SCHOOL OF INFORMATION TECHNOLOGY
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech. DATA SCIENCE

EFFECTIVE FROM ACADEMIC YEAR 2022 - 23 ADMITTED BATCH

R22 COURSE STRUCTURE AND SYLLABUS

I YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core – I	Advanced Data Structures using Python	3	0	0	3
Professional Core – II	Statistical Foundations for Data Science	3	0	0	3
Professional Elective – I	1. Image and Video Processing 2. Advanced Databases 3. Data wrangling and Data Visualization 4. Machine Learning	3	0	0	3
Professional Elective – II	1. Adhoc Networks 2. Social Media Analytics 3. Web and Database Security 4. Artificial Intelligence and Intelligent Systems	3	0	0	3
Lab – I	Advanced Data Structures using Python Lab	0	0	4	2
Lab – II	*Professional Elective- I Lab	0	0	4	2
	Research Methodology & IPR	2	0	0	2
Audit – I	Audit Course – I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

*Professional Elective- I and Professional Elective- I Lab must be of same course.

I YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core – III	Big Data Analytics	3	0	0	3
Professional Core – IV	Deep Learning	3	0	0	3
Professional Elective – III	1. Edge Analytics 2. Blockchain Technology 3. Enterprise Cloud Concepts 4. Natural Language Processing	3	0	0	3
Professional Elective – IV	1. Predictive Analytics 2. Machine Translation 3. Nature Inspired Computing 4. Network Programming	3	0	0	3
Lab – III	Big Data Analytics Lab	0	0	4	2
Lab – IV	*Professional Elective -III Lab	0	0	4	2
	Mini Project with Seminar	0	0	4	2
Audit – II	Audit Course – II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

*Professional Elective- III and Professional Elective- III Lab must be of same course.

II YEAR I SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Elective – V	1. Digital Forensics 2. Conversational AI 3. Service Oriented Architectures 4. Business Analytics	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review – II	0	0	12	6
	Total	**6**	**0**	**12**	**12**

II YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review – III	0	0	12	6
Dissertation	Dissertation Viva-Voce	0	0	28	14
	Total	**0**	**0**	**40**	**20**

Note: For Dissertation Work Review - I, Please refer 7.10 in R22 Academic Regulations.

Audit Course I & II:

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

Open Electives:

1. Advanced Artificial Intelligence
2. Cyber Security
3. Functional Programming
4. Reinforcement Learning
5. Optimization Techniques
6. Mining Massive Datasets
7. Multi Agent Systems
8. GPU Computing

ADVANCED DATA STRUCTURES USING PYTHON (PC - I)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: UG level course in Data Structures

Course Objectives: This course will enable students to
1. Implement Object Oriented Programming concepts in Python.
2. Understand Lists, Dictionaries and Regular expressions in Python.
3. Understanding how searching and sorting is performed in Python.
4. Understanding how linear and non-linear data structures works.
5. To learn the fundamentals of writing Python scripts.

Course Outcomes: The students should be able to:
1. Examine Python syntax and semantics and apply Python flow control and functions.
2. Create, run and manipulate Python Programs using core data structures like Lists,
3. Apply Dictionaries and use Regular Expressions.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Master object-oriented programming to create an entire python project using objects and classes

UNIT - I

Oops Concepts- class, object, constructors, types of variables, types of methods. **Inheritance:** single, multiple, multi-level, hierarchical, hybrid, **Polymorphism:** with functions and objects, with class methods, with inheritance, **Abstraction:** abstract classes.

UNIT - II

Data Structures – Definition, Linear Data Structures, Non-Linear Data Structures

Python Specific Data Structures: List, Tuples, Set, Dictionaries, Comprehensions and its Types, Strings, slicing.

UNIT - III

Arrays - Overview, Types of Arrays, Operations on Arrays, Arrays vs List.

Searching -Linear Search and Binary Search.

Sorting - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort.

UNIT - IV

Linked Lists – Implementation of Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists.

Stacks - Overview of Stack, Implementation of Stack (List & Linked list), Applications of Stack

Queues: Overview of Queue, Implementation of Queue (List & Linked list), Applications of Queues, Priority Queues.

UNIT - V

Graphs -Introduction, Directed vs Undirected Graphs, Weighted vs Unweighted Graphs, Representations, Breadth First Search, Depth First Search.

Trees - Overview of Trees, Tree Terminology, Binary Trees: Introduction, Implementation, Applications. Tree Traversals, Binary Search Trees: Introduction, Implementation, AVL Trees: Introduction, Rotations, Implementation.

TEXT BOOKS:

1. Data structures and algorithms in python by Michael T. Goodrich
2. Data Structures and Algorithmic Thinking with Python by Narasimha Karumanchi

REFERENCE BOOKS:

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka.
2. Data Structures and Algorithms with Python by Kent D. Lee and Steve Hubbard.
3. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L.Ranum.
4. Core Python Programming -Second Edition,R. Nageswara Rao, Dreamtech Press.

STATISTICAL FOUNDATIONS FOR DATA SCIENCE (PC-II)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Mathematics courses of first year of study.

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: After learning the contents of this course, the student must be able to

1. Apply the number theory concepts to cryptography domain
2. Apply the concepts of probability and distributions to some case studies
3. Correlate the material of one unit to the material in other units
4. Resolve the potential misconceptions and hazards in each topic of study.

UNIT - I

Greatest 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, JohnWiley & Sons Ltd, 2004.
3. Sheldon M Ross, Probability and statistics for Engineers and scientists, Academic Press.

IMAGE AND VIDEO PROCESSING (Professional Elective -I)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

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

1. Comprehend the image processing fundamentals and enhancement techniques in spatial and frequency domain.
2. Describe the color image fundamentals, models and various restoration techniques.
3. Design and Analyze the image compression systems.
4. Outline the various image segmentation and morphology operations.
5. Comprehend the basics of video processing and video coding.

Course Outcomes: After completion of this course, students will be able to –

1. Understand theory and models in Image and Video Processing.
2. Explain the need of spatial and frequency domain techniques for image compression.
3. Comprehend different methods, models for video processing and motion estimation.
4. Illustrate quantitative models of image and video segmentation.
5. Apply the process of image enhancement for optimal use of resources.

UNIT - I:

Digital image fundamentals: A simple image formation model, Image sampling and quantization, Some basic relationships between pixels, Basic intensity transformation functions, Sampling and fourier transform of sampled functions, The discrete fourier transform of one variable, Extensions to functions of two variables (2-D discrete fourier transform, Properties of 2-D DFT and IDFT, 2-D Discrete Convolution Theorem

UNIT - II:

Image Enhancement (spatial domain): Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, The Laplacian-use of second order derivative for image sharpening, The Gradient-use of first order derivative for image sharpening.
Image Enhancement (frequency domain): Basics of filtering in frequency domain, Image smoothing using lowpass frequency domain filters, Image sharpening using highpass filters

UNIT - III:

Image restoration: Noise Models, Restoration in the presence of noise only – Spatial filters, Periodic noise reduction using Frequency domain filtering, Estimating the degradation function, inverse filtering, Minimum Least square error filtering, constrained least square filters.
Wavelet and Multiresolution processing: Matrix-based transform, Walsh-Hadamard Transform, Slant transform, Haar transform.

UNIT - IV:

Image compression: Lossy and lossless compression schemes: Huffman coding, Run-length coding, Arithmetic coding, Block transform coding, JPEG Image Morphology: Fundamental operations, Morphological Algorithms.
Image segmentation: Point, Line and Edge detection, Canny edge detection, Hough Transform, Edge linking, Thresholding, Region-based segmentation, Pixel-based segmentation.

UNIT - V:

Feature Extraction: Boundary preprocessing, Boundary feature descriptor, Region feature descriptor, Principal components as feature descriptor, Whole image feature.
Video Processing: Video Formats, Video Enhancement and Restoration, Video Segmentation.

TEXT BOOKS:

1. Digital Image Processing, R. C. Gonzalez and R. E. woods, Pearson Education.
2. Handbook of Image and Video Processing, AL Bovik, Academic Press.

REFERENCES:

1. Digital Image Processing and Analysis, B. Chanda and D. Dutta Mazumdar, PHI.
2. Digital Image Processing, W. K. Pratt, Wiley-Interscience.
3. Fundamentals of Digital Image Processing, A. K. Jain, Pearson India Education.
4. Pattern Classification and Scene Analysis, R. O. Duda and P. E. Hart, Wiley.

ADVANCED DATABASES (Professional Elective -I)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on concepts of Distributed Databases, Object-Based Databases, advanced database models

Course Outcomes:

1. Understand Database system Architectures and parallel databases.
2. Analyze transactions, Concurrency Control in Distributed Databases.
3. Understand the importance of Data Warehousing and Mining.
4. Illustrate concepts of object-based databases.

UNIT - I

Database System Architectures: Centralized and Client –Server Architectures, Server System Architectures, Parallel Systems, Distributed Systems, Network Types.

Parallel Databases: Introduction, I/O Parallelism, Interquery Parallelism, Intra Query Parallelism, Intraoperation Parallelism, Interoperation Parallelism, Query Optimization, Design of Parallel Systems, Parallelism on Multicore Processors.

UNIT - II

Distributed Databases: Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems.

UNIT - III

Data Warehousing and Mining: Decision-Support Systems, Data Warehousing, Data Mining, Classification, Association Rules, Other Types of Associations, Clustering, Other Forms of Data Mining

UNIT - IV

Object-Based Databases: Introduction, Complex Data Types, Structured Types and Inheritance in SQL, Table Inheritance, Array and Multiset Types in SQL, Object-Identity and Reference Types in SQL, Implementing O-R Features, Persistent Programming Languages, Object-Relational Mapping, Object-Oriented versus Object-Relational

UNIT - V

XML: Motivation, Structure of XML Data, XML Document Schema, Querying and Transformation, Application Program Interfaces to XML, Storage of XML Data, XML Applications

Advanced database models and applications: Active Database Concepts and Triggers, Temporal database concepts, Spatial database concepts, Multimedia database concepts, Deductive databases

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan Database System Concepts, Sixth Edition
2. Ramez Elmasri, Shamkant B. Navathe, Database systems- Models, Languages, Design and Application Programming

DATA WRANGLING AND DATA VISUALIZATION (Professional Elective -I)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To learn data wrangling techniques
2. To introduce visual perception and core skills for visual analysis

Course Outcomes: Upon completion of the course, the students will be able to

1. Perform data wrangling
2. Explain principles of visual perception
3. Apply core skills for visual analysis
4. Apply visualization techniques for various data analysis tasks
5. Evaluate visualization techniques

UNIT - I:

Data Wrangling: Need of data cleanup, data clean up basics – formatting, outliers, duplicates, Normalizing and standardizing data.

UNIT - II:

Introduction of visual perception, visual representation of data, Gestalt principles, information overloads. Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

UNIT - III:

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

UNIT - IV:

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization.

UNIT -V:

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations.

TEXT BOOKS:

1. Jacqueline Kazil and Katharine Jarmul, Data Wrangling with Python: Tips and Tools to Make Your Life Easier, O'Reilly.
2. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick A K Peters, Ltd.

REFERENCE:

1. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

MACHINE LEARNING (Professional Elective - I)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To have a thorough understanding of the Supervised and Unsupervised learning techniques
3. To study the various probability based learning techniques
4. To understand graphical models of machine learning algorithms

Course Outcomes: Upon completion of the course, the students will be able to:

1. Distinguish between, supervised, unsupervised and semi-supervised learning
2. Apply the apt machine learning strategy for any given problem
3. Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
4. Design systems that use the appropriate graph models of machine learning
5. Modify existing machine learning algorithms to improve classification efficiency

UNIT - I:

Introduction: Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants: – Perceptron – Linear Separability – Linear Regression.

UNIT - II:

Linear Models: Multi-layer Perceptron– Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

UNIT - III:

Tree and Probabilistic Models: Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms

UNIT - IV:

Dimensionality Reduction and Evolutionary Models: Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example

UNIT - V:

Graphical Models: Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TEXT BOOKS:

1. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, —Machine Learning, First Edition, McGraw Hill Education, 2013.

REFERENCES:

1. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014
3. Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014

ADHOC NETWORKS(Professional Elective - II)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Course objectives:

- Explain fundamental principles of Adhoc Networks
- MAC Protocols for Adhoc Wireless Networks
- Routing Protocols for Adhoc Wireless Networks
- Transport Layer Protocols for Ad-hoc Networks
- Security Protocols for Adhoc Networks
- Wireless Sensor Networks

Course Outcomes:

- Understand Mac Protocols for Adhoc networks
- Understand Routing protocols
- Understand Transprot layer protocols
- Understand Security related issues
- Understand Wireless sensor networks

Unit -1

Ad-hoc Wireless Networks: Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; **MAC Protocols for Ad-hoc Wireless Networks:** Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms.

Unit -2

Routing Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks, Classification of Routing Protocols, Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols.

Unit – 3

Transport Layer Protocols for Adhoc Networks: Introduction, Issues in Designing a Transport Layer Protocol, Design Goals of a Transport Layer Protocol, Classification of Transport Layer Solutions, TCP over Adhoc Wireless Networks

Unit-4

Security Protocols for Adhoc Networks: Security in Adhoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Adhoc Wireless Networks.

Unit-5

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks

Text Books:

1. C. Siva Ram Murthy & B. S. Manoj: Adhoc Wireless Networks: Architectures and Protocols, 2nd Edition, Pearson Education, 2011

Reference Books:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

SOCIAL MEDIA ANALYTICS (Professional Elective - II)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on social media and its analytics

Course Outcomes:

1. Understanding characteristics and types of social media
2. Knowledge on layers of social media analytics
3. Apply text analysis tools on social media data
4. Understand the significance of action analytics
5. Detect viral topics on social media (YouTube)

UNIT - I:

Introduction To Social Media: World Wide Web, Web 1.0, Web 2.0, Web 3.0, Social Media, Core Characteristics Of Social Media, Types Of Social Media, Social Networking Sites, Using Facebook For Business Purposes, Content Communities

UNIT - II:

Social Media Analytics Overview: Purpose Of Social Media Analytics, Social Media Vs. Traditional Business Analytics, Seven Layers Of Social Media Analytics, Types Of Social Media Analytics, Social Media Analytics Cycle, Challenges To Social Media Analytics, Social Media Analytics Tools.
Case Study: The Underground Campaign That Scored Big

UNIT - III:

Social Media Text Analytics: Types Of Social Media Text, Purpose Of Text Analytics, Steps In Text Analytics, Social Media Text Analysis Tools.
Case Study: Tapping Into Online Customer Opinions

UNIT - IV:

Social Media Actions Analytics: Introduction To Actions Analytics, Common Social Media Actions, Actions Analytics Tools. **Case Study**: Cover-More Group

UNIT - V:

Social Media Hyperlink Analytics: Types Of Hyperlinks, Hyperlink Analytics, Types Of Hyperlink Analytics, Hyperlink Analytics Tools.
Case Study: Hyperlinks And Viral YouTube Videos

TEXT BOOKS:

1. Seven Layers of Social Media Analytics Mining Business Insights From Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, And Location Data By Gohar F. Khan Isbn: 1507823207, Isbn-13: 9781507823200

REFERENCES:

1. Social Media Analytics: Techniques And Insights For Extracting Business Value Out Of Social Media By Matthew Ganis, Avinash Kohirkar, Pearson Education.
2. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, Marshall Sponder, MGH.
3. Big Data And Analytics,Seema Acharya, Subhasinin Chellappan, Wiley Publications.
4. Big Data, Black Book^{tm} , Dreamtech Press, 2015 Edition.

WEB AND DATABASE SECURITY (Professional Elective - II)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. Give an Overview of information security
2. Give an overview of Access control of relational databases

Course Outcomes: Students should be able to

1. Understand the Web architecture and applications
2. Understand client side and server side programming
3. Understand how common mistakes can be bypassed and exploit the application
4. Identify common application vulnerabilities

UNIT - I

The Web Security,The Web Security Problem ,Risk Analysis and Best Practices
Cryptography and the Web: Cryptography and Web Security, Working Cryptographic Systems and Protocols, Legal Restrictions on Cryptography, Digital Identification

UNIT - II

The Web's War on Your Privacy, Privacy-Protecting Techniques, Backups and Antitheft, Web Server Security, Physical Security for Servers, Host Security for Servers, Securing Web Applications

UNIT - III

Database Security: Recent Advances in Access Control, Access Control Models for XML, Database Issues in Trust Management and Trust Negotiation, Security in Data Warehouses and OLAP Systems

UNIT - IV

Security Re-engineering for Databases: Concepts and Techniques, Database Watermarking for Copyright Protection, Trustworthy Records Retention, Damage Quarantine and Recovery in Data Processing Systems, Hippocratic Databases: Current Capabilities and

UNIT - V

Future Trends Privacy in Database Publishing: A Bayesian Perspective, Privacy-enhanced Location-based Access Control, Efficiently Enforcing the Security and Privacy Policies in a Mobile Environment

TEXT BOOK:

1. Web Security, Privacy and Commerce Simson Garfinkel, Gene Spafford, O'Reilly.
2. Handbook on Database security applications and trends Michael Gertz, Sushil Jajodia

REFERENCES:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, O'reilly
2. Jonathan LeBlanc Tim Messerschmidt, Identity and Data Security for Web Development - Best Practices, O'reilly
3. McDonald Malcolm, Web Security for Developers, No Starch Press, US

ARTIFICIAL INTELLIGENCE AND INTELLIGENT SYSTEMS
(Professional Elective – II)

M.Tech DS I Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: UG level course in Mathematics, Data Structures

Course Objectives:

1. To impart knowledge about Artificial Intelligence.
2. To give understanding of the main abstractions and reasoning for intelligent systems.
3. To enable the students to understand the basic principles of Artificial Intelligence in various applications.

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

1. Solve basic AI based problems.
2. Define the concept of Artificial Intelligence.
3. Apply AI techniques to real-world problems to develop intelligent systems.
4. Select appropriately from a range of techniques when implementing intelligent systems.

UNIT - I

Introduction: Overview of AI problems, AI problems as NP, NP-Complete and NP Hard problems. Strongand weak, neat and scruffy, symbolic and sub-symbolic, knowledge-based and data-driven AI.

UNIT -II

Search Strategies: Problem spaces (states, goals and operators), problem solving by search, Heuristics and informed search, Min-max Search, Alpha-beta pruning. Constraint satisfaction (backtracking and local search methods).

UNIT - III

Knowledge representation and reasoning: propositional and predicate logic, Resolution and theorem proving, Temporal and spatial reasoning. Probabilistic reasoning, Bayes theorem. Totally-ordered and partially-ordered Planning. Goal stack planning, Nonlinear planning, Hierarchical planning.

UNIT - IV

Learning: Learning from example, Learning by advice, Explanation based learning, Learning in problem solving, Classification, Inductive learning, Naive Bayesian Classifier, decision trees.

Natural Language Processing: Language models, n-grams, Vector space models, Bag of words, Text classification. Information retrieval.

UNIT - V

Agents: Definition of agents, Agent architectures (e.g., reactive, layered, cognitive), Multi-agent systems-Collaborating agents, Competitive agents, Swarm systems and biologically inspired models. **Intelligent Systems:** Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Key Application Areas: Expert system, decision support systems, Speech and vision, Natural language processing, Information Retrieval, Semantic Web.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall

REFERENCES:

1. Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.
2. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, PearsonEducation.

ADVANCED DATA STRUCTURES USING PYTHON LAB (Lab - I)

M.Tech DS I Year I Sem.

L	T	P	C
0	0	4	2

Pre-Requisites: UG level course in Data Structures

Course Objectives: This course will enable students to

1. Implement Object Oriented Programming concepts in Python.
2. Understand Lists, Dictionaries and Regular expressions in Python.
3. Understanding how searching and sorting is performed in Python.
4. Understanding how linear and non-linear data structures works.
5. To learn the fundamentals of writing Python scripts.

Course Outcomes: The students should be able to:

1. Examine Python syntax and semantics and apply Python flow control and functions.
2. Create, run and manipulate Python Programs using core data structures like Lists,
3. Apply Dictionaries and use Regular Expressions.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Master object-oriented programming to create an entire python project using objects and classes

List of Experiments:

1. Write a Python program for class, Flower, that has three instance variables of type str, int, and float, that respectively represent the name of the flower, its number of petals, and its price. Your class must include a constructor method that initializes each variable to an appropriate value, and your class should include methods for setting the value of each type, and retrieving the value of each type.
2. Develop an inheritance hierarchy based upon a Polygon class that has abstract methods area( ) and perimeter( ). Implement classes Triangle, Quadrilateral, Pentagon, that extend this base class, with the obvious meanings for the area( ) and perimeter( ) methods. Write a simple program that allows users to create polygons of the various types and input their geometric dimensions, and the program then outputs their area and perimeter.
3. Write a python program to implement Method Overloading and Method Overriding.
4. Write a Python program to illustrate the following comprehensions:
   a) List Comprehensions b) Dictionary Comprehensions c) Set Comprehensions d) Generator Comprehensions
5. Write a Python program to generate the combinations of n distinct objects taken from the elements of a given list. Example: Original list: [1, 2, 3, 4, 5, 6, 7, 8, 9] Combinations of 2 distinct objects: [1, 2] [1, 3] [1, 4] [1, 5] [7, 8] [7, 9] [8, 9].
6. Write a python program for Linear Search and Binary search
7. Write a python program to implement Bubble Sort and Selection Sort.
8. Write a python program to implement Merge sort and Quicksort.
9. Write a python program to implement Stacks and Queues.
10. Write a python program to implement a Singly Linked List.
11. Write a python program to implement a Doubly Linked list.
12. Write a python program to implement Binary Search Tree.

TEXT BOOKS:

1. Data structures and algorithms in python by Michael T. Goodrich
2. Data Structures and Algorithmic Thinking with Python by Narasimha Karumanchi

REFERENCE BOOKS:

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka.
2. Data Structures and Algorithms with Python by Kent D. Lee and Steve Hubbard.
3. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum.
4. Core Python Programming -Second Edition,R. Nageswara Rao, Dreamtech Press.

IMAGE AND VIDEO PROCESSING LAB (Professional Elective - I Lab)

M.Tech DS I Year I Sem.

L	T	P	C
0	0	4	2

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

1. Comprehend the image processing fundamentals and enhancement techniques in spatial and frequency domain.
2. Describe the color image fundamentals, models and various restoration techniques.
3. Design and Analyze the image compression systems.
4. Outline the various image segmentation and morphology operations.
5. Comprehend the basics of video processing and video coding.

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

1. Understand theory and models in Image and Video Processing.
2. Explain the need of spatial and frequency domain techniques for image compression.
3. Comprehend different methods, models for video processing and motion estimation.
4. Illustrate quantitative models of image and video segmentation.
5. Apply the process of image enhancement for optimal use of resources.

The students will be given 8-10 programming/simulation/projects/assignments based on the syllabus as mentioned below:

List of Experiments:

1. Implement any four Image Enhancement Algorithms
2. Frequency Domain Filtering Algorithms.
3. Image Restoration Algorithms.
4. Color Image Processing Algorithms
5. Image compression techniques
6. Morphological Image Processing Methods
7. Image Segmentation Algorithms
8. Spatial Filtering Algorithms for image enhancement and segmentation
9. Object Recognition algorithms
10. Video restoration techniques
11. Video segmentation techniques
12. Video compression techniques

ADVANCED DATABASES LAB (Professional Elective - I Lab)

M.Tech DS I Year I Sem.

L	T	P	C
0	0	4	2

Course Objectives: Knowledge on concepts of Distributed Databases, Object-Based Databases, advanced database models

Course Outcomes:

1. Understand Database system Architectures and parallel databases
2. Analyze transactions, Concurrency Control in Distributed Databases
3. Understand the importance of Data Warehousing and Mining
4. Illustrate concepts of object-based databases

List of Experiments

1. Write a program to implement RDBMS - Cursors, Triggers
2. Write a Program to implement Range Partitioning sort.
3. Write a program to implement parallel hash join
4. Write a program to implement parallel nested join loop
5. Write a program to implement parallelize duplicate elimination by partitioning the tuples
6. Perform data fragmentation of distributed data(Horizontal, Vertical, Hybrid fragmentation)
7. Implement deadlock detection in distributed databases
8. Implement Semi Join algorithm.
9. DataCube Implementation - Aggregation
10. Perform data Integration - Extraction, Transformation, Loading
11. Implement any one classifier
12. Implement vector space models for Text corpus
13. Demonstrate type inheritance, table inheritance in object based databases
14. Write queries in XQueries on DTD
15. Write queries in SQL/XML to convert University data - XML Schema

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan Database System Concepts, Sixth Edition
2. Ramez Elmasri, Shamkant B. Navathe, Database systems- Models, Languages, Design and Application Programming

DATA WRANGLING AND DATA VISUALIZATION LAB (Professional Elective - I Lab)

M.Tech DS I Year I Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. To learn data wrangling techniques
2. To introduce visual perception and core skills for visual analysis

Course Outcomes: Upon completion of the course, the students will be able to

1. Perform data wrangling
2. Explain principles of visual perception
3. Apply core skills for visual analysis
4. Apply visualization techniques for various data analysis tasks
5. Evaluate visualization techniques

Implement the following experiments using Python

1. Find missing values and perform data imputation.
2. Find outliers in a chosen dataset.
3. Methods to handle duplicate data.
4. Perform data normalization
5. Explore 2-D charts
   - I. Clustered bar charts
   - II. Connected dot plots
   - III. Pictograms
   - IV. Bubble charts
   - V. Radar charts
   - VI. Polar charts
   - VII. Range chart
   - VIII. Box-and-whisker plots
   - IX. Univariate scatter plots
   - X. histograms word cloud
   - XI. Pie chart
   - XII. Waffle chart
   - XIII. Stacked bar chart
   - XIV. Tree map.
6. Multi-dimensional data visualization
7. Graph data visualization

TEXT BOOKS:

1. Jacqueline Kazil and Katharine Jarmul, Data Wrangling with Python: Tips and Tools to Make Your Life Easier, O'Reilly
2. Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016
3. Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010.

MACHINE LEARNING LAB (Professional Elective - I Lab)

M.Tech DS I Year I Sem. **L T P C**

Course Objective: **0 0 4 2**

1. The objective of this lab is to get an overview of the various machine learning
2. Techniques and can demonstrate them using python.

Course Outcomes:

1. Understand modern notions in predictive data analysis
2. Select data, model selection, model complexity and identify the trends
3. Understand a range of machine learning algorithms along with their strengths and weaknesses
4. Build predictive models from data and analyze their performance

List of Experiments:

1. Write a python program to compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation
2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
3. Study of Python Libraries for ML application such as Pandas and Matplotlib
4. Write a Python program to implement Simple Linear Regression
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn
6. Implementation of Decision tree using sklearn and its parameter tuning
7. Implementation of KNN using sklearn
8. Implementation of Logistic Regression using sklearn
9. Implementation of K-Means Clustering
10. Performance analysis of Classification Algorithms on a specific dataset (Mini Project)

TEXT BOOK:

1. Machine Learning – Tom M. Mitchell, - MGH.

REFERENCE:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis.

RESEARCH METHODOLOGY & IPR

M.Tech DS I Year I Sem.

L	T	P	C
2	0	0	2

Prerequisite: None

Course Objectives:

1. To understand the research problem
2. To know the literature studies, plagiarism and ethics
3. To get the knowledge about technical writing
4. To analyze the nature of intellectual property rights and new developments
5. To know the patent rights

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

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

UNIT - I:

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

UNIT - II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT - III:

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 - IV:

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 - V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. 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. C.R. Kothari, Research Methodology, methods & techniques, 2nd edition, New age International publishers

REFERENCES:

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

BIG DATA ANALYTICS (PC - III)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

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

Courses Outcomes

1. Ability to explain the foundations, definitions, and challenges of Big Data and various Analytical tools.
2. Ability to program using HADOOP and Map reduce, NOSQL
3. Ability to 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.

DEEP LEARNING (PC - IV)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: students will be able

1. To understand complexity of Deep Learning algorithms and their limitations
2. To be capable of performing experiments in Deep Learning using real-world data.

Course Outcomes:

1. Implement deep learning algorithms, understand neural networks and traverse the layers of data
2. Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
3. Understand applications of Deep Learning to Computer Vision
4. Understand and analyze Applications of Deep Learning to NLP

UNIT - I

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout

UNIT - II

Convolutional Neural Networks: Architectures, convolution/pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures. Deep Unsupervised Learning: Auto encoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models, Dynamic Memory Models

UNIT - III

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention Models for computer vision tasks

UNIT - IV

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Wordsmodel (CBOW), Glove, Evaluations and Applications in word similarity

UNIT - V

Analogy reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C, M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

EDGE ANALYTICS (Professional Elective - III)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites

- A basic knowledge of “Python Programming”

Course Objectives

1. The aim of the course is to introduce the fundamentals of Edge Analytics.
2. The course gives an overview of – Architectures, Components, Communication Protocols and tools used for Edge Analytics.

Course Outcomes

1. Understand the concepts of Edge Analytics, both in theory and in practical application.
2. Demonstrate a comprehensive understanding of different tools used at edge analytics.
3. Formulate, Design and Implement the solutions for real world edge analytics .

UNIT - I

Introduction to Edge Analytics

What is edge analytics, Applying and comparing architectures, Key benefits of edge analytics, Edge analytics architectures, Using edge analytics in the real world.

UNIT - II

Basic edge analytics components, Connecting a sensor to the ESP-12F microcontroller, KOM-MICS smart factory platform, Communications protocols used in edge analytics, Wi-Fi communication for edge analytics, Bluetooth for edge analytics communication, Cellular technologies for edge analytics communication, Long-distance communication using LoRa and Signfox for edge analytics.

UNIT - III

Working with Microsoft Azure IoT Hub, Cloud Service providers, Microsoft Azure, Exploring the Azure portal, Azure ioT Hub, Using the Raspberry Pi with Azure IoT edge, Connecting our Raspberry Pi edge device, adding a simulated temperature sensor to our edge device.

UNIT - IV

Using Micropython for Edge Analytics, Understanding Micropython, Exploring the hardware that runs MicroPython, Using MicroPython for an edge analytics application, Using edge intelligence with microcontrollers, Azure Machine Learning designer, Azure IoT edge custom vision.

UNIT - V

Designing a Smart Doorbell with Visual Recognition setting up the environment, Writing the edge code, creating the Node-RED dashboard, Types of attacks against our edge analytics applications, Protecting our edge analytics applications

TEXT BOOK:

1. Hands-On Edge Analytics with Azure IoT: Design and develop IoT applications with edge analytical solutions including Azure IoT Edge by Colin Dow

REFERENCE:

1. Learn Edge Analytics - Fundamentals of Edge Analytics: Automated analytics at source using Microsoft Azure by Ashish Mahajan

BLOCKCHAIN TECHNOLOGY (Professional Elective - III)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites:

1. Knowledge in information security and applied cryptography.
2. Knowledge in distributed databases.

Course Objectives:

1. To learn the fundamentals of BlockChain and various types of block chain and consensus mechanism.
2. To understand public block chain system, Private block chain system and consortium blockchain.
3. Able to know the security issues of blockchain technology.

Course Outcomes: Able to work in the field of block chain technologies.

UNIT-I

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain,The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. **Cryptocurrency – Bitcoin, Altcoin and Token:** Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT-II

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT-III

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Why We Need Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Why We Need Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT-IV

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT-V

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities. Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

TEXT BOOKS:

1. "Block chain Technology", Chandramouli Subramanian, Asha A.George, Abhilash K A and Meena Karthikeyan, Universities Press.

REFERENCES:

1. Blockchain Blueprint for Economy, Melanie Swan, SPD O'reilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson Addition Wesley.

ENTERPRISE CLOUD CONCEPTS (Professional Elective - III)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes:

1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

UNIT - I

Understanding Cloud Computing: Origins and influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

UNIT - II

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology.

Cloud Computing Mechanisms:

Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication.

UNIT - III

Cloud Management Mechanisms: Remote Administration System, Resource Management System, SLA Management System, Billing Management System, Case Study Example

Cloud Computing Architecture

Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture, Case Study Example

UNIT - IV

Cloud-Enabled Smart Enterprises: Introduction, Revisiting the Enterprise Journey, Service-Oriented Enterprises, Cloud Enterprises, Smart Enterprises, The Enabling Mechanisms of Smart Enterprises

Cloud-Inspired Enterprise Transformations: Introduction, The Cloud Scheme for Enterprise Success, Elucidating the Evolving Cloud Idea, Implications of the Cloud on Enterprise Strategy, Establishing a Cloud-Incorporated Business Strategy

UNIT - V

Transitioning to Cloud-Centric Enterprises: The Tuning Methodology, Contract Management in the Cloud

Cloud-Instigated IT Transformations

Introduction, Explaining Cloud Infrastructures, A Briefing on Next-Generation Services, Service Infrastructures, Cloud Infrastructures, Cloud Infrastructure Solutions, Clouds for Business Continuity, The Relevance of Private Clouds, The Emergence of Enterprise Clouds

TEXT BOOKS:

1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham, Cloud Computing: Concepts, Technology & Architecture 1st Edition,
2. Pethuru Raj, Cloud Enterprise Architecture, CRC Press

REFERENCE:

1. James Bond, The Enterprise Cloud, O'Reilly Media, Inc.

NATURAL LANGUAGE PROCESSING (Professional Elective - III)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites:

1. Data structures, finite automata and probability theory.

Course Objectives:

1. Introduction to some of the problems and solutions of NLP and their relation to linguistics and statistics.

Course Outcomes:

1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
3. Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
4. Able to design, implement, and analyze NLP algorithms Able to design different language modeling Techniques.
5. Able to design different language modeling Techniques.

UNIT - I

Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models. **Finding the Structure of Documents:** Introduction, Methods, Complexity of the Approaches, Performances of the Approaches

UNIT - II

Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues.

UNIT - III

Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

UNIT - IV

Predicate-Argument Structure, Meaning Representation Systems, Software.

UNIT - V

Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross Lingual Language Modeling.

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary

REFERENCE:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications

PREDICTIVE ANALYTICS (Professional Elective - IV)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: The course serves to advance and refine expertise on theories, approaches and techniques related to prediction and forecasting

Course Outcomes

1. Understand prediction-related principles, theories and approaches.
2. Learn model assessment and validation.
3. Understand the basics of predictive techniques and statistical approaches.
4. Analyze supervised and unsupervised algorithms

UNIT - I

Linear Methods for Regression and Classification: Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis, Logistic regression, Perceptron learning algorithm.

UNIT - II

Model Assessment and Selection: Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate, Estimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation, Bootstrap methods, conditional or expected test error.

UNIT - III

Additive Models, Trees, and Boosting: Generalized additive models, Regression and classification trees, Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples (Spam data, California housing, New Zealand fish, Demographic data)

UNIT - IV

Neural Networks (NN), Support Vector Machines (SVM), and K-nearest Neighbor: Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest – Neighbor classifiers (Image Scene Classification)

UNIT - V

Unsupervised Learning and Random forests: Association rules, Cluster analysis, Principal Components, Random forests and analysis.

TEXT BOOK:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning-Data Mining, Inference, and Prediction, Second Edition, Springer Verlag, 2009

REFERENCES:

1. C. M. Bishop –Pattern Recognition and Machine Learning, Springer, 2006
2. L. Wasserman - All of statistics
3. Gareth James. Daniela Witten. Trevor Hastie Robert Tibshirani. An Introduction to Statistical Learning with Applications in R

MACHINE TRANSLATION (Professional Elective - IV)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To teach students machine translation approaches.
2. To evaluate the performance of machine translation Systems.
3. To develop translation models for Indian Languages.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand machine translation approaches.
2. Apply and assess manual and automatic evaluation methods for machine translation.
3. Build machine translation model using existing tools for machine translation.

UNIT - I

Introduction to Machine Translation, MT Approaches: vauquois Triangle, Three major paradigms of Machine Translation, MT Evaluation

UNIT - II

Learning Bilingual word Mappings:

A Combinatorial Argument, Deeper look at one- one alignment, Heuristic based Computation of the V_E *V_F Table, Iterative Computation of the V_E *V_F Table, EM: Study of progress in Parameter values

UNIT - III

Phrase based Machine Translation:

Need for phrase alignment, An example to illustrate phrase alignment technique, Phrase table, Mathematics of Phrase based SMT, Decoding, Moses.

UNIT - IV

Rule based Machine Translation (RBMT):

Two kinds of RBMT: Interlingua and Transfer, Universal networking Language (UNL), UNL expressions as binary predicates, Interlingua and Word Knowledge, Translation using Interlingua, Details of english to UNL Conversion: with illustration, Transfer based MT.

UNIT - V

Example based Machine Translation:

Essential steps of EBMT, EBMTs working, EBMT and case based reasoning, Text similarity computation, EBMT and Translation Memory, EBMT and SMT.

TEXT BOOK:

1. Pushpak Bhattacharyya, Machine Translation, CRC Press

REFERENCES:

1. Statistical Machine Translation by Philipp Koehn, Cambridge University Press.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
3. Linguistic Fundamentals for Natural Language Processing by Emily Bender, Morgan & Claypool.

NATURE INSPIRED COMPUTING (Professional Elective - IV)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on significance of intelligence, genetic algorithms Ant Colony algorithms

Course Outcomes:

1. Familiar with Genetic algorithm and its applications.
2. Compare different Ant Colony Optimization algorithmic models.
3. Compare different Artificial Bee Colony Optimization algorithmic models.
4. Illustrate Particle swam optimization algorithm with an example.

UNIT - I:

Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organization, swarm and evolutionary algorithms. Optimisation problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

UNIT - II:

Genetic algorithms - Mathematical foundation, Genetic problem solving, crossover and mutation. genetic algorithms and Markov process, applications of genetic algorithms

UNIT - III:

Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimisation, variations of ACO, case studies.

UNIT - IV:

Particle Swarm algorithms - particles moves, particle swarm optimisation, variable length PSO, applications of PSO, case studies. Artificial Bee Colony algorithms - ABC basics, ABC in optimisation, multi-dimensional bee colony algorithms, applications of bee algorithms, case studies.

UNIT - V:

Selected nature inspired techniques - Hill climbing, simulated annealing, Gaussian adaptation, Cuckoo search, Firey algorithm, SDA algorithm, bat algorithm, case studies. Other nature inspired techniques - Social spider algorithm, Cultural algorithms, Harmony search algorithm, Intelligent water drops algorithm, Artificial immune system, Flower pollination algorithm, case studies.

TEXT BOOKS:

1. Albert Y.Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
2. Floreano, D. and C. Mattiussi -"Bio-Inspired Artificial Intelligence: Theories, methods, and Technologies" IT Press, 2008

REFERENCES:

1. Leandro Nunes de Castro - " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi, 2005
3. Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hall of India, New Delhi, 2020

NETWORK PROGRAMMING (Professional Elective - IV)

M.Tech DS I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives

- To understand Linux utilities
- To understand file handling, signals
- To understand IPC, network programming in Java
- To understand processes to communicate with each other across a Computer Network.

UNIT – I

Linux Utilities- File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking utilities, Filters, Text processing utilities and Backup utilities. Bourne again shell(bash) - Introduction, pipes and redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples.Review of C programming concepts- arrays, strings (library functions), pointers, function pointers, structures, unions, libraries in C.

UNIT - II

Files- File Concept, File types File System Structure, Inodes, File Attributes, file I/O in C using system calls, kernel support for files, file status information-stat family, file and record locking-lockf and fcntl functions, file permissions- chmod, fchmod, file ownership-chown, lchown , fchown, links-soft links and hard links – symlink, link, unlink. File and Directory management – Directory contents, Scanning Directories- Directory file APIs. Process- Process concept, Kernel support for process, process attributes, process control – process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process.

UNIT – III

Signals- Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise , alarm, pause, abort, sleep functions.Interprocess Communication - Introduction to IPC mechanisms, Pipes- creation, IPC between related processes using unnamed pipes, FIFOs- creation, IPC between unrelated processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions, Introduction to message queues, semaphores and shared memory.Message Queues- Kernel support for messages, UNIX system V APIs for messages, client/server example.Semaphores-Kernel support for semaphores, UNIX system V APIs for semaphores.

UNIT – IV

Shared Memory- Kernel support for shared memory, UNIX system V APIs for shared memory, client/server example.Network IPC - Introduction to Unix Sockets, IPC over a network, Client-Server model ,Address formats(Unix domain and Internet domain), Socket system calls for Connection Oriented - Communication, Socket system calls for Connectionless-Communication, Example-Client/Server Programs- Single Server-Client connection, Multiple simultaneous clients, Socket options – setsockopt, getsockopt, fcntl.

UNIT-V

Network Programming in Java-Network basics, TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI)-Basic RMI Process, Implementation details-Client-Server Application.

TEXT BOOKS:

1. Unix System Programming using C++, T.Chan, PHI.(Units II,III,IV)
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.(Unit I)
3. An Introduction to Network Programming with Java, Jan Graba, Springer, 2010.(Unit V)
4. Unix Network Programming ,W.R. Stevens, PHI.(Units II,III,IV)
5. Java Network Programming,3rd edition, E.R. Harold, SPD, O'Reilly.(Unit V)

REFERENCES:

1. Linux System Programming, Robert Love, O'Reilly, SPD.
2. Advanced Programming in the UNIX environment, 2nd Edition, W.R.Stevens, Pearson Education.
3. UNIX for programmers and users, 3rd Edition, Graham Glass, King Ables, Pearson Education.
4. Beginning Linux Programming, 4th Edition, N.Matthew, R.Stones, Wrox, Wiley India Edition.
5. Unix Network Programming The Sockets Networking API, Vol.-I,W.R.Stevens, Bill Fenner, A.M.Rudoff, Pearson Education.
6. Unix Internals, U.Vahalia, Pearson Education.
7. Unix shell Programming, S.G.Kochan and P.Wood, 3rd edition, Pearson Education.
8. C Programming Language, Kernighan and Ritchie, PHI

BIG DATA ANALYTICS LAB (Lab - III)

M.Tech DS I Year II Sem.

L	T	P	C
0	0	4	2

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

Course Outcomes

1. Use Excel as a Analytical tool and visualization tool.
2. Ability to program using HADOOP and Map reduce
3. Ability to perform data analytics using ML in R.
4. Use cassandra to perform social media analytics

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.

EDGE ANALYTICS LAB (Professional Elective - III Lab)

M.Tech DS I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives:

1. Understand the concept of edge computing
2. Understand the Edge computing Architecture
3. Implement the edge computing in IOT
4. Understand the concept of multi-access edge computing
5. Implement edge computing in MEC

Course Outcomes:

1. Identify the benefits of edge computing
2. Develop the microservices in iofog
3. Develop user defined services in the edge
4. Create use cases in IOT with edge computing
5. Develop services in MEC
6. Implement use cases in MEC

List of Experiments:

1. Set up the Arduino IDE for ESP8266-12 module and program it to blink a LED light.
2. Installation tools to create and manage ECN's
3. Deploy micro services and writing your own microservices
4. Setup the Communication Parameters
5. Implement any two Communications protocols
6. Deploy modules to a Windows IoT Edge device
7. Create an IoT hub.
8. Register an IoT Edge device to your IoT hub.
9. Install and start the IoT Edge for Linux on Windows runtime on your device.
10. Remotely deploy a module to an IoT Edge device and send telemetry.
11. Python based basic programs using Raspberry Pi.
12. Deploy a module Manage your Azure IoT Edge device from the cloud to deploy a module that sends telemetry data to IoT Hub.
13. Publishing Data using HTTP.
14. Sensor Interfacing and Logging using MQTT.
15. File IO Example - # Example code to demonstrate writing and reading data to/from files
16. write code to turn on one of the LEDs on the board (Breadboard)

Additional Exercises on IOT Edge Analytics Applications

17. Temperature Logger
18. Home Automation

TEXT BOOKS:

1. Hands-On Edge Analytics with Azure IoT: Design and develop IoT applications with edge analytical solutions including Azure IoT Edge by Colin Dow

2. MicroPython for the Internet of Things A Beginner's Guide to Programming with Python on Microcontroller, Charles Bell, A Press.

REFERENCE BOOKS:

1. Learn Edge Analytics - Fundamentals of Edge Analytics: Automated analytics at source using Microsoft Azure by Ashish Mahajan
2. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018
3. John C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", Packt Publishing, 2016
4. Python for Microcontrollers: Getting Started with MicroPython Paperback – 16 December 2016, by Donald Norris, McGraw-Hill Education TAB
5. Programming with MicroPython: Embedded Programming with Microcontrollers and Python, by Nicholas H. Tollervey, O′Reilly
6. R. Buyya, S.N. Srirama (2019), Fog and Edge Computing: Principles and Paradigms, Wiley-Blackwell, 2019.

BLOCKCHAIN TECHNOLOGY LAB (Professional Elective - III Lab)

M.Tech DS I Year II Sem.

L	T	P	C
0	0	4	2

Pre-requisites:

1. Knowledge in Basics of JavaScript /Java for Hyperledger Fabric.
2. Basics of Solidity for ETH.

Course Objectives:

1. To learn the basic blockchain applications.
2. To be familiar with the blockchain lab setup.

Course Outcomes: Able to work in the field of block chain technologies.

List of Experiments:

1) Setup Metamask in the System and Create a wallet in the Metamask with Test Network.
2) Create multiple accounts in Metamask and perform the balance transfer between the accounts and describe the transaction specifications.
3) Setup the Ganache Tool in the system.
4) Create a custom RPC network in Metamask and connect it with Ganache tool and transfer the ether between ganache accounts.
5) Write a smart contract using a solidity program to perform the balance transfer from contract to other accounts.
6) Write a solidity program to perform the exception handling.
7) Setup the Hyperledger Fabric Network with 2 Organizations 1 Peer Each in the system.
8) Create a channel called mychannel, carchannel in the deployed network.
9) Take the existing Fabcar smart contract and add a new function to query the car on the basis of person name and deploy the smart contract on the Hyperledger Fabric Network.
10) Write an SDK program to query the person details from the deployed smart.

TEXT BOOK:

1. Blockchain Blue print for Economy by Melanie Swan

REFERENCE:

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st ed. Edition, by Daniel Drescher

ENTERPRISE CLOUD CONCEPTS LAB (Professional Elective - III Lab)

M.Tech DS I Year II Sem.	L	T	P	C
	0	0	4	2

Course Objectives: Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes:

1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

List of Experiments:

1. Install Virtualbox/VMware Workstation with different flavors of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java..
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
6. Install Hadoop single node cluster and run simple applications like word count.

E-Resources:

1. https://www.iitk.ac.in/nt/faq/vbox.htm
2. https://www.google.com/urlsa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjqrNG0za73Ah XZt1YBHZ21DWEQFnoECAMQAQ&url=http%3A%2F%2Fwww.cs.columbia.edu%2F~sedwards%2F classes%2F2015%2F1102-fall%2Flinuxvm.pdf&usg=AOvVaw3xZPuF5xVgk-AQnBRsTtHz
3. https://www.cloudsimtutorials.online/cloudsim/
4. https://edwardsamuel.wordpress.com/2014/10/25/tutorial-creating-openstack-instance-in-trystack/
5. https://www.edureka.co/blog/install-hadoop-single-node-hadoop-cluster

NATURAL LANGUAGE PROCESSING LAB (Professional Elective - III Lab)

M.Tech DS I Year II Sem.

L	T	P	C
0	0	4	2

Prerequisites: Data structures, finite automata and probability theory

Course Objectives:

1. To Develop and explore the problems and solutions of NLP.

Course Outcomes:

1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
3. Able to design, implement, and analyze NLP algorithms

List of Experiments

Implement the following using Python

1. Tokenization
2. Stemming
3. Stop word removal (a, the, are)
4. Word Analysis
5. Word Generation
6. Pos tagging
7. Morphology
8. chunking
9. N-Grams
10. N-Grams Smoothing

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary.

REFERENCES:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications.

DIGITAL FORENSICS (Professional Elective - V)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Cybercrime and Information Warfare, Computer Networks

Course Objectives:

1. provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
4. E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

Course Outcomes: On completion of the course the student should be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

UNIT - I

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber criminalistics area, holistic approach to cyber-forensics

UNIT - II

Cyber Crime Scene Analysis:
Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT - III

Evidence Management & Presentation:
Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT - IV

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT - V

Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

TEXT BOOKS:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

REFERENCES:

1. William Oettinger, Learn Computer Forensics: A beginner's guide to searching, analyzing, and securing digital evidence, Packt Publishing; 1st edition (30 April 2020), ISBN: 1838648178.
2. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge.

Conversational AI (Professional Elective - V)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To be familiar with the basic knowledge about conversational systems.
2. To understand the different techniques of natural language processing

UNIT - I

Introducing Dialogue Systems: What's a Dialogue System? A Brief History Of Dialogue Systems, Present-Day Dialogue Systems, Modeling Conversation Dialogue Systems, Designing and Developing Dialogue Systems

UNIT - II

Rule-Based Dialogue Systems: Architecture, Methods, and Tools: A Typical Dialogue Systems Architecture, Designing a Dialogue System, Tools for Developing Dialogue Systems, Rule-Based Techniques in Dialogue Systems Participating in the Alexa Prize

UNIT - III

Statistical Data-Driven Dialogue Systems: Motivating the Statistical Data-Driven Approach, Dialogue Components in the Statistical Data-Driven Approach, Reinforcement Learning (RL), Representing Dialogue as a Markov Decision Process, From MDPs to POMDPs, Dialogue State Tracking, Dialogue Policy, Problems and Issues with Reinforcement Learning in POMDPs

UNIT - IV

Evaluating Dialogue Systems: How to Conduct the Evaluation, Evaluating Task-Oriented Dialogue Systems, Evaluating Open-Domain Dialogue Systems, Evaluation Frameworks- PARADISE, Quality of Experience (QoE), Interaction Quality, Best Way to Evaluate Dialogue Systems.

UNIT - V

End-to-End Neural Dialogue Systems: Neural Network Approaches to Dialogue Modeling, A Neural Conversational Model, Introduction to the Technology of Neural Dialogue, Retrieval-Based Response Generation, Task-Oriented Neural Dialogue Systems, Open-Domain Neural Dialogue Systems, Some Issues and Current Solutions, Dialogue Systems: Datasets, Competitions, Tasks, and Challenges.

TEXT BOOKS:

1. Michael McTear, “Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots”, Second Edition, Moran and Claypool Publishers, 2020.

REFERENCE:

1. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”, O’REILLY, 2016.

SERVICE ORIENTED ARCHITECTURES (Professional Elective - V)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives:

To establish essential coverage of service oriented architectural models and its underlying design paradigm, along with documentation of the methodology.

Course Outcomes:

1. Understand case studies of service-oriented architectures
2. Solving problems in service orientation
3. Understanding principles of SOA
4. Knowledge on characteristics of SOA
5. Perform service-oriented analysis and design

UNIT - I

Introduction, Case Study Backgrounds: Case Studies -Transit Line Systems, Inc., Midwest University Association

UNIT - II

Understanding Service-Orientation: Introduction to Service-Orientation, Problems Solved by Service-Orientation, Effects of Service-Orientation on the Enterprise, Goals and Benefits of Service-Oriented Computing, Four Pillars of Service-Orientation

UNIT - III

Service-Orientation Principles: A profile for the Standardized Service Contract principle, A profile for the Service Loose Coupling principle, A profile for the Service Abstraction principle, A profile for the Service Reusability principle, A profile for the Service Autonomy principle, A profile for the Service Statelessness principle, A profile for the Service Discoverability principle, A profile for the Service Composability principle (Appendix-A of the Textbook)

UNIT - IV

Understanding SO Architectures: Introduction to SOA, The Four Characteristics of SOA,The Four Common Types of SOA, The End Result of Service-Orientation and SOA, SOA Project and Lifecycle Stages

UNIT - V

Service-Oriented Analysis and Design: Web Service Modeling Process, Decompose the Business Process (into Granular Actions), Filter Out Unsuitable Actions, Define Entity Service Candidates, Identify Process-Specific Logic, Apply Service-Orientation, Identify Service Composition Candidates, Analyze Processing Requirements, Define Utility Service Candidates, Define Microservice Candidates, Apply Service-Orientation, Revise Service Composition Candidates, Revise Capability Candidate Grouping

TEXT BOOK:

1. Thomas Erl, Service-Oriented Architecture Concepts, Technology and Design, PH

REFERENCE BOOKS:

1. SOA in Practice: The Art of Distributed System Design Nicolai M. Josuttis, O'Reilly Media, Inc.
2. Java Web Service Architecture, James McGovern, Sameer Tyagi et al., Elsevier
3. Building Web Services with Java, 2nd Edition, S. Graham and others, Pearson Edn.
4. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.
5. Web Services, G. Alonso, F. Casati and others, Springer.

BUSINESS ANALYTICS (Professional Elective - V)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course objectives

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Unit 1:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear ptimization.

Unit 4:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.,Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

ADVANCED ARTIFICIAL INTELLIGENCE (Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on significance of planning, Learning, Perception and Action

Course Outcomes:

1. Understand the concepts of Game Playing and Planning.
2. Analyze parallel and Distributed AI and Learning
3. Illustrate Expert Systems, Perception and Action
4. Analyze Genetic algorithms, Artificial Immune Systems

UNIT - I

Game Playing: introduction, The Min - Max search procedure, adding alpha-beta cutoffs, Additional Refinements, Iterative Deepening, References on Specific Games

Planning: Introduction, An Example Domain, The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear planning using Constraint Posting, Hierarchical Planning, Reactive systems, Other Planning Techniques

UNIT - II

Parallel and Distributed AI: Psychological Modeling, Parallelism in Reasoning Systems, Distributed Reasoning Systems

Learning: Introduction, Rote learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples: Induction, Explanation based Learning, Discovery, Analogy, Formal Learning Theory, Neural Net Learning and Genetic learning

UNIT - III

Expert Systems: Representing and using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition

Perception and Action: Real time Search, Perception, Action, Robot Architectures

UNIT - IV

Genetic algorithms: Copying Nature's Approaches: A Peek into the Biological World, Genetic Algorithms (GAs), Significance of the Genetic Operators, Termination Parameters, Niching and Speciation, Evolving Neural Networks, Theoretical Grounding, Ant Algorithms

Artificial Immune Systems: Introduction, The Phenomenon of Immunity, Immunity and Infection, The Innate Immune System- The first line of Defence, The Adaptive Immune System - The second line of defence, Recognition, Clonal Selection, Learning, Immune Network Theory, Mapping Immune Systems to Practical Applications, Other Applications

UNIT - V

Prolog - The Natural Language of Artificial Intelligence: Introduction, Converting English to Prolog facts and Rules, Goals, Prolog Terminology, Variables, Control Structures, Arithmetic Operators, Matching in Prolog, Backtracking, Cuts, Recursion, Lists, Dynamic Databases, Input/Output and Streams. Some Aspects Specific to LPA Prolog.

TEXT BOOKS:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair, Artificial Intelligence, Third Edition, McGrawHill Education.

REFERENCES:

1. Artificial Intelligence, 3rd Edn, Patrick Henry Winston, Pearson Education.
2. Artificial Intelligence, Shivani Goel, Pearson Education.
3. Artificial Intelligence and Expert systems – Patterson, Pearson Education.

CYBER SECURITY (Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course objectives:

1. To understand various types of cyber-attacks and cyber-crimes
2. To learn threats and risks within context of the cyber security
3. To have an overview of the cyber laws & concepts of cyber forensics
4. To study the defensive techniques against these attacks

Course Outcomes:

1. Analyze and evaluate the cyber security needs of an organization.
2. Understand Cyber Security Regulations and Roles of International Law
3. Design and develop a security architecture for an organization.
4. Understand fundamental concepts of data privacy attacks

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc

Cybercrime: Examples and Mini-Cases

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. **Mini-Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

FUNCTIONAL PROGRAMMING (Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. Understand the concepts and terms used to describe languages that support the imperative, functional, object-oriented, and logic programming paradigms.
2. Solve problems using the functional paradigm.
3. Solve problems using the object-oriented paradigm.
4. Solve problems using the logic programming paradigm.

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

1. Write programs in a functional style.
2. Reason formally about functional programs.
3. Use polymorphism and higher-order functions.
4. Reason about the time and space complexity of programs.

UNIT - I

Functional Programming: Introduction, Differences between Functional Programming and Object-Oriented Programming, concepts of functional programming, Functional Programming in Python: Introduction to Python, Built-in Functions, Dictionary Methods, String Methods, LIST/ARRAY Methods, Tuple Methods, Set Methods

UNIT - II

Python Exceptions, File Handling, Tuple Methods, Defining Iteration, Conditional Iterations, Random Module, Math Module, CMath Module, Python File I/O

UNIT - III

Python Sending Mail, Python CSV, Python OOP Concepts, Python Iterators, Python Generators, Python Decorators, Python Database Connections

UNIT - IV

Introduction to Haskell and Laziness, Structure, Modularity, Maintainability, Polymorphism, higher order functions, strings & characters, lazy evaluation, Data Types using Patterns

UNIT - V

LISP Programming: Basic LISP Programming, Data Types, Functions, Editing, Loading, Compiling LISP Programs, Control Structures: Recursions and Conditionals, LISTS, SETS, Structural Recursion with LISTS, Symbols

TEXT BOOKS:

1. The Haskell School of Expression: Learning Functional Programming through Multimedia, Paul Hudak.
2. Functional Programming in Python, David Mertz, O'Reilly Media.
3. LISP, Patrick Henry Winston, Bertbold Klaus Paul Horn, Pearson Education

REINFORCEMENT LEARNING (Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on fundamentals of reinforcement learning and the methods used to create agents that can solve a variety of complex tasks.

Course Outcomes

1. Understand basics of RL
2. Understand RL Framework and Markov Decision Process
3. Analyzing ning through the use of Dynamic Programming and Monte Carlo
4. Understand TD(0) algorithm, TD(λ) algorithm

UNIT - I

Basics of probability and linear algebra, Definition of a stochastic multi-armed bandit, Definition of regret, Achieving sublinear regret, UCB algorithm, KL-UCB, Thompson Sampling.

UNIT - II

Markov Decision Problem, policy, and value function, Reward models (infinite discounted, total, finite horizon, and average), Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration

UNIT - III

The Reinforcement Learning problem, prediction and control problems, Model-based algorithm, Monte Carlo methods for prediction, and Online implementation of Monte Carlo policy evaluation

UNIT - IV

Bootstrapping; TD(0) algorithm; Convergence of Monte Carlo and batch TD(0) algorithms; Model-free control: Q-learning, Sarsa, Expected Sarsa.

UNIT - V

n-step returns; TD(λ) algorithm; Need for generalization in practice; Linear function approximation and geometric view; Linear TD(λ). Tile coding; Control with function approximation; Policy search; Policy gradient methods; Experience replay; Fitted Q Iteration; Case studies.

TEXT BOOKS:

1. “Reinforcement learning: An introduction,” First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020
2. “Statistical reinforcement learning: modern machine learning approaches,” First Edition, Sugiyama, Masashi. CRC Press 2015

REFERENCES:

1. “Bandit algorithms,” First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020
2. “Reinforcement Learning Algorithms: Analysis and Applications,” Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021
3. Alexander Zai and Brandon Brown “Deep Reinforcement Learning in Action,” First Edition, Manning Publications 2020

OPTIMIZATION TECHNIQUES (Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Prerequisite: Mathematics –I, Mathematics –II

Course Objectives:

1. To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2. Constrained and unconstrained optimization techniques for solving and optimizing electrical and electronic engineering circuits design problems in real world situations.
3. To explain the concept of Dynamic programming and its applications to project implementation.

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

1. explain the need of optimization of engineering systems.
2. understand optimization of electrical and electronics engineering problems.
3. apply classical optimization techniques, linear programming, simplex algorithm, transportation problem.
4. apply unconstrained optimization and constrained non-linear programming and dynamic programming.
5. Formulate optimization problems.

UNIT - I

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surface - classification of Optimization problems.

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT - II

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT - III

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints: Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints: Kuhn – Tucker conditions.

Single Variable Nonlinear Unconstrained Optimization: Elimination methods: Uni Model function-its importance, Fibonacci method & Golden section method.

UNIT - IV

Multi variable nonlinear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hooke - Jeeves, Rosenbrock's search methods. Gradient methods: Gradient of function & its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT - V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. Optimization Techniques & Applications by S.S.Rao, New Age International.
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

REFERENCES:

1. George Bernard Dantzig, Mukund Narain Thapa, “Linear programming”, Springer series in Operations Research 3rd edition, 2003.
2. H. A. Taha, “Operations Research: An Introduction”, 8th Edition, Pearson/Prentice Hall, 2007.
3. Optimization Techniques by Belegundu & Chandrupatla, Pearson Asia.
4. Optimization Techniques Theory and Practice by M.C. Joshi, K.M. Moudgalya, Narosa Publications

MINING MASSIVE DATASETS (Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites:

1. Students should be familiar with Data mining, algorithms, basic probability theory and Discrete math.

Course Objectives:

1. This course will cover practical algorithms for solving key problems in mining of massive datasets.
2. This course focuses on parallel algorithmic techniques that are used for large datasets.
3. This course will cover stream processing algorithms for data streams that arrive constantly, page ranking algorithms for web search, and online advertisement systems that are studied in detail.

Course Outcomes:

1. Handle massive data using MapReduce.
2. Develop and implement algorithms for massive data sets and methodologies in the context of data mining.
3. Understand the algorithms for extracting models and information from large datasets
4. Develop recommendation systems.
5. Gain experience in matching various algorithms for particular classes of problems.

UNIT - I:

Data Mining-Introduction-Definition of Data Mining-Statistical Limits on Data Mining,
MapReduce and the New Software Stack-Distributed File Systems, MapReduce, Algorithms Using MapReduce.

UNIT - II:

Similarity Search: Finding Similar Items**-**Applications of Near-Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Distance Measures.
Streaming Data: Mining Data Streams-The Stream Data Model , Sampling Data in a Stream, Filtering Streams.

UNIT - III:

Link Analysis-PageRank, Efficient Computation of PageRank, Link Spam
Frequent Itemsets-Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream.
Clustering-The CURE Algorithm, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism.

UNIT - IV:

Advertising on the Web-Issues in On-Line Advertising, On-Line Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation.
Recommendation Systems-A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction, The NetFlix Challenge.

UNIT - V:

Mining Social-Network Graphs-Social Networks as Graphs, Clustering of Social-Network Graphs, Partitioning of Graphs, Simrank, Counting Triangles.

TEXT BOOK:

1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, Mining of Massive Datasets, 3rd Edition.

REFERENCES:

1. Jiawei Han & Micheline Kamber , Data Mining – Concepts and Techniques 3rd Edition Elsevier.
2. Margaret H Dunham, Data Mining Introductory and Advanced topics, PEA.
3. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann.

MULTIAGENT SYSTEMS

(Open Elective)

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

Objectives:

- To introduce the student to the concept of an agent and multi-agent systems, and the main applications for which they are appropriate;
- To introduce the main issues surrounding the design of intelligent agents;
- To introduce the main issues surrounding the design of a multi-agent society.
- To introduce a contemporary platform for implementing agents and multi-agent systems

UNIT-I

Introduction: what is an agent? agents and objects, agents and expert systems, agents and distributed systems, typical application areas for agent systems.

UNIT-II

Intelligent Agents: the design of intelligent agents - reasoning agents (eg AgentO), agents as reactive systems (eg subsumption architecture), hybrid agents (eg PRS), layered agents (eg Interrap) a contemporary (Java-based) framework for programming agents (eg the Jack language, the JAM! system).

UNIT-III

Multi-Agent Systems: Classifying multi-agent interactions - cooperative versus non-cooperative, zero-sum and other interactions, what is cooperation? how cooperation occurs - the Prisoner's dilemma and Axelrod's experiments, Interactions between self-interested agents: auctions & voting systems: negotiation

UNIT-IV

Interactions between benevolent agents: cooperative distributed problem solving (CDPS), partial global planning, coherence and coordination;

UNIT-V

Interaction languages and protocols: speech acts, KQML/KIF, the FIPA framework

Text Books

1. *An Introduction to MultiAgent Systems - Second Edition.* Michael Wooldridge (Wiley, 2009)
2. *Programming Multi-agent Systems in AgentSpeak Using Jason.* Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge (Wiley, 2007)

GPU COMPUTING
(Open Elective **)**

M.Tech DS II Year I Sem.

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

To learn parallel programming with Graphics Processing Units (GPUs).

COURSE OUTCOMES

After completion of course:

Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

Unit 1

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC,
Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

Unit 2

Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Unit 3

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU
Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit 4

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects
Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit 5

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning 5
Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334).

ENGLISH FOR RESEARCH PAPER WRITING(Audit Course)

M.Tech DS I Year ISem./ II Sem **L T P C**
2 0 0 0

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

UNIT - I
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT - II
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT - III
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT - IV
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,

UNIT - V
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

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

DISASTER MANAGEMENT(Audit Course)

M.Tech DS I YearISem./ II Sem **L T P C**

Course Objectives: - **2 0 0 0**

Students will be able to:

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

UNIT-I

Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II

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.

UNIT-III

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

UNIT-IV

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.

UNIT-V

Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE(Audit Course)

M.Tech DS I YearISem./ II Sem

L	T	P	C
2	0	0	0

Objectives:

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

UNIT - I

Alphabets in Sanskrit,
Past/Present/Future Tense
Simple Sentences

UNIT - II

Order
Introduction of roots
Technical information about Sanskrit Literature

UNIT - III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading:

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

VALUE EDUCATION(Audit Course)

M.Tech DS I Year ISem./ II Sem **L T P C**

Course Objectives **2 0 0 0**

Students will be able to

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

UNIT - I

Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments

UNIT - II

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity, Power of faith , National Unity, Patriotism, Love for nature, Discipline

UNIT - III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking,Integrity and discipline. Punctuality, Love and Kindness, Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT - IV

True friendship. Happiness Vs suffering, love for trut, Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT - V

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control.Honesty, Studying effectively

TEXTBOOK:

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

CONSTITUTION OF INDIA(Audit Course)

M.Tech DS I Year ISem./ II Sem

L	T	P	C
2	0	0	0

Course Objectives:
Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

UNIT - I

History of Making of the Indian Constitution: History Drafting Committee, (Composition& Working) Philosophy of the Indian Constitution:Preamble Salient Features

UNIT - II

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.

UNIT - III

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

UNIT - IV

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO 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

UNIT - V

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.

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

PEDAGOGYSTUDIES(Audit Course)

M.Tech DS I Year ISem./ II Sem **L T P C**

Prerequisite: None 2 0 0 0

CourseObjectives: Studentswillbeableto:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicymakingundertakenbythe DfID,otheragenciesandresearchers.
- Identifycriticalevidencegapstoguidethedevelopment.

CourseOutcomes: Studentswillbeabletounderstand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassroomsindevelopingcountries?
- Whatis theevidenceontheeffectivenessofthesepedagogicalpractices,inwhatconditions,andwithwhatpopulation oflearners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumandguidancematerialsbestsupporteffective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework andterminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Researchquestions**.**OverviewofmethodologyandSearching.

UNIT-II:

Thematicoverview: Pedagogicalpracticesarebeingusedbyteachersinformalandinformalclassroomsin developing countries.Curriculum,Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: qualityassessment of included studies. How can teacher education (curriculum and practicum) and the schocurriculum and guidance materials best support effective pedagogy? Theory of change. Strength andnature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogicalapproaches.Teachers' attitudesandbeliefsand Pedagogicstrategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support,Support from the head teacher and the community. Curriculum and assessment, Barriers to learning:limitedresourcesand large classsizes

UNIT-V:

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,**Curriculum and assessment**,**Dissemination andresearch impact.

TEXT BOOKS/REFERENCES:

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare,31(2):245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,JournalofCurriculum Studies,36 (3):361-379.
3. Akyeampong K(2003)TeachertraininginGhana -doesitcount? Multi-siteteachereducationresearchproject(MUSTER)countryreport1.London:DFID

STRESS MANAGEMENT BY YOGA(Audit Course)

M.Tech DS I Year ISem./ II Sem	L	T	P	C
Prerequisite: None	2	0	0	0

CourseObjectives:

- Toachieveoverallhealthofbody andmind
- Toovercomestress

CourseOutcomes: Studentswillbeableto:

- Develophealthymindina healthybodythusimprovingsocialhealth also
- Improveefficiency

UNIT-I:
DefinitionsofEight partsof yog. (Ashtanga)

UNIT-II:
Yam andNiyam.

UNIT-III:
Do`sand Don't'sin life.
i) Ahinsa,satya,astheya,bramhacharyaandaparigraha
ii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT-IV:
AsanandPranayam

UNIT-V:
i) Variousyogposesandtheirbenefitsformind&body
ii) Regularizationof breathingtechniquesanditseffects-Typesofpranayam

TEXT BOOKS/REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur2."RajayogaorconqueringtheInternalNature"bySwamiVivekananda,AdvaitaAshrama (PublicationDepartment),Kolkata

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS(Audit Course)

M.Tech DS I Year ISem./ II Sem

L	T	P	C
2	0	0	0

Prerequisite: None

CourseObjectives:

- Tolearnto achievethe highestgoalhappily
- Tobecomeapersonwithstablemind,pleasingpersonality anddetermination
- Toawakenwisdom instudents

CourseOutcomes: Studentswillbeableto

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityandachievethe highestgoal inlife
- ThepersonwhohasstudiedGeeta willleadthenationandmankindtopeaceand prosperity
- Studyof Neetishatakamwillhelpindevelopingversatilepersonalityofstudents

UNIT-I:

Neetisatakam-Holisticdevelopmentofpersonality

- Verses-19,20,21,22(wisdom)
- Verses-29,31,32(pride&heroism)
- Verses-26,28,63,65(virtue)

UNIT-II:

Neetisatakam-Holisticdevelopmentofpersonality

- Verses-52,53,59(dont's)
- Verses-71,73,75,78(do's)

UNIT-III:

Approachtoday today work andduties.

- ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
- Chapter3-Verses13,21, 27, 35, Chapter6-Verses5,13,17, 23,35,
- Chapter18-Verses45,46,48.

UNIT-IV:

Statementsofbasicknowledge.

- ShrimadBhagwadGeeta:Chapter2-Verses56,62,68
- Chapter12-Verses13,14,15,16,17,18
- PersonalityofRolemodel.ShrimadBhagwadGeeta:

UNIT-V:

- Chapter2-Verses17, Chapter3-Verses36,37,42,
- Chapter4-Verses18, 38,39
- Chapter18–Verses37,38,63

TEXT BOOKS/REFERENCES:

1. "SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment),Kolkata.
2. Bhartrihari'sThreeSatakam(Niti-sringar-vairagya)byP.Gopinath,RashtriyaSanskritSansthanam,NewDelhi.