KKR & KSR INSTITUTE OF TECHNOLOGY AND SCIENCES
(AUTONOMOUS)
M.Tech in Computer Science and Engineering

COURSE STRUCTURE & SYLLABUS - M. TECH (CSE-DS) – R23 Regulation
(Applicable from the academic year: 2024-25 onwards)

M.Tech.– I Year I Semester (SEMESTER-I)

S. No	Course Cat	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PCC	**23CD1T01**	Statistical Foundations for Data Science	3	0	0	3	25	75	100
2	PCC	**23CD1T02**	Data Science Applications with Python	3	0	0	3	25	75	100
3	PEC-I	**23CD1E01** **23CD1E02** **23CD1E03**	**Professional Elective – I** i) Advanced Graph Theory ii) Data Ware housing& Data Mining iii) Advanced Data Structures	3	0	0	3	25	75	100
4	PEC-II	**23CD1E04** **23CD1E05** **23CD1E06**	**Professional Elective – II** i) Data Analysis using SQL and Excel ii) Social Network and Semantic Web iii) Cloud Computing	3	0	0	3	25	75	100
5	MC	**23GR1A01**	Research Methodology and IPR	2	0	0	2	25	75	100
6	AC	**23GS1A0X**	**Audit Courses (AC)-I**	2	0	0	0	---	---	---
7	PCC	**23CD1L01**	Data Science Applications with Python Lab	0	0	2	2	25	75	100
8	PCC	**23CD1L02**	Statistical Foundations for Data Science Lab	0	0	2	2	25	75	100
			Total Credits				**18**	**175**	**525**	**700**

Theory: PC-2, MC-1, AC-1, PE-I-1, PE-II-1 **Practical:** PC-2

M.Tech.– I Year II Semester (SEMESTER-II)

S. No	Course Cat	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PCC	**23CD2T01**	Big Data Analytics	3	0	0	3	25	75	100
2	PCC	**23CD2T02**	Machine Learning Techniques	3	0	0	3	25	75	100
3	PEC-III	**23CD2E01** **23CD2E02** **23CD2E03**	**Professional Elective – III** i) Natural Language Processing ii) High Performance Computing iii) Digital Image Processing	3	0	0	3	25	75	100
4	PEC-IV	**23CD2E04** **23CD2E05** **23CD2E06**	**Professional Elective – IV** i) Principles of Deep Learning ii) Image and Video Analytics iii) Principles of Data Security	3	0	0	3	25	75	100
5	PC	**23CD2P01**	Mini Project with Seminar	0	0	0	2	100	--	100
6	AC	**23GS2A0X**	**Audit Courses (AC)-II**	2	0	0	0	---	---	---
7	PCC	**23CD2L01**	Big Data Analytics Lab	0	0	2	2	25	75	100
8	PCC	**23CD2L02**	Machine Learning Techniques Lab	0	0	2	2	25	75	100
			Total Credits				**18**	**250**	**450**	**700**

Theory: PC-3, PE-III-1, PE-IV-1, AC-1 Practical: PC-2

M.Tech in Computer Science and Engineering

M.Tech.– II Year I Semester (SEMESTER-III)

S. No	Course Cat	CourseCode	Course Title	L	T	P	C	IM	EM	TM
1	PEC-V	23CD3E01 23CD3E02 23CD3E03	**Professional Elective – V** i) AI Chatbots ii) Next Generation Databases iii) MOOCs-1through NPTEL/ SWAYAM/COURSER A 12 Week Program related to the programme	3	0	0	3	25	75	100
2	OEC-I	23CD3O01 23CD3O02 23CD3O03	**Open Elective-I** i) Advanced Python Programming ii) Deep Learning iii) MOOCs-2 through NPTEL/SWAYAM/ COURSERA - Any 12-week course on Engineering/ Management/ Mathematics offered by other than parent department	3	0	0	3	25	75	100
3	PCC	23CD3P01	Dissertation Phase-I/Industrial Project#,$	0	0	20	10	100	--	100
			Total Credits				**16**	**150**	**150**	**300**

Theory: PC-3, PE-1, OE-1, ES-1 **Practical:** PC-2, SEC-1

M.Tech.– II Year II Semester (SEMESTER-IV)

S. No	Course Cat	CourseCode	CourseTitle	L	T	P	C	IM	EM	TM
1	PCC	23CD4P01	Dissertation Phase-II	0	0	32	16	100	100	200
			Total Credits				**16**	**100**	**100**	**200**

List of Audit Course

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

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	STATISTICAL FOUNDATIONS FOR DATA SCIENCE	3	0	0	3
COURSE CATEGORY	PCC1				

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: apply the number theory concepts to cryptography domain
CO 2: apply the concepts of probability and distributions to some case studies
CO 3: correlate the material of one unit to the material in other units
CO 4: resolve the potential misconceptions and hazards in each topic of study.
CO 5: students will apply data science concepts Stochastic process and Markov chains.

UNIT I:

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

UNIT II:

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

UNIT III:

Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve,Applications of the Normal Distribution, Normal Approximation to the Binomial,

Fundamental Sampling Distributions: Random Sampling, Sampling Distributions, Sampling, Distribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t–Distribution, F Distribution.

UNIT IV:

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

UNIT V:

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

Text Books:

1. Kenneth H. Rosen, Elementary number theory & its applications, sixth edition, Addison Wesley, ISBN 978 0-321-50031-1
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
3. S. D. Sharma, Operations Research, Kedarnath and Ramnath Publishers, Meerut, Delhi

Reference Books:

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

Web Links:

1. http://www.cse.iitm.ac.in/~pratyush/cs6741.html
2. https://www.iitg.ac.in/rhythmgrover/DA241.html

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Data Science Applications with Python	3	0	0	3
COURSE CATEGORY	PCC2				

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 vitalfor data science.
- Produce Python code to statistically analyze a data set.
- Critically evaluate data visualizations based on their design and use for communicatingstories from data.

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: explain how data is collected, managed and stored for data science.
CO 2: understand the key concepts in data science, including their real-world applications andthe toolkit used by data scientists.
CO 3: implement data collection and management scripts using Python Pandas.
CO 4: perform Data Loading Cleaning, Transformation & Merging
CO 5: create different plots for basic exploratory data analysis

UNIT I:

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

UNIT II:

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

UNIT III:

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

UNIT IV:

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

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

Text Books:

1. Learning Python , OReilly, MarkLutz
2. Programming Python, OReilly, MarkLutz
3. Python For Data Analysis (O Reilly, WesMckinney)

Reference Books:

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

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://www.youtube.com/watch?v=yGN28LY5VuA

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Advanced Graph Theory	3	0	0	3
COURSE CATEGORY	PEC1				

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: evaluate precise and accurate mathematical definitions of objects in graph theory.
CO2: determine and solve some real time problems using concepts of graph theory (e.g.,scheduling problems).
CO3: build some classical graph algorithms in order to find sub graphs with desirableproperties
CO4: compile and deduce properties of chromatic numbers and polynomials and identify certain problems as graph coloring problems.
CO5: understand the concepts of graphs, directed graphs, and network flows

UNIT I:

Basic Concepts: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the auto morphism 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:

Matching's : Berge's Theorem, perfect matching's, 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, External 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 B. West, Prentice Hall of India
2. Graph Theory with Applications to Engineering and Computer Science, NarsinghDeo, Prentice-Hall

Reference Books:

1. Graph Theory, Frank Harary, Narosa
2. Network Flows: Theory, Algorithms, and Applications, R.Ahuja, T. Magnanti, and J. Orlin,Prentice- Hall

Web Links:

1. https://www.youtube.com/playlist?app=desktop&list=PLGzubT3mVJiO0OBdwdKO3aLGDb7t85wct
2. https://www.youtube.com/playlist?list=PLEAYkSg4uSQ3NwwQtfSgnKPF5x4iI_XTb

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Data Warehousing & Data Mining	3	0	0	3
COURSE CATEGORY	PEC1				

COURSE OBJECTIVES:

- Able to learning the basic definition and concepts of Data ware houses.
- Able to learn Data Warehousing architecture and operations.
- Describe the process used in developing and managing Data ware houses.
- Understand the role of Data Warehouses in decision support.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: understand compelling needs for Data Warehousing.
CO2: analyze business requirements and data design.
CO3: identify different Data Warehouse Architecture and need of metadata.
CO4:apply Dimensional Modelling, Data Extraction, Transformation, and Loading techniques.
CO5: identifies tool for analyzing Data quality and perform OLAP operations.

UNIT I:

The Compelling Need For Data Warehousing: Escalating Need for Strategic Information, Failures of Past Decision-Support Systems, Operational Versus Decision-Support Systems, Data Warehousing—The Only Viable Solution, Data Warehouse Defined, Data Warehouse: The Building Blocks- Defining Features, Data Warehouses and Data Marts, Overview of the Components, Metadata in the Data Warehouse, Trends in Data Warehousing- Continued Growth in Data Warehousing, Significant Trends, Emergence of Standards, Web- Enabled Data Ware house.

UNIT II:

Planning And Project Management: Planning Your Data Warehouse, The Data Warehouse Project, The Project Team, Project Management Considerations, Defining the Business Requirements- Dimensional Analysis, Information Packages—A New Concept, Requirements Gathering Methods, Requirements Definition: Scope and Content, Requirements as the Driving Force for Data Warehousing- Data Design, The Architectural Plan, Data Storage Specifications, Information Delivery Strategy

UNIT III:

The Architectural Components: Understanding Data Warehouse Architecture, Distinguishing Characteristics, Architectural Framework, Technical Architecture, Infrastructure as the Foundation for Data Warehousing- Infrastructure Supporting Architecture, Hardware and Operating Systems, Database Software, Collection of Tools, The Significant Role ofMetadata- Why Metadata is Important, Metadata Types by Functional Areas, Business Metadata, Technical Metadata, How to Provide Metadata

UNIT - IV:

Principles Of Dimensional Modelling: Requirements to Data Design, The STAR Schema, STAR Schema Keys, Advantages of the STAR Schema, Dimensional Modelling: Advanced Topics- Updates to the Dimension Tables, Miscellaneous Dimensions, The Snowflake Schema, Aggregate Fact Tables, Families of STARS, Data Extraction, Transformation, and Loading- ETL Overview, Data Extraction, Data Transformation, Data Loading, ETL Summary.

UNIT -V:

Data Quality: A Key to Success- Why is Data Quality Critical? Data Quality Challenges, Data Quality Tools, Data Quality Initiative, OLAP in the Data Warehouse- Demand for Online Analytical Processing, Major Features and Functions, OLAP Models, OLAP Implementation Considerations.

Text Books:

1. Data Warehousing: Fundamentals for IT Professionals, 2ed ,by Paulraj Ponniah,2010

Reference Books:

1. Data Warehouse Systems Design Implementation Vaisman Alejandro, Springer-Verlag Berlin and Heidelberg GmbH & Co. K

Web Links:

1. https://www.youtube.com/watch?v=m-aKj5ovDfg
2. https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs15/

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Advanced Data Structures	3	0	0	3
COURSE CATEGORY	PEC1				

COURSE OBJECTIVES:

- Single Linked, Double Linked Lists, Stacks, Queues, Searching and Sorting techniques, Trees, Binary trees, representation, traversal, Graphs- storage, traversal.
- Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees.
- AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: write and analyze algorithms for algorithm correctness and efficiency
CO 2: master a variety of advanced abstract data type (ADT) and data structures and their Implementation
CO 3: demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of real life
CO 4:design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees
CO 5:compare various search trees and find solutions for IT related problems

UNIT I:

Introduction to Data Structures: Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

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. Data Structures: A Pseudo Code Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon and Cengage
2. Data Structures, Algorithms and Applications in java, 2/e, Sartaj Sahni, University Press

Reference Books:

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

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://www.youtube.com/playlist?list=PL54i8TI-dREZtNaEDi6pe5z8Vp6SRKS8G

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Data Analysis using SQL and Excel	3	0	0	3
COURSE CATEGORY	PEC2				

COURSE OBJECTIVES:

1.To learn noSQL and other databases
2.To introduce data exploration and other statistical concepts

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1:perform different types of operations on databases
CO 2: learn data explorations with excel
CO 3: apply basic statistical concepts
CO 4: apply latitude and longitude and data for analytics
CO 5:know about visualizing customers

UNIT I:

A Data Miner Looks at SQL, Relational Databases, Hadoop and Hive, NoSQL and Other Types of Databases, SQL, Data Model, Table, Allowing NULL Values, Column Types, The Zip Code Tables, Subscription Dataset, Purchases Dataset, Picturing Data Analysis Using Dataflows, SQL Queries, Subqueries and Common Table Expressions

UNIT II:

Data Exploration, Excel for Charting, Column Charts, Bar Charts in Cells, Useful Variations on the Column Chart, Sparklines, Histograms, More Values to Explore—Min, Max, and Mode, Exploring String Values, Exploring Values in Two Columns, From Summarizing One Column to Summarizing All Columns

UNIT III:

Basic Statistical Concepts, The Null Hypothesis, Confidence and Probability, Normal Distribution, Standard Deviation for Subset Averages, Sampling from a Table, Counting Possibilities, Ratios and Their Statistics, Chi-Square, Data Investigation, Multidimensional Chi-Square.

UNIT IV:

Definition of Latitude and Longitude, Distance between Two Locations, Pictures with Zip Codes, The Scatter Plot Map, Census Demographics, Geographic Hierarchies, Mapping in

Excel Dates and Times in Databases, Extracting Components of Dates and Times, Comparing Counts by Date, Billing Date by Day of the Week, How Long Between Two Dates, Year-over-Year Comparisons, Counting Active Customers by Day

UNIT V:

Background on Survival Analysis, Life Expectancy, The Hazard Calculation, Visualizing Customers: Time versus Tenure, Survival and Retention, Survival and Retention, Comparing Survival over Time, Estimated Revenue for a Group of Existing Customers, Forecasting.

Text Books:

1.Gordon . S. linoff , Data Analysis using SQL and Excel, Second Edition, Wiley.

Reference Books:

1. Upom Malik, Matt Goldwasser, Benjamin Johnston, SQL for Data Analytics, Packt Publishing, 2019.
2. Anthony Molinaro ,SQL Cookbook, Oreilly, 2006
3. Lynn Beighley , Head First SQL (A Brain Friendly Guide), Oreilly, 2007

Web Links:
https://nptel.ac.in/courses/106105175

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Social Network and Semantic Web	3	0	0	3
COURSE CATEGORY	PEC2				

COURSE OBJECTIVES:

- Explain the fundamentals of Semantic Web technologies. Implementation of semantic webapplications and the architectures of social networking.
- Social network performance analysis.

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: demonstrate the semantic web technologies like RDF Ontology and others.
CO 2: learn the various semantic web applications.
CO 3: identify the architectures and challenges in building social networks.
CO 4: analyze the performance of social networks using electronic sources.
CO 5: understand and knowledge representation for the semantic web and Develop social-semantic applications.

UNIT I:

Web Intelligence: Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

UNIT II:

Knowledge Representation: For the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema

UNIT III:

Ontology Engineering: Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

UNIT IV:

Semantic Web Applications: Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

UNIT V: Social Network Analysis and semantic web: What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Text Books:

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008. 1. SocialNetworks and the Semantic Web, Peter Mika, Springer, 2007.

Reference Books:

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor &Francis Group).
3. Programming the Semantic Web, T.Segaran, C.Evans, J.Taylor,O'Reilly.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_cs78/preview
2. https://archive.nptel.ac.in/courses/106/106/106106169/

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	CLOUD COMPUTING	3	0	0	3
COURSE CATEGORY	PEC2				

COURSE OBJECTIVES:

- The student will also learn how to apply trust-based security model to real-world security problems.
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: identify security aspects of each cloud model, Develop a risk-management strategy for moving to the Cloud

CO2: implement a public cloud instance using a public cloud service provider

CO3: apply trust-based security model to different layer

CO4: analyze the performance of Cloud Computing.

CO5: understand the concept of Cloud Security & Learn the Concept of Cloud Infrastructure Model

UNIT I:

Introduction to Cloud Computing: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

UNIT II:

Cloud Computing Architecture: Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models: Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

UNIT III:

Security Issues in Cloud Computing: Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management: Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

UNIT IV

Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

UNIT V

Audit and Compliance: Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud Advanced Topics Recent developments in hybrid cloud and cloud security.

Text Books:

1.Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood.
2.Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg, and Andrzej Goscinski.

Reference Books:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009.
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://www.shiksha.com/online-courses/cloud-computing-by-nptel-course-nptel18

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	RESEARCH METHODOLOGY AND IPR	2	0	0	2
COURSE CATEGORY	AC-I				

COURSE OBJECTIVES:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: understand the research problems and find the scope of the solution
CO 2: analyzing the research proposals based on the problem identification
CO 3: understand the process and development of the Nature of Intellectual Property
CO 4: understand the scope of the patent rights.
CO 5: understand the Administration of Patent System for new developments in IPR

UNIT I:

Research problem: 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:

Literature study: 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 informationand data bases. 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".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd , 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall,1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age",2016.
7. T.Ramappa,"Intellectual Property Rights Under WTO", S.Chand,200

Web Links:

1. https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview
2. https://archive.nptel.ac.in/courses/127/106/127106227/

AC: PEDAGOGY STUDIES

COURSE OBJECTIVES:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design andpolicy 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 classroomsin 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 andguidance 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 informal 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 thecommunity. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
6	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	4

Suggested reading

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

AC: SANSKRIT FOR TECHNICAL KNOWLEDGE

COURSE OBJECTIVES

1. To get a working knowledge in illustrious Sanskrit, the scientific language in theworld
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 explorethe huge knowledge from ancient literature

COURSE OUTCOMES

At the end of course students will be able to

1. Understand 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.	4
6	Technical concepts of Engineering – Mathematics.	4

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, NewDelhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri,Rashtriya Sanskrit Sansthanam, New DelhiPublication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., NewDelhi.

AC: 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 they should know about the importance of character

COURSE OUTCOMES

Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

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 fornature, 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-managementand good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women.	4
6	All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	4

Suggested reading

1 Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, NewDelhi

AC: CONSTITUTION OF INDIACOURSE

COURSE OBJECTIVES:

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:

At the end of course students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians beforethe 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 of1956.

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 andEducational 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	4
6	**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.	4

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.

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Data Science Applications with Python Lab	0	0	2	2
COURSE CATEGORY	PCCLAB2				

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 vitalfor data science.
- Produce Python code to statistically analyze a data set.
- Critically evaluate data visualizations based on their design and use for communicatingstories from data.

COURSE OUTCOMES:

At the end of the course students will be able to

CO 1: implement data science operations like data collection, management and storing
CO 2: apply Python programming concepts in data science, including their real-world applications
CO 3: implement data collection and management scripts using Python Pandas.
CO 4: perform Data Loading Cleaning, Transformation & Merging
CO 5: **c**reate different plots for basic exploratory data analysis

List of Experiments:

Experiment1:

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 SecondElement 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.** Heap sort

Experiment 8:
Write a Python Program to Reverse a String Using Recursion
Experiment 9:
Write a Python Program to Count the Number of Words in a Text File
Experiment 10:
Write a Python Program to Read the Contents of a File in Reverse Order
Experiment 11:
Write a program to Merge and Join Data Frames with Pandas in Python
Experiment 12
Write a program to implement Merge and Join Data Frames with Python Pandas
Experiment 13:
Write a Python Program to Append the Contents of One File to another File
Experiment 14:
How to install and Load CSV files to Python Pandas
Experiment 15:
Write a program to implement Data analysis and Visualization with Python using pandas.
Experiment 16:
Write a program to Implement Plotting Functions in python pandas.

Text Books:
4. Learning Python , OReilly, MarkLutz
5. Programming Python, OReilly, MarkLutz
6. Python For Data Analysis (O Reilly, WesMckinney)

Reference Books:
3. Python: The Complete Reference, Martin C. Brown, McGraw Hill Education
4. Head First Python, Paul Barry, O'Reilly

Web links:

https://www.geeksforgeeks.org/different-ways-to-import-csv-file-in-pandas/
https://www.sanfoundry.com/python-program-create-list-tuples/

PROGRAM: M.Tech DATA SCIENCE SEMESTER-I					
COURSE CODE		L	T	P	C
	Statistical Foundations of Data Science Lab	0	0	2	2
COURSECATEGORY	PCCLAB1				

COURSE OBJECTIVES:

- The students are exposed to various experimental skills in data analytics which is very essential for Data Science.
- Students are exposed to the Probability distribution using R & Python Programming.
- Students are able to use R and Python Programming and perform all types of operators and functions to generate the effective reports.
- To inculcate in students professional and ethical attitude, multidisciplinary approach and an ability to relate statistical analysis in data science by using various statistical methods or principles.
- Students should aware of Hypothetical Tests, Regression Analysis and Monte Carlo Integration.
- To provide student with an academic environment aware of excellence, written ethical codes and guidelines and lifelong learning needed for a successful bright and professional career.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: The student learns the concept of R and Python Programming and Statistical analysis and try formulate new solutions or programs.

CO2: Demonstrate an ability to design and develop R and Python programs with this, analysis the data and generate the related report or results.

CO3: Demonstrate an ability to design programming on probability distribution and computed all possible outcomes or required reports.

CO4: Able to do hypothetical analysis and transformation of data into useful manner using Python Programming

CO5: Able to generate the linear algebra, Monte Carlo Integrations etc by using Python programming.

List of Experiments:

WEEK 1: Study R Languages, Commands, etc

Consider 50 observations (dataset), generating random data using functions provided, like rbinom, performing basic statistical computations using built-in functions of R. Discussion of R graphics. Histograms. Stem and leaf plots. Boxplots. Scatterplots. Bar graphs plotting the data using line graph, histograms, multiple graphs, etc. Generate 3D graphs or plots.

WEEK 2: Measures of Central Tendency: Given a sample of 50 Observations (from any dataset), use possible functions R or Python and calculate mean, sd, var, min, max, median, range, and quantile. Discuss the properties of this distribution. generate bell curve of a random normal distribution.

WEEK 3: Pragmatic matters. Tabulating data. Transforming a variable. Sub setting vectors and data frames.

WEEK 4: (i) Consider 100 observations, find out Correlation "cor()" and Covariance "cov()" and programs on Frequencies and Crosstabs.

(ii) Finding and analyze the missing data.

WEEK 5: Sorting, transposing and merging data. Reshaping a data frame. Basics of text processing. Reading unusual data files. Basics of variable coercion.

WEEK 6: Hypothesis testing and t-test for any given dataset. Find out null hypothesis, alternate hypothesis, draw the picture (graph) to visualize problem. Test the value of population means.

WEEK 7: State alpha level and rejection region, estimate the maximum likely hood and inference.

WEEK 8: Binomial simulation: Making the computer flip coins for you. Make use of rbinom function of R to generate samples, and other functions: counts, avgs, mean, sd, sqrt, hist (histogram).

WEEK 9: Bayesian Hypothesis testing on any given dataset or dataframe.

WEEK 10: Use seaborn and combines simple statistical fits with plotting on pandas dataframes.

WEEK 11: Working on Linear Algebra and Linear Systems

WEEK 12: Working on Monte Carlo Integration (Quasi-random numbers and find out the variance on any dataframe)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Big Data Analytics	3	0	0	3
COURSE CATEGORY	PCC3				

COURSE OBJECTIVES:

- The purpose of this course is to provide the students with the knowledge of Big data Analytics principles and techniques.
- This course is also designed to give an exposure of the frontiers of Big data Analytics
- This course gives an overview of Big Data, it helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions

COURSES OUTCOMES:
At the end of the course, student will be able to
CO 1: explain the foundations, definitions, and challenges of Big Data and various Analytical tools.
CO 2: program using HADOOP and Map reduce
CO 3:design and Implementation of Big Data Analytics to solve data intensive problems and to generate analytics.
CO 4: understand the importance of Data Visualization and implementation using Tableau Software
CO 5: understand the importance of Big Data in social media and Mining

UNIT - I
Getting an Overview of Big Data: What is Big Data? History of Data Management – Evolution of Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics, Careers in Big Data, Future of Big Data Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Introducing Hadoop, Cloud Computing and Big Data, In-Memory Computing Technology for Big Data.

UNIT - II
Understanding Hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, MapReduce, Hadoop YARN, Hbase, Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie Understanding MapReduce Fundamentals and Hbase: The MapReduce Framework, Techniques to Optimize MapReduce Jobs, Uses of MapReduce, Role of HBase in Big Data Processing

UNIT - III

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics, Points to Consider during Analysis, Developing an Analytic Team, Understanding Text Analytics Analytical Approaches and Tools to Analyze Data: Analytical Approaches, History of Analytical Tools. Introduction to Popular Analytical Tools, Comparing Various Analytical Tools, Installing R

UNIT - IV

Data Visualization-I: Introducing Data Visualization, Techniques Used for Visual Data Representation, Types of Data Visualization, Applications of Data Visualization, Visualizing Big Data, Tools Used in Data Visualization, Tableau Products Data Visualization with Tableau (Data Visualization-II): Introduction to Tableau Software, Tableau Desktop Workspace, Data Analytics in Tableau Public, Using Visual Controls in Tableau Public

UNIT - V

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

TEXT BOOKS:

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

REFERENCES:

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

Weblinks:

1. Big Data Computing - Course (nptel.ac.in)
2. Introduction to Hadoop - GeeksforGeeks

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Machine Learning Techniques	3	0	0	3
COURSE CATEGORY	PCC4				

COURSE OBJECTIVES:

- 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:

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

CO 1: domain Knowledge for Productive use of Machine Learning and Diversity of Data.
CO 2: demonstrate on Supervised and Computational Learning
CO 3: analyze on Statistics in learning techniques and Logistic Regression Illustrate.
CO 4: understand Support Vector Machines and Perceptron Algorithm.
CO 5: 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 Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification**.**

UNIT-III:

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

UNIT-IV:

SUPPORT VECTOR MACHINES (SVM)-Introduction, Linear Discriminate Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, and Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, and Regression by Support vector Machines.

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

UNIT -V:

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

Textbooks:

1. Applied Machine Learning, M.Gopal, McGraw Hill Education

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer2009 (freely availableonline)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2007.

Weblinks:

1. Introduction to Machine Learning - Course (nptel.ac.in)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Natural Language Processing	3	0	0	3
COURSE CATEGORY	PEC3				

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:

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

CO 1: demonstrate a given text with basic Language features
CO 2: design an innovative application using NLP components
CO 3: explain a rule based system to tackle morphology/syntax of a language
CO 4: design a tag set to be used for statistical processing for real-time applications
CO 5: compare and contrast the use of different statistical approaches for differenttypes 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 Back off – 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, Tree banks, 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.

Weblinks:

1. Natural Language Processing - Course (nptel.ac.in)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	High Performance Computing	3	0	0	3
COURSE CATEGORY	PEC3				

COURSE OBJECTIVES:

- 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 bio molecular/materials systems that generally require large-sc HPC platform with hybrid CPU-GPU architectures

COURSE OUTCOMES:

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

CO 1: design, formulate, solve and implement high performance versions of standardsingle threaded algorithms.
CO 2: demonstrate the architectural features in the GPU and MIC hardware accelerators.
CO 3: design programs to extract maximum performance in a multi core, shared memory execution environment processor.
CO 4: analyze Symmetric and Distributed architectures.
CO 5: develop and deploy large scale parallel programs on tightly coupled parallelsystems using the message passing paradigm.

UNIT I:

GRAPHICS PROCESSING UNITS- Introduction to Heterogeneous Parallel Computing, GPU architecture, Thread hierarchy, GPU Memory Hierarchy.

UNIT II:

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

UNIT III:

MANY INTEGRATED CORES-Introduction to Many Integrated Cores. MIC, Xeon Phi architecture. Thread hierarchy. Memory Hierarchy. Memory Bandwidth and performance considerations.

UNIT IV:

SHARED MEMORY PARALLEL PROGRAMMING- Symmetric and Distributed architectures. Open MP Introduction. Thread creation, Parallel regions. Work sharing, 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 Open MP, Scientific and Engin edition, Barbara Chapman, Gabriele Jost, Ruud vander Pas, MIT Press,2008.

Reference Books:

1. Intel Xeon Phi Coprocessor Architecture and Tools, RezaurRahman, Apress Open,2013.
2. Using MPI, Gropp, Lusk, Skjellum, The MIT press,2014.
3. Recent publications in IPDPS, PACT, andsimilar.

Weblinks:

1. High Performance Computing for Scientists and Engineers - Course (nptel.ac.in)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Digital Image Processing	3	0	0	3
COURSE CATEGORY	PEC3				

COURSE OBJECTIVES:

- Describe and explain basic principles of digital image processing.
- Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement).
- Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation).
- Assess the performance of image processing algorithms and systems.

COURSE OUTCOMES:

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

CO 1: demonstrate the components of image processing
CO 2: explain various filtration techniques.
CO 3: apply image compression techniques.
CO 4: discuss the concepts of wavelet transforms.
CO 5: analyze the concept of morphological image processing.

UNIT I:

Introduction: Fundamental steps in Image Processing System, Components of Image Processing System, Elements of Visual Perception, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels. Image Enhancement Techniques: Spatial Domain Methods: Basic grey level transformation, Histogram equalization, Image subtraction, image averaging.

UNIT II:

Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters, Smoothing and sharpening filters, Homomorphism is filtering. Image Restoration & Reconstruction: Model of Image Degradation/restoration process, Noise models, Spatial filtering, Inverse filtering, Minimum mean square Error filtering, constrained least square filtering, Geometric mean filter, Image reconstruction from projections. Color Fundamentals, Color Models, Color Transformations.

UNIT III:

Image Compression: Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Elements of Information Theory; Loss Less and Lossy

Compression; Run length coding, Differential encoding, DCT, Vector quantization, Entropy coding, LZW coding; Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.

UNIT IV:

Wavelet Based Image Compression: Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous, Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding.

UNIT V:

Image Segmentation: Discontinuities, Edge Linking and boundary detection,

Thresholding, Region Based Segmentation, Watersheds; Introduction to morphological operations; binary morphology- erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.

Digital Image Watermarking: Introduction, need of Digital Image Watermarking, applications of watermarking in copyright protection and Image quality analysis.

Text Books:

1. Digital Image Processing. 2nd ed. Gonzalez, R.C. and Woods, R.E. India: Person Education, (2009)

Reference Books:

1. Digital Image Processing. John Wiley, Pratt, W. K, (2001)
2. Digital Image Processing, Jayaraman, S., Veerakumar, T. and Esakkiranjan, S. (2009),Tata McGraw- Hill

Web links:

1. Digital Image Processing - Course (nptel.ac.in)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Principles of Deep Learning	3	0	0	3
COURSE CATEGORY	PEC4				

COURSE OBJECTIVES:

- To acquire knowledge on the basics of neural networks.
- To implement neural networks using computational tools for variety of problems.
- To explore various deep learning algorithms.
- To enable design of an artificial neural networks for classification.

COURSE OUTCOMES:

At the end of the course, student will able to

CO 1: develop algorithms simulating human brain.
CO 2: implement Neural Networks in Tensor Flow for solving problems.
CO 3: explore the essentials of Deep Learning and Deep Network architectures.
CO 4: define, train and use a Deep Neural Network for solving real world problems thatrequire artificial Intelligence based solutions.
CO 5:explore the essentials of Deep Learning at Enterprise Scale, Deep Learning Models for Healthcare Applications.

UNIT I:

Basics of Deep leaning- Deep learning architectures, Convolution Neural Networks, Neurons in Human Vision-The Shortcomings of Feature Selection-Vanilla Deep Neural Networks Don't Scale-Filters and Feature Maps-Full Description of the Convolution Layer-Max Pooling-Full Architectural Description of Convolution Networks-Closing the Loop on MNIST with Convolutional Networks-Image Preprocessing Pipelines Enable More Robust Models-Accelerating Training with Batch Normalization- Building a Convolutional Network for CIFAR-10-Visualizing Learning in Convolutional Networks- Leveraging Convolutional Filters to Replicate Artistic Styles-Learning Convolutional Filters for Other Problem Domains-Training algorithms.

UNIT II:

Memory Augmented Neural Networks: Neural Turing Machines-Attention-Based Memory Access-NTM Memory Addressing Mechanisms-Differentiable Neural Computers-Interference-Free Writing in DNCs-DNC Memory Reuse-Temporal Linking of DNC Writes-Understanding the DNC Read Head-The DNC Controller Network- Visualizing the DNC in Action-Implementing the DNC in Tensor Flow-Teaching a DNC to Read and Comprehend.

UNIT III:

Deep Reinforcement Learning: Deep Reinforcement Learning Masters Atari Games- What Is Reinforcement Learning?-Markov Decision Processes (MDP)-Explore Versus Exploit-Policy versus Value Learning-Pole-Cart with Policy Gradients-Q-Learning and Deep Q-Networks-Improving and Moving Beyond DQN.

UNIT IV:

Implementing Neural Networks in Tensor flow: What Is Tensor Flow?-How Does Tensor Flow Compare to Alternatives?-Installing Tensor Flow-Creating and Manipulating Tensor Flow Variables- Tensor Flow Operations-Placeholder Tensors-Sessions in Tensor Flow-Navigating Variable Scopes and Sharing Variables-Managing Models over the CPU and GPU-Specifying the Logistic Regression Model in Tensor Flow-Logging and Training the Logistic Regression Model- Leveraging Tensor Board to Visualize

UNIT V:

Computation Graphs and Learning-Building a Multilayer Model for MNIST in Tensor Flow. Applications: Deep learning for computer vision, Deep Learning Applications at the Enterprise Scale, Deep Learning Models for Healthcare Applications.

Text Books:

1. "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence **Algorithms", Nikhil Buduma, Nicholas Locascio, O'Reilly Media, 2017.**
2. "Deep Learning (Adaptive Computation and Machine Learning series", Ian Goodfellow, **YoshuaBengio, Aaron Courville, MIT Press,2017.**

Reference Books:

1. Deep learning from first principle,2nd edition, tinniam vGanesh,2018
2. Introduction to Deep Learning ,1st edition, by Eugene charniak, The MITPress,2019

Weblinks:

1. Deep Learning - Course (nptel.ac.in)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Image and Video Analytics	3	0	0	3
COURSE CATEGORY	PEC4				

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:

At the end of the course, student will able to

CO 1: understand the fundamentals of digital image processing techniques
CO 2: understand several Image filtering methods for image enhancement
CO 3: understand several Image segmentation approaches.
CO 4: learn about object detection and classification models
CO 5: 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", Asier erallos, Unai Hernandez- Jayo, Enrique Onieva, Ignacio Julio GarcíaZuazola,Wiley, 2015.
5. "Analysis of Urban Growth and Sprawl from Remote Sensing Data", Basudeb Bhatta,Springer, 2010

Weblinks :

1. Digital Image Processing - Course (nptel.ac.in)
2. Medical Image Analysis - Course (nptel.ac.in)

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Principles of Data Security	3	0	0	3
COURSE CATEGORY	PEC4				

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

At the end of the course, student will able to

CO 1: describe the key security requirements of confidentiality, integrity, and availability, types of security threats and attacks and summarize the functional requirements for computer security.

CO 2: explain the basic operation of symmetric block encryption algorithms, use of secure hash functions for message authentication, digital signature mechanism.

CO 3: 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.

CO 4: 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.

CO 5: 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, DatabaseManagement 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 Book:

1. Computer Security: Principles and Practices, 3e, William Stallings, Lawrie Brown, Pearson

Reference book:

1. Network Security Essentials, Principles and Practices, William Stallings,Pearson

Weblinks:

1. Cyber Security and Privacy - Course (nptel.ac.in)

AC: 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
4. Ensure the good quality of paper at very first- time submission

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 Criticizing, 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 theResults, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possiblybe the first- time submission	4

Suggested Studies:

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

AC: DISASTER MANAGEMENT

COURSE OBJECTIVES: -

Students will be able to:

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

Syllabus		
Units	**CONTENTS**	**Hours**
1	**Introduction:** Disaster: Definition, Factors and Significance; Difference Between Hazard andDisaster; 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.	4
6	**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.	4

Suggested Readings:

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

AC: STRESS MANAGEMENT BY YOGACOURSE

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

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 breathing techniques and its effects-Types of pranayam	4

Suggested reading

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

AC: 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 hispersonality and achieve the highest goal inlife
2. The person who has studied Geeta will lead the nation and mankind to peace andprosperity
3. Study of Neetishatakam will help in developing versatile personality ofstudents

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)	4
3	Approach to day-to-day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,	4
4	Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	4
5	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2 Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18	4
6	Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17,Chapter 3-Verses36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	4

Suggested reading

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication **Department), Kolkata**
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya SanskritSansthanam, NewDelhi.

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Big Data Analytics Lab	0	0	2	2
COURSE CATEGORY	PCCLAB3				

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

At the end of the course, student will able to

CO 1: use Excel as an Analytical tool and visualization tool.
CO 2: ability to program using HADOOP and Map reduce
CO 3: ability to perform data analytics using ML in R.
CO 4: use Cassandra to perform social media analytics
CO 5: ability to perform data visualization using R

List of Experiments:

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

TEXT BOOKS:

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

4. Big Data Analytics: Disruptive Technologies for Changing the Game, Arvind Sathi, 1st Edition, IBM Corporation, 2012.

REFERENCES:

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

Web links:

1. https://khalidmammadov.github.io/hadoop/inverted_index.html
2. https://www.tutorialspoint.com/hbase/hbase_enabling_table.html

PROGRAM: M.Tech DATA SCIENCE SEMESTER-II					
COURSE CODE		L	T	P	C
	Machine Learning Techniques Lab	0	0	2	2
COURSE CATEGORY	PCCLAB4				

COURSE OBJECTIVES:

- To learn and understand different Data sets in implementing the machine learning algorithms.
- Implement the machine learning concepts and algorithms in any suitable language of choice.

COURSE OUTCOMES :

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

CO 1: implement procedures for the machine learning algorithms
CO 2: design Python programs for various Learning algorithms
CO 3: apply appropriate data sets to the Machine Learning algorithms
CO 4: identify and apply Machine Learning algorithms to solve real world problems
CO 5: design ANN for the machine learning algorithms

Experiment-1:

Exercises to solve the real-world problems using the following machine learning methods:
a) Linear Regression
b) Logistic Regression.

Experiment-2:

Write a program to Implement Support Vector Machines.

Experiment-3:

Exploratory Data Analysis for Classification using Pandas and Matplotlib.

Experiment-4:

Implement a program for Bias, Variance, and Cross Validation.

Experiment-5:

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

Experiment-6:

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Experiment-7:

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets

Experiment-8:

Write a program to implement the naïve Bayesian classifier for Iris data set. Compute the accuracy of the classifier, considering few test data sets.

Experiment-9:

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.

Experiment-10:

Apply EM algorithm to cluster a Heart Disease Data Set. 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.

Experiment-11: Write a program to implement k-Nearest Neighbor algorithm to classify the I Iris data set. Print both correct and wrong predictions.

Textbooks:

1. Applied Machine Learning, M.Gopal, McGraw Hill Education

References:

2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,2012
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer2009 (freely availableonline)
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2007.

Web links:

1. https://ml-lectures.org/docs/supervised_learning_wo_NNs/Linear-regression.html
2. https://www.geeksforgeeks.org/cross-validation-machine-learning/

PROGRAM: M.Tech DATA SCIENCE SEMESTER-III					
COURSE CODE		L	T	P	C
	AI Chatbots	3	0	0	3
COURSE CATEGORY	PEC 5				

COURSE OBJECTIVES:

- Learn how artificial intelligence powers chatbots, get an overview of the bot ecosystem and bot anatomy, and study different types of bots and use cases.
- Identify best practices for defining a chatbot use case, and use a rapid prototyping framework to develop a use case for a personalized chatbot.

COURSE OUTCOMES:

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

CO1:develop an in-depth understanding of conversation design, including onboarding, flows, utterances, entities, and personality.
CO2:design, build, test, and iterate a fully-functional, interactive chatbot using a commercial platform.
CO3: deploy the finished chatbot for public use and interaction.
CO4:understanding the analysis of NLP done by chatbot.
CO5:introduction to the basics of Microsoft Bot, RASA, and Google Dialogflow

UNIT-I

Introduction: Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape, Identifying the Sources of Data: Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

UNIT-II

Chatbot Development Essentials: Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

UNIT-III

Building a Chatbot Solution: Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots

UNIT-IV

Natural Language Processing, Understanding, and Generation: Chatbot Architecture, Popular Open Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

UNIT-V

Introduction to Microsoft Bot, RASA, and Google Dialogflow: Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialogflow Chatbot Integration Mechanism: Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

Text Books:

1. Abhishek Singh, Karthik Ramasubramanian, Shrey Shivam, "Building an Enterprise Chatbot: Work with Protected Enterprise Data Using Open Source Frameworks", ISBN 978-1-4842-5034-1, Apress, 2019.

Reference Books:

1. Janarthanam and Srini, Hands-on chatbots and conversational UI development: Build chatbots and voice user interfaces with C (1 ed.), Packt Publishing Ltd, 2017. ISBN 978-1788294669.
2. Galitsky, Boris., Developing Enterprise Chatbots (1 ed.), Springer International Publishing, 2019. ISBN 978-303004298
3. Kelly III, John E. and Steve Hamm, Smart machines: IBM's Watson and the era of cognitive computing (1 ed.), Columbia University Press, 2013. ISBN 978- 0231168564.
4. Abhishek Singh, Karthik Ramasubramanian and Shrey Shivam, Building an Enterprise Chatbot (1 ed.), Springer, 2019. ISBN 978-1484250334.

Web Links:
https://www.chatbot.com/academy/chatbot-designer-free-course/

PROGRAM: M.Tech DATA SCIENCE SEMESTER-III					
COURSE CODE		L	T	P	C
	Next Generation Databases	3	0	0	3
COURSE CATEGORY	PEC5				

COURSE OBJECTIVES:

- To explore the concepts of NoSQL Databases.
- To understand and use columnar and distributed database patterns.
- To learn to use various Data models for a variety of databases.

COURSE OUTCOMES:

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

CO1: explore the relationship between Big Data and NoSQL databases
CO2: work with NoSQL databases to analyze the big data for useful business applications.
CO3: work with different data models to suit various data representation and storage needs.
CO4: working with different databases like distributed relational databases,MONGODB
CO5:understanding Data models and storage.

UNIT-I:

Database Revolutions- System Architecture- Relational Database- Database Design Data Storage- Transaction Management- Data warehouse and Data Mining- Information Retrieval**.**

UNIT II:

Big Data Revolution- CAP Theorem- Birth of NoSQL- Document Database—XML Databases- JSON Document Databases- Graph Databases.

UNIT III:

Column Databases— Data Warehousing Schemes- Columnar Alternative- Sybase IQ- CStore and Vertica- Column Database Architectures- SSD and In-Memory Databases— InMemory Databases- Berkeley Analytics Data Stack and Spark.

UNIT IV:

Distributed Database Patterns— Distributed Relational Databases- Non-Relational Distributed Databases- MongoDB - Sharing and Replication- HBase- CassandraConsistency Models— Types of Consistency- Consistency MongoDB- HBase Consistency- Cassandra Consistency.

UNIT V:

Data Models and Storage- SQL- NoSQL APIs- Return SQL- Advance Databases—PostgreSQL- Riak- CouchDB- NEO4J- Redis- Future Databases— Revolution Revisited Counter revolutionaries- Oracle HQ- Other Convergent Databases- Disruptive Database Technologies.

Text Books:

1. "Next Generation Databases",1st Edition, Guy Harrison, Apress, 2015.

References Books:

1. Database System Concepts", Sixth Edition, Abraham Silberschatz, Henry F.Korth, S. Sudarshan, McGrawHill,2010.
2. "Seven Databases in Seven Weeks", Eric Redmond, Jim R Wilson, LLC.2012.
3. "NoSQL for Mere Mortals", Dan Sullivan, Addison-Wesley,2015.
4. "NoSQL for Dummies ", Adam Fowler, John Wiley & Sons,2015.

Web links:

1 Big Data Computing - Course (nptel.ac.in)
2 Introduction to Hadoop - GeeksforGeeks

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

PROGRAM: M.Tech DATA SCIENCE SEMESTER-III					
COURSE CODE		L	T	P	C
	Advanced Python Programming	3	0	0	3
COURSE CATEGORY	OEC				

COURSE OBJECTIVES:

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

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

CO 1: understand and comprehend the basics of python programming.
CO 2: demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
CO 3: explain the use of the built-in data structures list, sets, tuples and dictionary.
CO 4: make use of functions and its applications.
CO 5: identify real-world applications using oops, files and exception handling provided by python.

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

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

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

UNIT – IV:

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions,

Fruitful Functions (Function Returning Values), Scope of the Variables in a Function – Global and Local Variables, Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT – V:

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

Text Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson
3.

Reference Books:

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

Web links:

https://www.bing.com/videos/riverview/relatedvideo?&q=free+web+resources+for+advanced+python+programming+course&&mid=8B2835B714D34DCD44B98B2835B714D34DCD44B9&&FORM=VRDGAR

PROGRAM: M.Tech DATA SCIENCE SEMESTER-III					
COURSE CODE		L	T	P	C
	Deep Learning	3	0	0	3
COURSE CATEGORY	OEC				

COURSE OBJECTIVES:

- The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks.
- The course also requires students to implement programming assignments related to these topics.
- To design and analyses various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.

COURSE OUTCOMES

At the end of the course, students would be able to:

CO 1:explore Deep learning techniques and various feature extraction strategies.
CO 2: mathematically understand the deep learning approaches and paradigms
CO 3: apply the deep learning techniques for various applications
CO4: understand recurrent Neural networks and its types
CO5: explore recent trends in deep learning

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 layer wise training.

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

UNIT IV:

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

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and GibbsSampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V:

Recent trends- Variational Auto encoders, Generative Adversarial networks, Multi-taskDeep Learning, Multi-view Deep Learning Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

Textbooks

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

References:

1.Neural Networks: A Systematic Introduction, Raúl Rojas, 1996 Pattern Recognition and Machine Learning, Christopher Bishop

Web links:
https://onlinecourses.nptel.ac.in/noc22_cs124/preview