html and web apis, interacting with databases; Data Wrangling: Clean, Transform, Merge, Reshape - Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation; Data Aggregation and Group Operations – Group by Mechanics, Data Aggregation, Group by Operations and Transformations, Pivot Tables and Cross- Tabulation

UNIT V:

Data Visualization: A Brief matplotlib API Primer, Plotting Functions in pandas, Time Series, Financial and Economic Data Applications

TEXT BOOKS:

1. Learning Python, 5th Edition, MarkLutz, OReilly, 2013.
2. Python Programming: A Modern Approach, VamsiKurama, Pearson.,1/e
3. Programming Python, 4th Edition, MarkLutz, OReilly, 2010.
4. Python For Data Analysis, 2nd Edition, WesMckinney, O Reilly, 2017.

REFERENCE BOOKS:

1. Python: The Complete Reference, 1st Edition, Martin C. Brown, McGraw Hill Education, 2018.
2. Head First Python, 2nd Edition, Paul Barry, O'Reilly, 2016.

I Year - I Semester M.Tech	DATA MINING (MTDS1103)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Students will be enabled to understand and implement classical models and algorithms in data mining.
2. They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
3. They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior

Course Outcomes:

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

1. **Compare** types of data, quality of data, suitable measures required to perform data analysis. (UNIT-I)
2. **Choose** appropriate classification technique to perform classification, model building and evaluation (UNIT-II)
3. **Make use of** association rule mining techniques on categorical and continuous data (UNIT III)
4. **Identify and apply** clustering algorithm (with open source tools), interpret, evaluate and report the result (UNIT IV)
5. **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. Nearest Neighborhood classifier, Bayesian Classifier, Support vector Machines: Linear SVM, Separable and Non Separable case.

UNIT III:

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

UNIT IV:

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

UNIT V:

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; Anuj Karpatne; Vipin Kumar, 2nd edition.
2. Data Mining: The Textbook, Charu C. Aggarwal , Springer, May 2015

REFERENCE BOOKS:

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

2. Data Mining, Concepts and Techniques, 2nd edition, Jiawei Han, Micheline Kamber, Elsevier, 2006.

3. Data Mining: Practical Machine Learning Tools and Techniques, 2nd Edition, Ian H. Witten, Eibe Frank, Elsevier, 2005

Suggested NPTEL Course and other Useful Websites:

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

I Year - I Semester M.Tech	ARTIFICIAL INTELLIGENCE (MTDS1103)	L	T	P	C
		3	0	0	3

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 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, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI, **Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening a*, constraint satisfaction

UNIT-II:

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

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-IV:

Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory

UNIT-V:

Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

TEXT BOOKS:

1. Artificial intelligence, A modern Approach, 2nd edition, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence, Saroj Kaushik, 1st Edition, CENGAGE Learning, 2011.

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, A new Synthesis, 1st Edition, Nils J Nilsson, Elsevier, 1998
4. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
5. Introduction To Artificial Intelligence And Expert Systems, 1st Edition, Patterson, Pearson India, 2015

I Year - I Semester M.Tech	PREDICTIVE ANALYTICS (MTDS1103)	L	T	P	C
		3	0	0	3

Course Objectives:

Students develop skills in predictive analytics that will allow them to:

- Develop and use advanced predictive analytics methods;
- Develop expertise in the use of popular tools and software for predictive analytics;
- Learn how to develop predictive analytics questions, identify and select the most appropriate predictive analytics methods and tools, apply these methods to answer the respective questions and presenting data-driven solutions.

Course Outcomes:

After completing this course, you will be able to:

- Design effective experiments and analyze the results.
- Use resampling methods to make clear and bulletproof statistical arguments without invoking esoteric notation.
- Explain and apply a core set of classification methods of increasing complexity (rules, trees, random forests), and associated optimization methods (gradient descent and variants).
- Explain and apply a set of unsupervised learning concepts and methods.

UNIT-1

INTRODUCTION TO MACHINE LEARNING

Introduction to analytics and machine learning, why machine learning? , framework for developing machine learning models, why python? , python stack for data science, getting started with anaconda platform

Introductions to python: declining variables, conditional statement, generating sequence numbers, control flow statements, functions, working with collections: list, tuples,set, dictionaries; functional programming: map , filter ; modules and packages, other features .

UNIT-2

DESCRIPTIVE ANALYTICS

Working with data frames in python: IPL Dataset Description using DataFrame in python , Loading Dataset into pandas data frame ,Displaying first few records of the Dataframe , Finding summary of the dataframe , slicing and indexing of dataframe, Values counts and cross tabulations , sorting data frames by column value, creating new columns ,Growing and Aggregating, Joining dataframes , Renaming columns , Applying operations to multiple columns, Filtering records based on conditions, Removing a column or a row from a dataset ; Handling missing values,

Exploring of Data using visualization: - Drawing plots, bar chart, histogram, Distribution or density plot, box plot, comparing distributions, scatter plot, pair plot , correlation and Heatmap.

UNIT- 3

PROBABILITY DISTRIBUTIONS AND HYPOTHESIS TESTS

Overview, Probability theory – terminology: random experiment , sample space , event ; random variables, binomial distinction: example is of exponential distribution , exponential distribution : example of exponential distribution, nominal distribution: example of nominal distribution, mean and variance , confidence interval , cumulative probability distribution, other important distribution; central limit theorem , Hypothesis test : z-test , one-sample t- Test , two-

sample t-Test , paired sample t-Test , chi-square goodness of fit test; Analysis of variance (ANOVA):Example of One-way ANOVA

UNIT 4:

LINEAR REGRESSION:

Simple Linear Regression, Steps in Building a Regression Model,

Building Simple Linear Regression Model: Creating Feature Set (X) and Outcome Variable(Y), Splitting the Dataset Into Traing and Validation Sets, Fitting the Model: Printing Estimated Parameters and Interpreting Them, Complete Coe for Building Regression Model.

Model Diagnostics: Co-efficient of Determination (R-Squared or R^2),Hypothesis Test fr the Regression Co-eficient,Analysis of Vriance (ANOVA) in Regression Analysis, Regression Model Summary Using Python.

Residual Analysis: Check for Normal Distribution of Residual, Test of Homoscedaticity.

Outer Analysis: Z-score, Cook's Distance, Leverage Values

Making Prediction and Measuring Accuracy: Prediction Using the validation set, Finding R-Squared and RMSE, Calculating Prediction Intervals.

Multiple Linear regression: Predicting the SOLID PRICE (Auction Price) of players, Developing Multiple Linear Regression Model Using Python: Loading the Dataset, Displaying the First Five Records,

Categorical Encoding Feature, Splitting the Dataset into Train Validation Sets, Building the model on training Dataset,

Multi-Collinearity and Handling Multi-Collinearity: Variance Inflation Factor, Checking Correlation of columns with Large VIF's, Building a New Model Removing Multi – Collinearity.

Residual Analysis in Multiple Linear Regression: Test for Normality of Residuals (P-P Plot), Residual Plot for Homoscedaticity and Model Specification.

Detecting Influencers, Transforming Response Variable, Making Prediction on the validation set: Measuring RMSE, Measuring R-Squared Value, Auto Correlation between Error Terms

UNIT 5:

CLASSIFICATION PROBLEMS:

Classification Review, Binary Logistic Regression, and Credit Classification: Encoding Categorical Features, Splitting dataset into training and test sets, Building Logistic Regression Model, Printing Model summary, Model Diagnostics, Predicting Test data, creating a Confusion matrix, Receiver Operating Characteristics (ROC) and Area under Curve (AUC), Finding Optimal Classification Cut off: Youden's Index, Cost Based Approach.

Gain Chart and Lift Chart: Loading and preparing the dataset, Building the logistic Regression Model

Classification Tree (Decision Tree Learning): Splitting the dataset, Building Decision Tree Classifier using Gini Criteria, Measuring Test Accuracy, Displaying the Tree, Understanding Gini Impurity, Building Decision Tree using Entropy Criteria, Finding Optimal Criteria and Max Depth, Benefits of Decision Tree.

TEXT BOOKS:

1. Manaranjan Pradhan and U Dinesh Kumar, "Machine Learning Using Python", Wiley, 2019
2. U Dinesh Kumar, "Business Analytics – The Science of Data Driven Decision Making", Wiley, 2017.
3. Dinesh Kumar, U., Crocker, J., Chitra, T., and Saranga, H., (2006), Reliability and Six Sigma, Springer, USA
4. Dinesh Kumar, U., Knezevic, J., Crocker J., and El-Haram, M., (2000), Reliability, Maintenance and Logistic Support - A Life Cycle Approach, Kluwer Academic Publishers, USA

I Year - I Semester M.Tech	INTERNET OF EVERYTHING (MTDS1104)	L	T	P	C
		3	0	0	3

Course Objectives:

- Learns about various types of sensors, actuators and different network protocols.
- Construction of wireless sensor networks and communication using different connectivity technologies
- To Know about how m2M communication performs and communication between user and the device
- To Know about programming platforms to implement IOT
- Learns about how data is handled generated by IOT application
- how IoT is used for industrial purpose , able to build IoT applications

Course Outcomes:

- Aware about how sensors and actuators are connected by using different network protocols
- Node behavior in wireless sensor networks and known about which connectivity technology was used according to the application.
- Knows about Arduino boards and their connection with sensors and actuators
- Learns about how Pi OS is installed and how code is embedded into the board
- Came to know about how data is stored using cloud computing and knows about sensor clouds.
- Construction various IOT applications using various sensors and Actuators

UNIT I:

Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.

UNIT II:

Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

UNIT III:

Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture

UNIT IV:

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking, Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics – Introduction

UNIT V: Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

TEXT BOOKS:

1. .Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
2. "Industrial Internet of Things: Cybermanufacturing Systems "by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer).
3. Internet of Things: Architecture, Design Principles And Applications, Raj kamal, McGraw Hill Higher Education
4. 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, 2013
2. Getting Started with the Internet of Things (Make: Projects), CunoPfister , Oreilly, 2011

I Year - I Semester M.Tech	SOCIAL MEDIA ANALYTICS (MTDS1104)	L	T	P	C
		3	0	0	3

Course Objectives:
The learning objective of the course Social Media Analytics is to provide students with essential knowledge of network analysis applicable to real world data

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

- Demonstrate social network analysis and measures.
- Analyze random graph models and navigate social networks data
- Analyze the experiment with small world models and clustering models.
- Compare the application driven virtual communities from social network Structure.

UNIT - I:
INTRODUCTION: Social Networks: Preliminaries and properties, Homophily, Triadic Closure and Clustering Coefficient, Dynamics of Network Formation, Power-Law Degree Distributions, Measures of Centrality and Prestige, Degree Centrality, Closeness Centrality, Betweenness Centrality, Rank Centrality

UNIT - II:
COMMUNITY DISCOVERY IN SOCIAL NETWORKS: Introduction, Communities in Context, Core Methods, Quality Functions. The Kernighan-Lin (KL) algorithm, Agglomerative/Divisive Algorithms, Spectral Algorithms, Multi-level Graph Partitioning, Markov Clustering

UNIT – III:
LINK PREDICTION IN SOCIAL NETWORKS: Introduction, Feature based Link Prediction, Feature Set Construction, Classification Models, Bayesian Probabilistic Models, Link Prediction by Local Probabilistic Models, Network Evolution based Probabilistic Model, Hierarchical Probabilistic Model, Probabilistic Relational Models, Relational Bayesian Network, Relational Markov Network, Linear Algebraic Methods

UNIT- IV:
SOCIAL INFLUENCE ANALYSIS: Introduction, Influence Related Statistics, Edge Measures, Node Measures, Social Similarity and Influence, Homophily, Existential Test for Social Influence, Influence and Actions, Influence and Interaction, Influence Maximization in Viral Marketing, Influence Maximization

UNIT – V:
OPINION MINING AND SENTIMENT ANALYSIS: The Problem of Opinion Mining, Document Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Sentiment Analysis, Mining Comparative Opinions

TEXT BOOKS:
Social Network Data Analytics, Charu C. Aggarwal, Springer, 2011
Data mining The Text book, 1st Edition, Charu C Aggarwal , Springer Publications, 2015
Mining Text Data, Charu C. Aggarwal, Cheng Xiang Zhai, Springer Publications, 2012

REFERENCE BOOKS:

1. Networks, Crowds, and Markets: Reasoning about a Highly Connected World, David Easley, Jon Kleinberg, Cambridge University Press, 2010.
2. Stanley Wasserman, Katherine Faust. Social network analysis: methods and applications. Cambridge University Press, 1994
3. Networks: An Introduction, M. E. J. Newman, Oxford University Press, March 2010
4. Analyzing the Social Web, Jennifer Golbeck, Morgan Kaufmann Elsevier Publishers, 2014

I Year - I Semester M.Tech	BIG DATA ANALYTICS (MTDS1104)	L	T	P	C
		3	0	0	3

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, and 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. 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 IV:

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, 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 V:

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 Ambiga Dhiraj
2. SPARK: The Definitive Guide, Bill Chambers & Matei Zaharia, O'Reilley, 2018 Edition
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.

I Year - I Semester M.Tech	RESEARCH METHODOLOGY AND IPR (MTDS1105)	L	T	P	C
		2	0	0	2

Course Objectives:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
- To discuss leading International Instruments concerning Intellectual Property Rights.

Course Outcomes:

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

1. Formulate a research problem for a given engineering domain.
2. Analyze the available literature for given research problem.
3. Develop technical writing and presentation skills.
4. Comprehend concepts related to patents, trademark and copyright.

UNIT I:

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

UNIT II:

Effective literature studies approaches, analysis Plagiarism, Research ethics, 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 III:

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 IV:

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

UNIT V:

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.

CASE STUDY:

1. Prepare a prediction model for profit of 50_startups data. Do transformations for getting better predictions of profit and make a table containing R^2 value for each prepared model.(Multi linear Regression)

R&D Spend -- Research and devolop spend in the past few years
Administration -- spend on administration in the past few years
Marketing Spend -- spend on Marketing in the past few years
State -- states from which data is collected
Profit -- profit of each state in the past few years

2. Let's consider a Company dataset with around 10 variables and 400 records.
The attributes are as follows:

- Sales -- Unit sales (in thousands) at each location
- Competitor Price -- Price charged by competitor at each location
- Income -- Community income level (in thousands of dollars)
- Advertising -- Local advertising budget for company at each location (in thousands of dollars)
- Population -- Population size in region (in thousands)
- Price -- Price Company charges for car seats at each site
- Shelf Location at stores -- A factor with levels Bad, Good and Medium indicating the quality of the shelving location for the car seats at each site
- Age -- Average age of the local population
- Education -- Education level at each location
- Urban -- A factor with levels No and Yes to indicate whether the store is in an urban or rural location
- US -- A factor with levels No and Yes to indicate whether the store is in the US or not

The company dataset looks like this:

Sales	CompPrice	Income	Advertising	Population	Price	ShelveLoc	Age	Education	Urban	US
9.5	138	73	11	276	120	Bad	42	17	Yes	Yes
11.22	111	48	16	260	83	Good	65	10	Yes	Yes
10.06	113	35	10	269	80	Medium	59	12	Yes	Yes
7.4	117	100	4	466	97	Medium	55	14	Yes	Yes
4.15	141	64	3	340	128	Bad	38	13	Yes	No

Problem Statement:

A cloth manufacturing company is interested to know about the segment or attributes causes high sale. (Decision Tree)

3. Perform clustering (Both hierarchical and K means clustering) for the airlines data to obtain optimum number of clusters.
Draw the inferences from the clusters obtained.
Data Description: The file EastWestAirlinescontains information on passengers who belong to an airline's frequent flier program. For each passenger the data include information on their mileage history and on different ways they accrued or spent miles in the last year. The goal is to try to identify clusters of passengers that have similar characteristics for the purpose of targeting different segments for different types of mileage offers

ID --Unique ID
Balance--Number of miles eligible for award travel
Qual_mile--Number of miles counted as qualifying for Topflight status
cc1_miles -- Number of miles earned with freq. flyer credit card in the past 12 months:
cc2_miles -- Number of miles earned with Rewards credit card in the past 12 months:
cc3_miles -- Number of miles earned with Small Business credit card in the past 12 months:
1 = under 5,000
2 = 5,000 - 10,000
3 = 10,001 - 25,000

4 = 25,001 - 50,000
5 = over 50,000
Bonus miles--Number of miles earned from non-flight bonus transactions in the past 12 months
Bonus_trans--Number of non-flight bonus transactions in the past 12 months
Flight_miles_12mo--Number of flight miles in the past 12 months
Flight_trans_12--Number of flight transactions in the past 12 months
Days_since_enrolled--Number of days since enrolled in flier program
Award--whether that person had award flight (free flight) or not

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students" Juta Education, 1996.

REFERENCE BOOKS:

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

I Year - I Semester M.Tech	DATA SCIENCE PROGRAMMING LAB (MTDS1106)	L	T	P	C
		0	0	4	2

Course Objectives:

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

- Implement data science operations like data collection, management and storing.
- Apply Python programming concepts in data science, including their real-world applications.
- Implement data collection and management scripts using Python Pandas.

List of Experiments:

Experiment 1:
Installation of anaconda.
Write a Python Program to Find the Sum of the Series: 1 + 1/2 + 1/3 + .. + 1/N

Experiment2:
Write a Python Program to Split the array and add the first part to the end

Experiment 3:
Write a Python Program to Create a List of Tuples with the First Element as the Number and Second Element as the Square of the Number

Experiment 4:
Write a Python program to count number of vowels using sets in given string

Experiment 5:
Write a program to implement permutation of a given string using inbuilt function

Experiment 6:
Write a python program to sort list of dictionaries by values in Python – Using lambda function.

Experiment 7:
Write a Python Program for following sorting:

i. Quick Sort
ii. HeapSort

Experiment 8:
Write a Python Program to Reverse a String Using Recursion

Experiment 9:
Write a Python Program to Count the Number of Words in a Text File

Experiment 10:
Write a Python Program to Read the Contents of a File in Reverse Order

Experiment 11:
Write a program to Merge and Join Data Frames with Pandas in Python

Experiment 12:
Write a program to implement Merge and Join Data Frames with Python Pandas

Experiment 13:
Write a Python Program to Append the Contents of One File to Another File

Experiment 14:
How to install and Load CSV files to Python Pandas

Experiment 15:
Write a program to implement Data analysis and Visualization with Python using pandas.

Experiment 16:
Write a program to Implement Plotting Functions in python pandas.

Text Books:

1. Learning Python, 5th Edition, MarkLutz, OReilly, 2013.
2. Programming Python, 4th Edition, MarkLutz, OReilly, 2010.
3. Python for Data Analysis, 2nd Edition, WesMckinney, O Reilly, 2017.

I Year - I Semester M.Tech	ADVANCED COMPUTING LAB (MTDS1107)	L	T	P	C
		0	0	4	2

Course Objectives:

- Implement various heuristics search techniques.
- Solve problems with uncertain information using Bayesian approaches.
- Implement data summarization, query, and analysis.
- Applying data modelling techniques to large datasets.
- Creating applications for Big Data analytics.
- Building a complete business data analytic solution.

List of Experiments:

Experiment 1:
Write a python program to implement following Best First Heuristic Search in artificial intelligence.

Experiment 2:
Write a python program to implement following A* Heuristic Search in artificial intelligence.

Experiment 3:
Write a python program to implement following Hill climbing Heuristic Search in artificial intelligence.

Experiment 4:
Write a python program to implement following Bidirectional Heuristic Search in artificial intelligence.

Experiment 5:
Do the following case study:

i) For the Bayesian network given in fig below and the corresponding probabilities, generate the conditional probability table.
ii) Also the compute the following probabilities:
   a) Joint probability P(A,B, C,D)
   b) P(A|B)
   c) P(A|C)
   d) P(A|B,C)

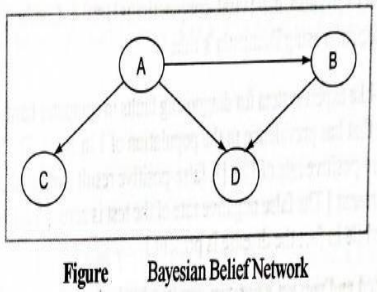

Figure Bayesian Belief Network

P(A)	=	0.4
P(B|A)	=	0.5
P(B|~A)	=	0.1
P(C|A)	=	0.6
P(C|~A)	=	0.3
P(D|A, B)	=	0.8
P(D|A, ~B)	=	0.3
P(D|~A, B)	=	0.3
P(D|~A, ~B)	=	0.05

Experiment 6:

(a) Perform setting up and Installing Hadoop in its two operating modes:
   i. Pseudo distributed,
   ii. Fully distributed.

(b) Use web based tools to monitor your Hadoop setup.

Experiment 7:

(a) Implement the following file management tasks in Hadoop:
   i. Adding files and directories
   ii. Retrieving files
   iii. Deleting files

(b) Benchmark and stress test an Apache Hadoop cluster

Experiment 8:

(a) Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
   i. Find the number of occurrence of each word appearing in the input file(s)
   ii. Performing a MapReduce Job for word search count (look for specific keywords in a file)

Experiment 9:

Stop word elimination problem:

Input:
   i. A large textual file containing one sentence per line
   ii. A small file containing a set of stop words (One stop word per line)

Output:
   iii. A textual file containing the same sentences of the large input file without the words appearing in the small file.

Experiment 10:

Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.

Data available at: https://github.com/tomwhite/hadoopbook/ tree/master/input/ncdc/all.

(a) Find average, max and min temperature for each year in NCDC dataset?

(b) Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.

Experiment 11:

Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

Experiment 12:

Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

Experiment 13:

Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.

Experiment 14:

Perform Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

Write a single Spark application that:

(a) Transposes the original Amazon food dataset, obtaining a Pair RDD of the type: <user_id> → <list of the product_ids reviewed byuser_id>

(b) Counts the frequencies of all the pairs of products reviewed together;

(c) Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

Experiment 15:

Write a python program to implement following: breadth-first search and depth first search.

Text Books:

1. Artificial Intelligence with Python - Heuristic Search, Prateek Joshi, Packt, 2017.
2. Big Data, Big Analytics: Emerging, Michael Minnelli, Michelle Chambers, and Ambiga Dhiraj, Wiley, 2013.
3. SPARK: The Definitive Guide, Bill Chambers &Matei Zaharia, O'Reilley, 2018Edition

I Year - II Semester M.Tech	ADVANCED MACHINE LEARNING TECHNIQUES (MTDS1202)	L	T	P	C
		3	0	0	3

Course Objectives:

Machine Learning course will

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

Course Outcomes:

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

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

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT -V:

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

Text Books:

1. Applied Machine Learning, M.Gopal, McGraw Hill Education, 2019.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,2012

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

I Year - II Semester M.Tech	DEEP LEARNING (MTDS1204)	L	T	P	C
		3	0	0	3

Course Objectives:

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks.

Course Outcomes

After completion of course, students would be able to:

- To explore feed forward networks and Deep Neural networks
- To mathematically understand the deep learning approaches and paradigms
- To apply the deep learning techniques for various applications

UNIT I:

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

UNIT II:

Feedforward Networks- Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders.

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

UNIT III:

Better Training of Neural Networks- Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT IV:

Recurrent Neural Networks- Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Convolutional Neural Networks: LeNet, AlexNet, Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V:

Recent trends- Variational Auto encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Applications: Vision, NLP, Speech

Textbooks

1. Deep Learning, Ian Good fellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2007
3. Deep Learning with Python, François Chollet, Manning Publications, 2017.

I Year - II Semester M.Tech	NATURAL LANGUAGE PROCESSING (MTDS1203)	L	T	P	C
		3	0	0	3

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, and 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 Ling Pipe 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, Nitin Indurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rd Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.

I Year - II Semester M.Tech	DATA STRUCTURES AND ALGORITHMS (MTDS1201)	L	T	P	C
		3	0	0	3

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

UNIT I:

THE ROLE OF ALGORITHMS IN COMPUTING -Algorithms as a technology, Insertion sort, Analyzing algorithms, Designing algorithms, Growth of Functions, Asymptotic notation, Standard notations and common functions

UNIT II:

SEARCHING-Linear and Binary, Search Methods, **Sorting**-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort. **Trees**- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix). **Graphs**-Basic Concepts, Storage structures and Traversals.

UNIT III:

DICTIONARIES-ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, **Open Addressing**-Linear Probing, Double Hashing.

UNIT IV:

PRIORITY QUEUES- Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion, **Search Trees**- Binary Search Trees, Definition, ADT, Implementation, **Operations**- Searching, Insertion, and Deletion.

UNIT V:

SEARCH TREES- AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

TEXT BOOKS:

1. Introduction to Algorithms, 3/e, Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, The MIT Press.
2. Data Structures: A Pseudo Code Approach, 2/e, Richard F.Gilberg, BehrouzA. Forouzon and Cengage

REFERENCE BOOKS:

1. Data Structures, Algorithms and Applications in java, 2/e, Sartaj Sahni, University Press
2. Data Structures and Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson.
3. Data Structures and Algorithms, 3/e, Adam Drozdek, Cengage

C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co,2009.

I Year - II Semester M.Tech	CLOUD COMPUTING (MTDS1203)	L	T	P	C
		3	0	0	3

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.
- To 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, and 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, **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 III:

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, **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 IV:

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 V:

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

I Year - II Semester M.Tech	IMAGE AND VIDEO ANALYTICS (MTDS1204)	L	T	P	C
		3	0	0	3

Course Objectives:

- To teach the fundamentals of digital image processing, image and video analysis.
- To understand the real time use of image and video analytics.
- To demonstrate real time image and video analytics applications and others.

Course Outcomes:

Students will be able to:

- Describe the fundamental principles of image and video analysis and have an idea of their application.
- Apply image and video analysis in real world problems.

UNIT I:

Digital image representation- Visual Perception- Sampling and Quantization- Basic Relations between Pixels- Mathematical Tools Used in Digital Image Processing: Fundamental Operations – Vector and Matric Operations- Image Transforms (DFT, DCT, DWT, Hadamard).

UNIT II:

Fundamentals of spatial filtering: spatial correlation and convolution-smoothing blurring-sharpening- edge detection - Basics of filtering in the frequency domain: smoothing-blurring-sharpening--Histograms and basic statistical models of image.

UNIT III:

Color models and Transformations – Image and Video segmentation-Image and video demonising- Image and Video enhancement- Image and Video compression.

UNIT IV:

Object detection and recognition in image and video-Texture models Image and Video classification models- Object tracking in Video.

UNIT V:

Applications and Case studies- Industrial- Retail- Transportation & Travel- Remote sensing-Video Analytics in WSN: IoT Video Analytics Architectures.

TEXT BOOKS:

1. ” Digital Image Processing”. 3rd Edition, R.C. Gonzalez and R.E. Woods Addison Wesley, 2007.
2. “Computer Vision: Algorithms and Applications”, Richard Szelisk, Springer2011.

REFERENCE BOOKS:

1. “Nonparametric and Semi parametric Models”, W. Härdle, M. Müller, S. Sperlich, A. Werwatz, Springer, 2004.
2. “Intelligent Video Surveillance Systems”, Jean-Yves Dufour, Wiley, 2013.
3. “Video Analytics for Business Intelligence”, Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, Springer, 2012.
4. “Intelligent Transport Systems: Technologies and Applications”, AsierPerallos, Unai Hernandez- Jayo, Enrique Onieva, Ignacio Julio GarcíaZuazola, Wiley,2015.
5. “Analysis of Urban Growth and Sprawl from Remote Sensing Data”, BasudebBhatta, Springer, 2010

I Year - II Semester M.Tech	RECOMMENDER SYSTEMS (MTDS1203)	L	T	P	C
		3	0	0	3

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

UNIT-I:
INTRODUCTION: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II:
COLLABORATIVE FILTERING: User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.

UNIT-III:
CONTENT-BASED RECOMMENDATION: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms. **Knowledge based recommendation:** Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

UNIT-IV:
HYBRID APPROACHES: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.

UNIT-V:
EVALUATING RECOMMENDER SYSTEM: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centered metrics.
RECOMMENDER SYSTEMS AND COMMUNITIES: Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations.

TEXT BOOKS:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.

REFERENCE BOOKS:

1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer(2013),1st ed.

I Year - II Semester M.Tech	PRINCIPLES OF DATA SECURITY (MTDS1204)	L	T	P	C
		3	0	0	3

Course Objectives:

In the course the student will learn

- An overview of modern cryptographic theories and techniques, mainly focusing on their application into real systems.
- Database and Cloud Security, Malicious Software, Denial-of-Service Attacks, Software Security, Operating System Security, Wireless Network Security and mobile device security.

Course Outcomes:

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

- Describe the key security requirements of confidentiality, integrity, and availability, types of security threats and attacks and summarize the functional requirements for computer security.
- Explain the basic operation of symmetric block encryption algorithms, use of secure hash functions for message authentication, digital signature mechanism
- Discuss the issues involved and the approaches for user authentication and explain how access control fits into the broader context that includes authentication, authorization, and audit
- Explain the basic concept of a denial-of-service attack, nature of flooding attacks, distributed denial-of-service attacks and describe how computer security vulnerabilities are a result of poor programming practices
- List the steps used to secure the base operating system, specific aspects of securing Unix/Linux systems, Windows systems, and security in virtualized systems and describe the security threats and countermeasures for wireless networks.

UNIT I:

INTRODUCTION: Computer Security Concepts, Threats, Attacks, and Assets, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy. **CRYPTOGRAPHIC TOOLS:** Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Random and Pseudorandom Numbers.

UNIT II:

USER AUTHENTICATION: Electronic User Authentication Principles, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Security Issues for User Authentication. **Access Control:** Access Control Principles, Subjects, Objects, and Access Rights, Discretionary Access Control, Example: UNIX File Access Control, Role-Based Access Control, Attribute-Based Access Control, Identity, Credential, and Access Management, Trust Frameworks.

UNIT III:

DATABASE AND CLOUD SECURITY: The Need For Database Security, Database Management Systems, Relational Databases, Sql Injection Attacks, Database Access Control, Database Encryption, Cloud Computing, Cloud Security Risks And Countermeasures, Data Protection In The Cloud, Cloud Security As A Service.

MALICIOUS SOFTWARE: Types of Malicious Software (Malware), Advanced Persistent Threat, Propagation, Infected Content, Viruses, Propagation, Vulnerability Exploit, Worms, Propagation, Social Engineering, Spam E-Mail, Trojans, Payload, System Corruption, Payload, Attack Agent, Zombie, Bots, Payload, Information Theft, Key loggers, Phishing, Spyware, Payload, Stealthing, Backdoors, Root kits, Countermeasures.

UNIT IV:

DENIAL-OF-SERVICE ATTACKS: Denial-of-Service Attacks, Flooding Attacks, Distributed Denial- of-Service Attacks, Application-Based Bandwidth Attacks, Reflector and Amplifier Attacks, Defenses Against Denial-of-Service Attacks, Responding to a Denial-of-Service Attack. **Software Security:** Software Security Issues, Handling Program Input, Writing Safe Program Code, Interacting with the Operating System and Other Programs.

UNIT V:

OPERATING SYSTEM SECURITY: Introduction To Operating System Security, System Security Planning, Operating Systems Hardening, Application Security, Security Maintenance, Linux/Unix Security, Windows Security, Virtualization Security.

WIRELESS NETWORK SECURITY: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security.

TEXT BOOKS:

1. Computer Security: Principles and Practices, 3rd Edition, William Stallings, Lawrie Brown, Pearson
2. Network Security Essentials, Principles and Practices, William Stallings, Pearson

REFERENCE BOOK:

1. Principles of Data Security 1st Edition, Leiss, Ernst, Springer,1982

I Year - II Semester M.Tech	MACHINE LEARNING LAB (MTDS1206)	L	T	P	C
		3	0	0	3

Course Outcome's:

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

EXPERIMENTS:

1. Implement **Principal Component Analysis (PCA) and Singular Value Decomposition (SVD**) using NumPy.
2. Implement and demonstrate the **FIND-S algorithm** for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
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. Build an Artificial Neural Network by implementing the **Back propagation algorithm** and test the same using appropriate data sets.
6. Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. 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 data set.
8. 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.
9. 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.
10. Write a program to implement **k-Nearest Neighbor algorithm** to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
11. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.
12. 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 2nd Edition: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, 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
4. https://towardsdatascience.com/introduction-to-data-visualization-in-python-89a54c97fbed

IYear - II Semester M.Tech	DEEP LEARNING LAB (MTAIML1205)	L	T	P	C
		0	0	4	2

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

- Implement deep neural networks to solve real world problems.
- Choose appropriate pre-trained model to solve real time problem.
- Interpret the results of two different deep learning models.

Software Packages required:

- Keras
- Tensorflow
- PyTorch

List of Experiments:

1. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
2. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
3. Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset.
4. Design a neural network for predicting house prices using Boston Housing Price dataset.
5. Build a Convolution Neural Network for MNIST Hand written Digit Classification.
6. Build a Convolution Neural Network for simple image (dogs and Cats) Classification
7. Use a pre-trained convolution neural network (VGG16) for image classification.
8. Implement one hot encoding of words or characters.
9. Implement word embedding for IMDB dataset.
10. Implement a Recurrent Neural Network for IMDB movie review classification problem.

TEXT BOOKS:
Reza Zadeh and BharathRamsundar, “Tensorflow for Deep Learning”, O’Reilly publishers, 2018

REFERENCES:
https://github.com/fchollet/deep-learning-with-python-notebooks

Python Programming

Course Objectives:

- To acquire programming skills in core Python.
- To acquire Object Oriented Skills in Python.
- To develop the skill of designing Graphical user Interfaces in Python.
- To develop the ability to write database applications in Python.

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

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

UNIT – I:

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT – II:

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

UNIT – III:

Data Structures-Lists- Operations, Slicing, Methods, Tuples, Sets, Dictionaries, Sequences, Comprehensions.

UNIT – IV:

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function -

Global and Local Variables, **Modules**: Creating modules, import statement, from. Import statement, name spacing, **Python packages**, Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT – V:

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, **Error and Exceptions:** Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User defined Exceptions, **Brief Tour of the Standard Library** - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics, **Testing:** Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

Text books

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly

Reference Books:

1. Think Python, Allen Downey, Green Tea Press
2. Core Python Programming, W.Chun, Pearson
3. Introduction to Python, Kenneth A. Lambert, Cengage

Principles of Cyber Security

Course Objectives:

- To learn threats and risks within context of the cyber security architecture.
- Student should learn and Identify security tools and hardening techniques.
- To learn types of incidents including categories, responses and timelines for response.

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

- Apply cyber security architecture principles.
- Describe risk management processes and practices.
- Appraise cyber security incidents to apply appropriate response
- Distinguish system and application security threats and vulnerabilities.
- Identify security tools and hardening techniques

UNIT I:

Introduction to Cyber Security-Cyber security objectives, roles, differences between information security and cyber security, Cyber security principles-confidentiality, integrity, availability, authentication and non-repudiation

UNIT II:

Information Security within Lifecycle Management-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, **Risks & Vulnerabilities**-Basics of risk management, Operational threat environments, Classes of attacks

UNIT III:

Incident Response-Incident categories, Incident response, Incident recovery, **Operational security protection**-Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management

UNIT IV:

Threat Detection and Evaluation Monitoring-Vulnerability management, Security logs and alerts, Monitoring tools and appliances, **Analysis**-Network traffic analysis, packet capture and analysis

UNIT V:

Introduction to backdoor System and security-Introduction to metasploit, backdoor, demilitarized zone (DMZ), Digital signature, Brief study on Harding of operating system.

Text Books:

1) NASSCOM: Security Analyst Student Hand Book, Dec 2015

2) Information Security Management principles, David Alexander, Amanda Finch, David Sutton, BCS Publishers, 2013

Reference Books:

1) Cyber Security Fundamentals-Cyber Security, Network Security and Data Governance Security, 2nd Edition, ISACA Publishers, 2019

Internet of Things
Code: MCA3102

Course Objectives:

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

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

- Explain the definition and usage of the term 'the internet of things' in different contexts
- Discover the various network protocols used in IoT
- Define the role of big data, cloud computing and data analytics in a typical IoT system.
- Compare and contrast the threat environment based on industry and/or device type
- Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software

UNIT I:

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind Io Ts Sources of the Io Ts, 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, 1st ed, Rajkamal, McGraw Hill Higher Education, 2017.
2) Internet of Things, 1st ed, A.Bahgya and V.Madisetti, Univesity Press, 2014

Reference Books:

1) Designing the Internet of Things, 1st ed, Adrian McEwen and Hakim Cassimally, Wiley, 2013.
2) Getting Started with the Internet of Things, 1st ed, CunoPfister , Oreilly, 2011.

Machine Learning

Course Objectives:

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

Course Outcomes:

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

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

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

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

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

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

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

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

Textbooks:

1. Applied Machine Learning, M. Gopal, McGraw Hill Education
2. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press,2012
3. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2009 (freely available online)

Reference Books:

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer,2007
2. Programming Collective Intelligence: Building Smart Web 2.0 Applications - Toby Segaran
3. Building Machine Learning Systems with Python - WilliRichert, Luis Pedro Coelho

Deep Learning
Code: MCA4101

Course Objectives:
- Demonstrate the major technology trends driving Deep Learning
- Build, train and apply fully connected deep neural networks
- Implement efficient (vectorized) neural networks
- Analyze the key parameters and hyper parameters in a neural network's architecture

Course Outcomes:
- Demonstrate the mathematical foundation of neural network
- Describe the machine learning basics
- Compare the different architectures of deep neural network
- Build a convolutional neural network
- Build and train RNN and LSTMs

UNIT I:
Linear Algebra: Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis.
Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bayes' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.

UNIT II:
Machine Learning: Basics and Underfitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning. Deep Feedforward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and other Differentiation Algorithms.

UNIT III:
Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. Optimization for Training Deep Models: Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter

Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.

UNIT IV:
Convolutional Networks: The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolutional Networks.

UNIT V:
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, Echo State Networks, LSTM, Gated RNNs, Optimization for Long-Term Dependencies, Auto encoders, Deep Generative Models.

Text Books:

1) Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016.
2) Josh Patterson and Adam Gibson, "Deep learning: A practitioner's approach", O'Reilly Media, First Edition, 2017.

Reference Books:

1) Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O'Reilly, Shroff Publishers, 2019.
2) Deep learning Cook Book, Practical recipes to get started Quickly, Douwe Osinga, O'Reilly, Shroff Publishers, 2019.

e-Resources:

1) https://keras.io/datasets/
2) http://deeplearning.net/tutorial/deeplearning.pdf
3) https://arxiv.org/pdf/1404.7828v4.pdf
4) https://github.com/lisa-lab/DeepLearningTutorials

NoSQL Databases
Code: MCA2105

Course Objectives:
The objective of the course is to:

- Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column oriented and Graph)
- Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases
- Explain the detailed architecture, define objects, load data, query data and performance tune Document oriented NoSQL databases
- Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data

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

- Identify what type of NoSQL database to implement based on business requirements (key-value, document, full text, graph, etc.)
- Apply NoSQL data modeling from application specific queries
- Use Atomic Aggregates and denormalization as data modelling techniques to optimize query processing

UNIT I:
Introduction to NoSQL: Definition And Introduction, Sorted Ordered Column-Oriented Stores, Key/Value Stores, Document Databases, Graph Databases, Examining Two Simple Examples, Location Preferences Store, Car Make And Model Database, Working With Language Bindings.

UNIT II:
Interacting with NoSQL: If NoSql Then What, Language Bindings For NoSQL Data Stores, Performing Crud Operations, Creating Records, Accessing Data, Updating And Deleting Data

UNIT III:
NoSQL Storage Architecture: Working With Column-Oriented Databases, Hbase Distributed Storage Architecture, Document Store Internals, Understanding Key/Value Stores In Memcached And Redis, Eventually Consistent Non-Relational Databases.

UNIT IV:
NoSQL Stores: Similarities Between Sql And Mongodb Query Features, Accessing Data From Column-Oriented Databases Like Hbase, Querying Redis Data Stores, Changing Document Databases, Schema Evolution In Column-Oriented Databases, Hbase Data Import And Export, Data Evolution In Key/Value Stores.

UNIT V

Indexing and Ordering Data Sets : Essential Concepts Behind A Database Index, Indexing And Ordering In Mongodb, Creating and Using Indexes In Mongodb, Indexing And Ordering In Couchdb, Indexing In Apache Cassandra.

Text Books:

1) Pramod Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley Professional, 2012.
2) Dan McCreary and Ann Kelly, Making Sense of NoSQL, Manning Publications, 2013.

Reference Books:

1) Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6
2) Gaurav Vaish, Getting Started with NoSQL, Packt Publishing, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
(Established by Andhra Pradesh Act No.30 of 2008)

Kakinada – 533 003, Andhra Pradesh (India)

ACADEMIC REGULATIONS R19 FOR M. Tech (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2019-20 onwards. The M. Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfil all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

2.2 **The student shall register for all 68 credits and secure all the 68 credits.**

2.3 The minimum instruction days in each semester are 90.

3.0 PROGRAMME OF STUDY

The following specializations are offered at present for the M. Tech Programme of study.

M.Tech

1. M.Tech- Structural Engineering
2. M.Tech- Structural Design
3. M. Tech- Transportation Engineering
4. M.Tech- Infrastructure Engineering & Management
5. M. Tech - Computer Aided Structural Engineering
6. M. Tech - Soil Mechanics and Foundation Engineering
7. M. Tech- Environmental Engineering
8. M.Tech-Geo-Informatics
9. M.Tech-Spatial Information Technology

10. M.Tech- Civil Engineering
11. M. Tech-Highway Engineering
12. M.Tech -Geo-Technical Engineering
13. M.Tech- Remote Sensing
11. M.Tech- Power Electronics
12. M.Tech- Power & Industrial Drives
13. M.Tech- Power Electronics & Electrical Drives
14. M.Tech- Power System Control & Automation
15. M.Tech- Power Electronics & Drives
16. M.Tech- Power Systems
17. M.Tech- Power Systems Engineering
18. M.Tech- Electrical Power Systems
19. M.Tech- High Voltage Engineering
20. M.Tech- Power Electronics and Power Systems
21. M.Tech- Power System and Control
22. M.Tech- Power Electronics & Systems
23. M.Tech- Electrical Machines and Drives
24. M.Tech- Advanced Power Systems
25. M.Tech- Power Systems with Emphasis on High Voltage Engineering
26. M.Tech- Control Engineering
27. M.Tech- Control Systems
28. M.Tech- Electrical Power Engineering
29. M.Tech- Power Engineering & Energy System
29. M.Tech- Thermal Engineering
30. M.Tech- CAD/CAM
31. M.Tech- Machine Design
32. M.Tech- Computer Aided Design and Manufacture
33. M.Tech- Advanced Manufacturing Systems
34. M.Tech-Computer Aided Analysis & Design
35. M.Tech- Mechanical Engineering Design
36. M.Tech- Systems and Signal Processing
37. M.Tech- Digital Electronics and Communication Systems
38. M.Tech- Electronics & Communications Engineering
39. M.Tech- Communication Systems
40. M.Tech- Communication Engineering & Signal Processing
41. M.Tech- Microwave and Communication Engineering
42. M.Tech- Telematics
43. M.Tech- Digital Systems & Computer Electronics
44. M.Tech- Embedded System
45. M.Tech- VLSI
46. M.Tech- VLSI Design

47. M.Tech- VLSI System Design
48. M.Tech- Embedded System & VLSI Design
49. M.Tech- VLSI & Embedded System
50. M.Tech- VLSI Design & Embedded Systems
51. M.Tech- Image Processing
52. M.Tech- Digital Image Processing
53. M.Tech- Computers & Communication
54. M.Tech- Computers & Communication Engineering
55. M.Tech- Instrumentation & Control Systems
56. M.Tech – VLSI & Micro Electronics
57. M.Tech – Digital Electronics & Communication Engineering
58. M.Tech- Embedded System & VLSI
59. M.Tech- Computer Science & Engineering
60. M.Tech- Computer Science
61. M.Tech- Computer Science & Technology
62. M.Tech- Computer Networks
63. M.Tech- Computer Networks & Information Security
64. M.Tech- Information Technology
65. M.Tech- Software Engineering
66. M.Tech- Neural Networks
67. M.Tech- Chemical Engineering
68. M.Tech- Biotechnology
69. M.Tech- Nano Technology
70. M.Tech- Food Processing
71. M.Tech- Avionics
72. M. Tech- Mining Engineering
73. M. Tech- Auto mobile Engineering
74. M. Tech- Agricultural Engineering
75. M. Tech - Material Science and Technology

and any other course as approved by AICTE/ University from time to time.

3.0 B. <u>Departments offering M. Tech Programmes with specializations are noted below</u>:

Civil Engg.	1. M.Tech. - Structural Engineering 2. M.Tech. - Structural Design 3. M.Tech. - Computer Aided Structural Engineering 4. M.Tech - Infrastructure Engineering & Management 5. M.Tech - Civil Engineering 6. M. Tech - Soil Mechanics and Foundation Engineering 7. M.Tech - Geo-Technical Engineering 8. M.Tech - Transportation Engineering 9. M.Tech - Environmental Engineering

	10. M.Tech - Geo-Informatics 11. M. Tech-Highway Engineering
EEE	1. M.Tech- Power Electronics 2. M.Tech- Power & Industrial Drives 3. M.Tech- Power Electronics & Electrical Drives 4. M.Tech- Power System Control & Automation 5. M.Tech- Power Electronics & Drives 6. M.Tech- Power Systems 7. M.Tech- Power Systems Engineering 8. M.Tech- Electrical Power Systems 9. M.Tech- High Voltage Engineering 10. M.Tech- Power Electronics and Power Systems 11. M.Tech- Power System and Control 12. M.Tech- Power Electronics & Systems 13. M.Tech- Electrical Machines and Drives 14. M.Tech- Advanced Power Systems 15. M.Tech- Power Systems with Emphasis on High Voltage Engineering 16. M.Tech- Control Engineering 17. M.Tech- Control Systems 18. M.Tech- Electrical Power Engineering 19. M.Tech- Power Engineering & Energy System
ME	1. M.Tech- Thermal Engineering 2. M.Tech- CAD/CAM 3. M.Tech- Machine Design 4. M.Tech- Computer Aided Design and Manufacture 5. M.Tech- Advanced Manufacturing Systems 6. M.Tech-Computer Aided Analysis & Design 7. M.Tech- Mechanical Engineering Design 8. M.Tech- Mining Engineering 9. M. Tech- Automobile Engineering
ECE	1. M.Tech- Systems and Signal Processing 2. M.Tech- Digital Electronics and Communication Systems 3. M.Tech- Electronics & Communications Engineering 4. M.Tech- Communication Systems 5. M.Tech- Communication Engineering & Signal Processing 6. M.Tech- Microwave and Communication Engineering 7. M.Tech- Telematics 8. M.Tech- Digital Systems & Computer Electronics 9. M.Tech- Embedded System 10. M.Tech- VLSI 11. M.Tech- VLSI Design 12. M.Tech- VLSI System Design 13. M.Tech- Embedded System & VLSI Design

	14. M.Tech- VLSI & Embedded System 15. M.Tech- VLSI Design & Embedded Systems 16. M.Tech- Image Processing 17. M.Tech- Digital Image Processing 18. M.Tech- Computers & Communication 19. M.Tech- Computers & Communication Engineering 20. M.Tech- Instrumentation & Control Systems 21. M.Tech – VLSI & Micro Electronics 22. M.Tech – Digital Electronics & Communication Engineering 23. M.Tech- Embedded System & VLSI
CSE	1. M.Tech- Computer Science & Engineering 2. M.Tech- Computer Science 3. M.Tech- Computer Science & Technology 4. M.Tech- Computer Networks 5. M.Tech- Computer Networks & Information Security 6. M.Tech- Information Technology 7. M.Tech- Software Engineering 8. M.Tech- Neural Networks 9. M.Tech- Cyber Security 10. MCA
Metallurgical Engineering	1. M. Tech - Material Science and Technology
Inter disciplinary	2. M.Tech - Chemical Engineering 3. M.Tech – Bio-technology 4. M.Tech – Nano-Technology 5. M.Tech- Food Processing Technology 6. M.Tech- Avionics 7. M.Tech - Remote Sensing 8. M.Tech - Spatial Information Technology 9. M.Tech - Environmental Engineering & Management 10. M.Tech – Renewable Energy 11. M.Tech – Environmental Occupational Health & Safety 12. M.Tech - Agricultural Engineering
MBA	1. MBA Regular 2. Integrate MBA 3. MBA (Agribusiness Management/Entrepreneurship) 4. MBA (Master in Hospital Administration) 5. MBA (Logistics and Supply Chain Management) 6. Dual Degree MBA (Previously MAM)

4.0 ATTENDANCE

4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects/courses, and with minimum 50% in each and every course including practicals.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

4.3 Shortage of Attendance **below** 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.

4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

4.5 A prescribed fee shall be payable towards Condonation of shortage of attendance.

4.6 A student shall not be promoted to the next semester unless, he satisfies the attendance requirement of the present semester, as applicable. They may seek re-admission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for re-admission into the same class.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practical, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory subjects 75 marks shall be awarded based on the performance in the End Semester Examination and 25 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks, and it will be reduced to 25 marks. End semester examination is conducted for 75 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).

5.2 For practical subjects, 75 marks shall be awarded based on the performance in the End Semester Examinations and 25 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-5 marks, record- 5 marks and the remaining 15 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup marks of Procedure-20, Experimentation-30, Results-10, Viva-voce-15.

5.3 For Mini Project with Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Mini Project with Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to re-appear for the End semester Examination in that subject. A candidate shall be given **one** chance to re-register for each subject provided the internal marks secured by a candidate **are less than 50% and has failed in the end examination.** In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt shall stands cancelled. For re-registration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University before the start of the semester in which re-registration is required.

5.6 In case the candidate secures less than the required attendance in any re-registered subject(s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.

5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the second examiner shall be appointed by the University from the panel of examiners submitted by the respective college.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members in the department.

6.2 Registration of Dissertation/Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

6.5 Continuous assessment of Dissertation-I and Dissertation-II during the Semester(s) will be monitored by the PRC.

6.6 A candidate shall submit his status report in two stages to the PRC, at least with a gap of 3 months between them.

6.7 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate has to pass all the theory and practical subjects before submission of the Thesis.

6.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

6.9 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

6.10 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.

6.11 The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.

6.12 If the report of the examiner is favorable, Viva - Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the Examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for a maximum of 100 marks.

6.13 If the report of the Viva -Voce is unsatisfactory (i.e., <50 % of marks), the candidate shall retake the Viva-Voce examination, only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.

7.0 **Cumulative Grade Point Average (CGPA)**

Marks Range Theory/ Laboratory (Max – 100)	**Marks Range Mini Project/ Project Work or Dissertation (Max – 100)**	**Letter Grade**	**Level**	**Grade Point**
≥ 90	≥ 90	O	Excellent	10
≥80 to <90	≥80 to <90	S	Very Good	9
≥70 to <80	≥70 to <80	A	Good	8
≥60 to <70	≥60 to <70	B	Fair	7
≥50 to <60	≥50 to <60	C	Satisfactory	6
<50	<50	F	Fail	0
		AB	Absent	0

Computation of SGPA

- The following procedure is to be adopted to compute the Semester Grade Point Average(SGPA) and Cumulative Grade Point Average(CGPA):

- The **SGPA** is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

- **SGPA (Si) =** $\sum$ **(Ci X Gi) /** $\sum$ **Ci**

- Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Computation of CGPA

- The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a Programme, i.e.
- **CGPA =** $\sum$ **(Ci X Si) /** $\sum$ **Ci**
- Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.
- The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
- Equivalent Percentage = (CGPA – 0.75) x 10

8.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	**CGPA to be secured**	
First Class with Distinction	$\geq$ 7.75 (Without any supplementary appearance)	**From the CGPA secured from 68 Credits.**
First Class	$\geq$ 7.75 (With any supplementary appearance) $\geq$ 6.75 and < 7.75 (Without any supplementary appearance)	
Second Class	$\geq$ 6.75 and < 7.75 (With any supplementary appearance) $\geq$ 6.0 to < 6.75 (Without any supplementary appearance)	
Pass Class	$\geq$ 6.0 to < 6.75 (With any supplementary appearance)	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

9.0 WITHHOLDING OF RESULTS

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

10.0 TRANSITORY REGULATIONS (for R19)

10.1 Discontinued or detained candidates are eligible for readmission (within the duration as mentioned in item 2.1) as and when next offered.

10.2 The readmitted students will be governed by the regulations under which the candidate has been admitted.

11.0 GENERAL

11.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

11.2 The academic regulation should be read as a whole for the purpose of any interpretation.

11.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

11.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in	The candidate who has impersonated shall

	connection with the examination.	be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant –	In case of students of the college, they shall be expelled from examination halls and

	Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which	

	is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Impose a suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

Seminar/ comprehensive vivo evaluation

There shall be two seminar presentations during III semester and IV semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

(a) For Ist & IInd semesters Seminar 100 marks are allotted for each, which shall be awarded based on the performance of the student on the selected advanced topic which is subdivided as follows.

- Marks for assignment - 20
- Marks for Power Point Presentation - 60
- Marks for viva voce (Orals) - 20

Total marks - 100

(b) There shall be two seminar presentations during III semester and IV semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee (PRC) consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

M. Pharmacy

1. Pharmaceutical Analysis
2. Pharmaceutical Analysis & Q A
3. Pharmaceutical Analysis & QC
4. Pharmaceutical Chemistry
5. Pharmaceutical Management & Regulatory Affairs
6. Pharmaceutical Technology
7. Pharmaceutics
8. Pharmacognosy
9. Pharmacology
10. Pharmacology & Toxicology
11. Pharmacy Practices
12. Quality Assurance & Regulatory Affairs