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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

COURSE STRUCTURE & SYLLABUS - M. Tech
CSE for DATA SCIENCE Programme

(Applicable for batches admitted from 2020-2021)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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

I SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS1101	**Program Core-1** Feature Engineering	PC	3	0	0	3
2	MTDS1102	**Program Core-2** Data Science Applications	PC	3	0	0	3
3	MTDS1103	**Program Elective-1** 1. Advanced Graph Theory 2. Data Mining 3. Artificial Intelligence	PE	3	0	0	3
4	MTDS1104	**Program Elective-2** 1. Internet of Things 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 Applications 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

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS1201	**Program Core-3** Advanced Data Structures and Algorithms	PC	3	0	0	3
2	MTDS1202	**Program Core-4** Machine Learning Techniques	PC	3	0	0	3
3	MTDS1203	**Program Elective-3** 1. Natural Language Processing 2. High Performance Computing 3. Cloud Computing 4. Recommender Systems	PE	3	0	0	3
4	MTDS1204	**Program Elective-4** 1. Deep Learning 2. Image and Video Analytics 3. Principles of Data Security 4. Data Visualization	PE	3	0	0	3
5	MTDS1205	**Laboratory-3** Advanced Data Structures and Algorithms Lab	LB	0	0	4	2
6	MTDS1206	**Laboartory-4** Machine 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
TotalCredits							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

S.No	Course Code	Courses	Category	L	T	P	C
1	MTDS2101	**Program Elective-5** 1. Multivariate Analysis 2. NoSQL Databases 3. MOOCs-1 through NPTEL/SWAYAM 12 Week Program related to theprogramme which is not listed in the course structure	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 parentdepartment 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

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 Computer Science and Engineering 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	FEATURE ENGINEERING (MTDS1101)	L	T	P	C
		3	0	0	3

UNIT – I :
The Machine Learning Pipeline : Data, Tasks, Models, Features, Model EvaluationFancy Tricks with Simple Numbers: Scalars, Vectors, and Spaces, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Log Transform in Action, Power Transforms: Generalization of the Log Transform, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling), ℓ2 Normalization, Interaction Features, Feature Selection

UNIT – II :
Text Data: Flattening, Filtering, and Chunking: Bag-of-X: Turning Natural Text into Flat Vectors, Bag-of-Words, Bag-of-n-Grams, Filtering for Cleaner Features: Stopwords, Frequency-Based Filtering, Stemming; Atoms of Meaning: From Words to n-Grams to Phrases: Parsing and Tokenization, Collocation Extraction for Phrase Detection
The Effects of Feature Scaling: From Bag-of-Words to Tf-Idf :Tf-Idf : A Simple Twist on Bag-of-Words, Putting It to the Test : Creating a Classification Dataset, Scaling Bag-of-Words with Tf-Idf Transformation, Classification with Logistic Regression, Tuning Logistic Regression with Regularization

UNIT – III :
Categorical Variables: Counting Eggs in the Age of Robotic Chickens: Encoding Categorical Variables: One-Hot Encoding, Dummy Coding, Effect Coding, Pros and Cons of Categorical Variable Encodings; Dealing with Large Categorical Variables: Feature Hashing, Bin Counting
Dimensionality Reduction: Squashing the Data Pancake with PCA: Intuition, Derivation: Linear Projection, Variance and Empirical Variance, Principal Components: First Formulation, Principal Components: Matrix-Vector Formulation, General Solution of the Principal Components; Transforming Features, Implementing PCA: PCA in Action, Whitening and ZCA, Considerations and Limitations of PCA

UNIT – IV:
Nonlinear Featurization via K-Means Model Stacking: k-Means Clustering, Clustering as Surface Tiling, k-Means Featurization for Classification: Alternative Dense Featurization, Pros, Cons, and Gotchas

UNIT – V :
Item-Based Collaborative Filtering, First Pass: Data Import, Cleaning, and Feature Parsing, Academic Paper Recommender: Naive Approach, Second Pass: More Engineering and a Smarter Model, Academic Paper Recommender: Take 2, Third Pass: More Features is More Information, Academic Paper Recommender: Take 3

Text Books:
1. "Feature Engineering for Machine Learning Principles and Techniques for Data Scientists", Alice Zheng& Amanda Casari, O'REILLY, 2018
2. "Feature Engineering and Selection: A Practical Approach for Predictive Models", Max Kuhn, Kjell Johnson, CRC Press, 2019.

Reference Books:

1. "The art of feature engineering essentials for machine Learning" Pablo, Duboue, Cambridge University Press, 2020.
2. Feature Engineering Made Easy: Identify Unique Features from Your Dataset in Order to Build Powerful Machine Learning Systems, DivyaSusarla and SinanOzdemir, Packt Publishing, 2018.

I Year - I Semester	DATA SCIENCE APPLICATIONS (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 FileFormats - 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, Groupby 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. Programming Python, 4th Edition,MarkLutz, OReilly, 2010.
3. Python For Data Analysis, 2nd Edition, WesMckinney, O Reilly, 2017.

Reference Books:

1. Python: The Complete Reference,1stEdition, Martin C. Brown, McGraw HillEducation, 2018.
2. Head First Python,2ndEdition, Paul Barry,O′Reilly, 2016.

I Year - I Semester	ADVANCED GRAPH THEORY (MTDS1103)	L	T	P	C
		3	0	0	3

Course Objectives:
From the course the student will learn

- All elementary concepts such as coloring, covering, planarity, connectivity and so on, it will also introduce the students to some advanced concepts.
- The definitions of relevant vocabulary and various algorithms from graph theory.

Course Outcomes:

- Demonstrate basic concepts in graph theory: coloring, planar graphs.
- Evaluate precise and accurate mathematical definitions of objects in graph theory.
- Determine and solve some real time problems using concepts of graph theory (e.g., scheduling problems).
- Build some classical graph algorithms in order to find sub graphs with desirable properties.
- Compile and deduce properties of chromatic numbers and polynomials and identify certain problems as graph colouring problems.

UNIT–I:
Basic Concepts- Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group, **Trees-** Equivalent definitions of trees and forests, Cayley's formula, the Matrix-Tree theorem.

UNIT–II:
Connectivity- Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger's theorem, **Paths and Cycles-** Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, circumference, the Chinese Postman Problem, the Travelling Salesman problem, diameter and maximum degree.

UNIT–III:
Matchings- Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartitie and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem, **Extremal problems-** Independent sets and covering numbers, Turan's theorem, Ramsey theorems.

UNIT–IV:
Colorings- Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem, **Graphs on surfaces-** Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces.

UNIT–V:
Directed graphs- Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, **Networks and flows-** Flow cuts, max flow min cut theorem, **Selected topics-** Dominating sets, the reconstruction problem.

Text Books:

1. Introduction to Graph Theory, Douglas Brent West, Prentice Hall of India, 2001.
2. Graph Theory with Applications to Engineering and Computer Science, NarsinghDeo, PHI, Dover Publications, 2016.

Reference Books:

1. Graph Theory, Frank Harary, Narosa, CRC Press, 2018.
2. Network Flows: Theory, Algorithms, and Applications, Ravindra K. Ahuja, Thomas L. Magnanti, James B. Orlin, Pearson Education, 2013.

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

Course Objectives:

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) **- K2**
2. **Choose** appropriate classification technique to perform classification, model building and evaluation (UNIT-II)**- K3**
3. **Make use of** association rule mining techniques on categorical and continuous data (UNIT III) **- K3**
4. **Identify and apply** clustering algorithm (with open source tools), interpret, evaluate and report the result (UNIT IV) **- K3**
5. **Analyze and Compare**anomaly detection techniques (UNI-V) **- K4**

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

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

Text Books:

1. Introduction to Data Mining: Pang-Ning Tan; Michael Steinbach; AnujKarpatne; Vipin Kumar, 2nd edition.
2. Data Mining: 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, MichelineKamber, 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	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(COs): At the end of the course, student will be able to

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

UNIT-I:

Introduction to artificial intelligence: Introduction , history, intelligent systems, 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, fuzzysystems.

Text Books:

1. Artificial intelligence, A modern Approach, 2nd edition, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence, SarojKaushik, 1st Edition, CENGAGELearning, 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- 3rdEdition, 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	INTERNET OF THINGS (MTDS1104)	L	T	P	C
		3	0	0	3

Course Objectives:

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

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

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

UNIT I:

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

UNIT II:

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

UNIT III:

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

UNIT IV:

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

UNIT V:

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

Text Books:

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

Reference Books:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally,Wiley, 2013
2. Getting Started with the Internet of Things (Make: Projects), CunoPfister , Oreilly, 2011

I Year - I Semester	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:

1. Social Network Data Analytics, Charu C. Aggarwal, Springer, 2011
2. Data mining The Text book, 1st Edition, Charu C Aggarwal , Springer Publications, 2015
3. Mining Text Data,Charu C. Aggarwal, ChengXiang 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

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

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

Reference Books:

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

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

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

Course Objectives: To understand the research problem

- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

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

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

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

UNIT II:
Effective literature studies approaches, analysis Plagiarism, Research ethics, 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.

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 forbeginners"
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

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

I Year - I Semester	DATA SCIENCE APPLICATIONS 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 andstoring.
- Apply Python programming concepts in data science, including their real-worldapplications.
- Implement data collection and management scripts using PythonPandas.

List of Experiments:

Experiment 1:
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 DataFrames with Pandas in Python

Experiment 12:
Write a program to implement Merge and Join DataFrames 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.

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

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

Course Outcomes:

- Implement various heuristics searchtechniques.
- 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)

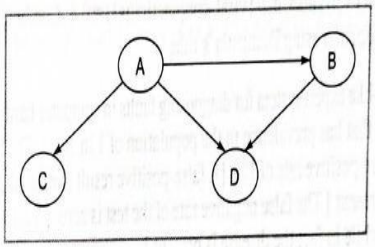


Figure Bayesian Belief Network

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 perline
   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 smallfile.

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.

Text Books:

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

I Year - II Semester	ADVANCED 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, Searchtrees.
- AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of searchtrees.

Course Outcomes:

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

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

UNIT I:

The Role of Algorithms in Computing, Algorithms, 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, 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, SartajSahni, University Press
2. Data Structures and Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson.
3. Data Structures and Algorithms, 3/e, Adam Drozdek,Cengage
4. C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co,2009

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

I Year - II Semester	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, 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.

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	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, British National Corpus (BNC).

Text Books:

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

Reference Books:

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

I Year - II Semester	HIGH PERFORMANCE COMPUTING (MTDS1203)	L	T	P	C
		3	0	0	3

Course Objectives:
The objective of the subject is to

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

Course Outcomes: After completion of this course

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

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

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

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

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

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

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

Reference Books:

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

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

I Year - II Semester	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, 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 ApplicationProgramming,RajKumar Buyya, Christen vecctiola, S Tammaraiselvi,TMH

I Year - II Semester	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-Centred 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. andFelFering 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	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 neuralnetworks.

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 andparadigms
- 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,autoencoders.
Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise 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- VariationalAutoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning
Applications: Vision, NLP, Speech

Textbooks
1. Deep Learning, Ian Goodfellow and YoshuaBengio 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	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:

Colour 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	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	DATA VISUALIZATION (MTDS1204)	L	T	P	C
		3	0	0	3

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

- Identify and recognize visual perception and representation of data.
- Illustrate about projections of different views of objects.
- Apply various Interaction and visualization techniques.
- Analyze various groups for visualization.
- Evaluate visualizations

UNIT-I:
INTRODUCTION TO DATA VISUALIZATIONS AND PERCEPTION: Introduction of visual perception, visual representation of data, Gestalt principles, Information overload.

UNIT-II :
VISUAL REPRESENTATIONS: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

UNIT-III :
CLASSIFICATION OF VISUALIZATION SYSTEMS: Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

UNIT-IV :
VISUALIZATION OF GROUPS: Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

UNIT-V :
VISUALIZATION OF VOLUMETRIC DATA AND EVALUATION OF VISUALIZATIONS: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

Text Books:

1. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2nd edition,A K Peters, Ltd 2015.

Reference Books:

1. Tamara Munzner,Visualization Analysis & Design ,1st edition,AK Peters Visualization Series 2014
2. Scott Murray,Interactive Data Visualization for the Web ,2nd Edition, 2017

I Year - II Semester	ADVANCED DATA STRUCTURES AND ALGORITHMS LAB (MTDS1205)	L	T	P	C
		0	0	4	2

Course Objectives:
From the course the student will learn various advanced data structures concepts like hashing, priority queues, Binary Search trees, AVL trees, B Trees.

Course Outcomes:
After the completion of the course, student will be able to
- Organize and apply to solve the complex problems using advanced data structures
- Apply and analyze functions of Dictionary

List of Experiments:

Experiment 1:
Write a java program to implement Merge & Heap Sort of given elements.

Experiment 2:
Write a java program to implement Quick Sort of given elements.

Experiment 3:
Write a java program for the following using stack
a) Infix to postfixconversion.
b) Expressionevaluation.
c) Obtain the binary number for a given decimal number.

Experiment 4:
Write a java program to implement the following for a graph.
a)BFS b) DFS

Experiment 5:
Write a java program to implementation of recursive and non-recursive functions to Binary tree Traversals

Experiment 6:
Write a java program to implement all the functions of Dictionary (ADT) using Hashing.

Experiment 7:
Write a java program to implement various operations on Priority Queue.

Experiment 8:
Write a java program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.

Experiment 9:
Write a java program to implement various operations on AVL trees.

Experiment 10:

Write a java program to perform the following operations:

a) Insertion into a B-tree b) Searching in a B-tree

Text Books:

1.Data Structures, Algorithms and Applications in java, 2nd Edition, SartajSahni, University Press
2.Data Structures and Algorithm Analysis, 2nd Edition, Mark Allen Weiss, Pearson.

I Year - II Semester	MACHINE LEARNING LAB (MTDS1206)	L	T	P	C
		0	0	4	2

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

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

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 toclassify 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 Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
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, AurelienGeron, 2019.

References:

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

II Year - I Semester	MULTIVARIATE ANALYSIS (MTDS2101)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the main features of multivariate data.
- To be able to use exploratory and confirmatory multivariate statistical methods properly.
- To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

Course Outcomes:

The course learning objectives include the following:

- To perform multivariate data analysis using R
- To interpret the results and test the assumptions of a multivariate data analysis.
- To understand academic research employing multivariate techniques.

Unit I:

Organization and Display of Data.Matrix Algebra and Random Vectors.Characterizing data, defining and classifying variables.Multivariate Normal Distribution, Multivariate analysis of variance, multivariate analysis of covariance.

Unit II:

Simple Linear Regression and Correlation analysis, Multiple Regression and Correlation, Variable Selection in Regression analysis, missing values, dummy variables, constraints on parameters and multi collinearity.

Unit III:

Canonical Correlation analysis: analyzing two sets of variables. Discriminant Analysis: Analyzing cases, adjusting the value of the dividing point, and the goodness of the discriminant function, classification in more than two groups.

Unit IV:

Logistic Regression: categorical, continuous and mixed variables. Log-linear regression model. Principal Component Analysis: Understanding inter correlations, interpretation and use of PCA in regression and other applications. Factor Analysis: examining the relationship among p variables, initial factor extraction, factor rotations and assigning factor scores.

Unit V:

Multidimensional Scaling: measures of similarity and dissimilarity, Classical scaling and Ordinal scaling. Cluster Analysis: distance measures and analytical clustering techniques. Log-linear analysis: analyzing categorical data, test of hypothesis and models for two way tables, sample size issues and the logic model.

Text Books:

1. Introduction to Multivariate Analysis by C. Chatfield and A.J. Collins, T&F/CRCPress
2. Applied Multivariate Statistical Analysis by Richard A. Johnson , Dean W. Wichern,Pearson.

Reference Books:

1. Multivariate Data Analysis by Joseph H. Hair, William C. Black, Barry J. Babin and RolphE.Anderson, Pearson.
2. Computer-Aided Multivariate Analysis by A.A. Afifi, CRC press.

II Year - I Semester	NoSQL DATABASES (MTDS2101)	L	T	P	C
		3	0	0	3

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

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

UNIT-I:

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

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

UNIT-II :

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

UNIT-III :

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

UNIT-IV:

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

UNIT-V :

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

Text Books:

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

Reference Books:

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

Open Electives offered by the Department of CSE for other Departments students

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

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

AUDIT 1 / 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:
Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Outcomes:

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	8

Suggested Studies:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA-533 003, ANDHRA PRADESH, INDIA

AUDIT 1 / 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course Outcomes:

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. **Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	8

Suggested Readings:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA-533 003, ANDHRA PRADESH, INDIA

AUDIT 1 / 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

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

Course Outcomes:

Students will be able to

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

Syllabus

Unit	Content	Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	4
2	Order Introduction of roots Technical information about Sanskrit Literature	4
3	Technical concepts of Engineering-Electrical,	4
4	Technical concepts of Engineering - Mechanical.	4
5	Technical concepts of Engineering - Architecture. Technical concepts of Engineering – Mathematics.	8

Suggested reading

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

AUDIT 1 / 2: VALUE EDUCATION

Course Objectives

Students will be able to

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

Course Outcomes:

Students will be able to

1.have Knowledge of self-development

2.Learn the importance of Human values 3.Developing the overall personality

Syllabus

Unit	Content	Hours
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements	4
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity, Patriotism. Love for nature ,Discipline	4
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking.	4
4	Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	4
5	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence , Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	8

Suggested reading

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

AUDIT 1 / 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

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

Course Outcomes:

Students will be able to:

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

Syllabus

Units	Content	Hours
1	**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	**Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4

4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4
5	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy **Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	8

Suggested reading

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

AUDIT 1 / 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

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

Course Outcomes:

Students will be able to understand:

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

Syllabus

Units	Content	Hours
1	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	4
3	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	4
4	Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
5	Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes **Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	8

Suggested reading

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA-533 003, ANDHRA PRADESH, INDIA

AUDIT 1 / 2: STRESS MANAGEMENT BY YOGA

Course Objectives

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

Course Outcomes:

Students will be able to:

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

Syllabus

Unit	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga)	5
2	Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha	5
3	Yam and Niyam. Do`s and Don't's in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	5
4	Asan and Pranayam Various yog poses and their benefits for mind & body	5
5	Regularization of breathingtechniques and its effects-Types of pranayam	4

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AUDIT 1 / 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

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

Course Outcomes

Students will be able to

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

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue)	4
2	Neetisatakam-Holistic development of personality Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's) Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,	8
3	Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	4
4	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18	4
5	Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	4

Suggested reading

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