GURU NANAK INSTITUTIONS TECHNICAL CAMPUS (AUTONOMOUS)
SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE
COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

III YEAR I SEMESTER

S.No.	Subject Code	Subject	L	T	P	Credits
1		Design and Analysis of Algorithms	3	1	0	4
2		Introduction to Data Science	3	0	0	3
3		Computer Networks	3	0	0	3
4		Business Economics & Financial Analysis	3	0	0	3
5		Professional Elective-I	3	0	0	3
6		Introduction to Data Science using R Lab	0	0	2	1
7		Computer Networks Lab	0	0	2	1
8		Advanced English Communication Skills Lab	0	0	2	1
9		ETL-Kafka/Talend	0	0	2	1
10		Intellectual Property Rights	3	0	0	0
		Total	**18**	**1**	**08**	**20**

Professional Elective-I :

1. Graph Theory
2. Advanced Computer Architecture
3. Web Programming
4. Image Processing
5. Computer Graphics

B. Tech-Artificial Intelligence & Data Science –

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III YEAR II SEMESTER

S.No.	Subject Code	Subject	L	T	P	Credits
1		Automata theory and Compiler Design	3	0	0	3
2		Machine Learning	3	0	0	3
3		Big Data Analytics	3	0	0	3
4		Professional Elective – II	3	0	0	3
5		Open Elective-I	3	0	0	3
6		Machine Learning Lab	0	0	3	1.5
7		Big Data Analytics Lab	0	0	3	1.5
8		UI design- Flutter	0	0	4	2
9		Environmental Science	3	0	0	0
Total			**18**	**0**	**10**	**20**

Professional Elective – II:

1. Software Testing Methodologies
2. Information Retrieval Systems
3. Pattern Recognition
4. Computer Vision and Robotics
5. Data Warehousing and Business Intelligence

List of Open Electives-I:

1. Fundamentals of AI
2. Machine Learning Basics

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DESIGN AND ANALYSIS OF ALGORITHMS

B.Tech. III Year I Sem   **L T P C**

                                                                          3 1 0 4

Prerequisites:

- A course on "Computer Programming and Data Structures".
- A course on "Advanced Data Structures".

Course Objectives:

- Introduces the notations for analysis of the performance of algorithms and the data structure of disjoint sets.
- Describes major algorithmic techniques (divide-and-conquer, backtracking, dynamic programming, greedy, branch and bound methods) and mention problems for which each technique is appropriate
- Describes how to evaluate and compare different algorithms using worst-, average-, and bestcase analysis.
- Explains the difference between tractable and intractable problems, and introduces the problems that are P, NP and NP complete.

UNIT - I

Introduction: Algorithm, Performance Analysis-Space complexity, Time complexity, Asymptotic Notations- Big oh notation, Omega notation, Theta notation and Little oh notation.
Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

UNIT - II

Disjoint Sets: Disjoint set operations, union and find algorithms, Priority Queue- Heaps, Heapsort **Backtracking:** General method, applications, n-queen's problem, sum of subsets problem, graph Coloring, hamitonian cycles.

UNIT - III

Dynamic Programming: General method, applications- Optimal binary search tree, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT - IV

Greedy method: General method, applications-Job sequencing with deadlines, knapsack problem, Minimum cost spanning trees, Single source shortest path problem.
Basic Traversal and Search Techniques: Techniques for Binary Trees, Techniques for Graphs, Connected components, Biconnected components.

UNIT - V

Branch and Bound: General method, applications - Traveling salesperson problem, 0/1 knapsack problem - LC Branch and Bound solution, FIFO Branch and Bound solution.
NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP-Hard andNP-Complete classes, Cook's theorem

TEXT BOOK:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharan, University press, 1998.

REFERENCE BOOKS:

1. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.
2. Introduction to Algorithms, second edition, T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C.Stein, PHI Pvt. Ltd./ Pearson Education.
3. Algorithm Design: Foundations, Analysis and Internet Examples, M.T. Goodrich and R.Tamassia, John Wiley and sons.

Course Outcomes:

- Analyze the performance of algorithms
- Choose appropriate data structures and algorithm design methods for a specified application
- Understand the choice of data structures and the algorithm design methods

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INTRODUCTION TO DATA SCIENCE

B.Tech. III Year I Sem.   **L   T   P   C**

                                                                              3   0   0   3

Course Objectives:

- Learn concepts, techniques and tools they need to deal with various facets of data sciencepractice, including data collection and integration
- Understand the basic types of data and basic statistics
- Identify the importance of data reduction and data visualization techniques

UNIT– I:
Introduction: What Is Data Science, Where Do We See Data Science, How Does Data Science Relate to Other Fields, The Relationship between Data Science and Information Science, Computational Thinking, Skills for Data Science, Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science.

UNIT– II:
Data: Introduction, Data Types, Data Reduction, Data Collections,Data Pre-processing.

UNIT– III:
Techniques: Introduction, Data Analysis and Data Analytics, Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis.

UNIT– IV:
Data Collection, Experimentation, and Evaluation: Introduction, Data Collection Methods, Picking Data Collection and Analysis Methods, Evaluation.

UNIT– V:
Solving Data Problems: Introduction, Collecting and Analyzing Twitter Data, Collecting and Analyzing YouTube Data, Analyzing Yelp Reviews and Ratings

TEXT BOOKSs:
1. A Hands-On Introduction to Data Science, Chirag Shah, Cambridge University Press, 2020.
2. EMC Education Services "DataScience and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley Publishers, 2012.

REFERENCE BOOKS:
1. NeilA.Weiss,"IntroductoryStatistics",10th Edition,Pearson Education Limited, 2017.
2. JiaweiHan, Micheline Kamber and JianPei, DataMining: Concepts and Techniques, 3rd ed.

B. Tech-Artificial Intelligence & Data Science –

Course Outcomes:

- Understand the significance of datascience tools and techniques.
- Apply data cleaning, transformation and discretization techniques.
- Analyze various inferentiall statistics and time-series methods.
- Understand predictive analytics and its applications.
- Apply datascience techniques to deal with thereal - worldproblems.

B. Tech-Artificial Intelligence & Data Science –

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COMPUTER   NETWORKS

B.Tech. III Year I Sem.   **L T P C**

                                                                                     3 0 0 3

Prerequisites

- A course on "Programming for problem solving"
- A course on "Data Structures"

Course Objectives

- The objective of the course is to equip the students with a general overview of the conceptsand fundamentals of computer networks.
- Familiarize the students with the standard models for the layered approach to communicationbetween machines in a network and the protocols of the various layers.

UNIT - I

Network hardware, Network software, OSI, TCP/IP Reference models, Example Networks: ARPANET,Internet.
Physical Layer: Guided Transmission media: twisted pairs, coaxial cable, fiber optics, WirelessTransmission.
Data link layer: Design issues, framing, Error detection and correction.

UNIT - II

Elementary data link protocols: simplex protocol, A simplex stop and wait protocol for an error-freechannel, A simplex stop and wait protocol for noisy channel.
Sliding Window protocols: A one-bit sliding window protocol, A protocol using Go-Back-N, A protocolusing Selective Repeat, Example data link protocols.
Medium Access sublayer: The channel allocation problem, Multiple access protocols: ALOHA, Carriersense multiple access protocols, collision free protocols. Wireless LANs, Data link layer switching.

UNIT - III

Network Layer: Design issues, Routing algorithms: shortest path routing, Flooding, Hierarchical routing, Broadcast, Multicast, distance vector routing, Congestion Control Algorithms, Quality of Service, Internetworking, The Network layer in the internet.

B. Tech-Artificial Intelligence & Data Science –

UNIT - IV

Transport Layer: Transport Services, Elements of Transport protocols, Connection management, TCP and UDP protocols.

UNIT - V

Application Layer –Domain name system, SNMP, Electronic Mail; the World WEB, HTTP, Streamingaudio and video.

TEXT BOOK:

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. PearsonEducation/PHI

REFERENCE BOOKS:

1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
2. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.

Course Outcomes

- Gain the knowledge of the basic computer network technology.
- Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
- Obtain the skills of subnetting and routing mechanisms.
- Familiarity with the essential protocols of computer networks, and how they can be applied innetwork design and implementation.

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GRAPH THEORY (Professional Elective – I)

B.Tech. III Year I Sem.   **L T P C**

                                                                                           3 0 0 3

Course Objectives:

- Understanding graphs, trees, connected paths, applications of trees and graphs.

UNIT - I

Introduction-Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion, Realization of a graphic sequence.

UNIT - II

Connected graphs and shortest paths - Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra‟s shortest path algorithm, Floyd-Warshall shortest path algorithm.

UNIT - III

Trees- Definitions and characterizations, Number of trees, Cayley‟s formula, Kircho↵-matrix-tree theorem, Minimum spanning trees, Kruskal‟s algorithm, Prim‟s algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Fleury‟s algorithm, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions.

UNIT - IV

Independent sets coverings and matchings– Introduction, Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall‟s Theorem, K¨onig‟s Theorem, Perfect matchings in graphs, Greedy and approximation algorithms.

B. Tech-Artificial Intelligence & Data Science –

UNIT - V

Vertex Colorings- Basic definitions**,** Cliques and chromatic number, Mycielski''s theorem, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class- 1 and Class-2 graphs, Edge-coloring of bipartite graphs, Class-2 graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring.

TEXT BOOKS:

1. J. A. Bondy and U. S. R. Murty. Graph Theory, volume 244 of Graduate Texts in Mathematics.Springer, 1st edition, 2008.
2. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications.

REFERENCE BOOKS:

1. Lecture Videos: http://nptel.ac.in/courses/111106050/13
2. Introduction to Graph Theory, Douglas B. West, Pearson.

Course Outcomes:

- Know some important classes of graph theoretic problems;
- Prove central theorems about trees, matching, connectivity, coloring and planar graphs;
- Describe and apply some basic algorithms for graphs;
- Use graph theory as a modeling tool.

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ADVANCED COMPUTER ARCHITECTURE (Professional Elective – I)

B.Tech. III Year I Sem.   **L T P C**

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Prerequisites: Computer Organization

Course Objectives:
- Impart the concepts and principles of parallel and advanced computer architectures.
- Develop the design techniques of Scalable and multithreaded Architectures.
- Apply the concepts and techniques of parallel and advanced computer architectures to designmodern computer systems

UNIT - I

Theory of Parallelism, Parallel computer models, The State of Computing, Multiprocessors and Multicomputers, Multivector and SIMD Computers, PRAM and VLSI models, Architectural development tracks, Program and network properties, Conditions of parallelism, Program partitioning and Scheduling, Program flow Mechanisms, System interconnect Architectures.

UNIT - II

Principles of Scalable performance, Performance metrics and measures, Parallel Processing applications, Speed up performance laws, Scalability Analysis and Approaches, Hardware Technologies, Processes and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors

UNIT - III

Shared-Memory Organizations, Sequential and weak consistency models, Pipelining and superscalar techniques, Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, superscalar pipeline design.

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UNIT - IV

Parallel and Scalable Architectures, Multiprocessors and Multicomputers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multicomputers, Message-passing Mechanisms, Multivetor and SIMD computers.

UNIT - V

Vector Processing Principles, Multivector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5.

TEXT BOOK:

1. Advanced Computer Architecture, Kai Hwang, 2nd Edition, Tata McGraw Hill Publishers.

REFERENCE BOOKS:

1. Computer Architecture, J.L. Hennessy and D.A. Patterson, 4th Edition, ELSEVIER.
2. Advanced Computer Architectures, S.G.Shiva, Special Indian edition, CRC, Taylor &Francis.
3. Introduction to High Performance Computing for Scientists and Engineers, G. Hager and G. Wellein, CRC Press, Taylor & Francis Group.
4. Advanced Computer Architecture, D. Sima, T. Fountain, P. Kacsuk, Pearson education.
5. Computer Architecture, B. Parhami, Oxford Univ. Press.

Course Outcomes:

- Computational models and Computer Architectures.
- Concepts of parallel computer models.
- Scalable Architectures, Pipelining, Superscalar processors

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WEB PROGRAMMING (Professional Elective – I)

B.Tech. III Year I Sem.   **L T P C**

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Course Objectives:

- Understand the technologies used in Web Programming.
- Know the importance of object-oriented aspects of Scripting.
- Understand creating database connectivity using JDBC.
- Learn the concepts of web-based application using sockets.

UNIT - I

Client side Programming

HTML- Basic Tags- List, Tables, Images, Forms, Frames, CSS
JAVA Script -

Web page Designing using HTML, Scripting basics- Client side and server side scripting. Java ScriptObject, names, literals, operators and expressions- statements and features- events - windows - documents - frames - data types - built-in functions- Browser object model - Verifying forms.-HTML5- CSS3- HTML 5 canvas - Web site creation using tools.

UNIT – II
JAVA

Introduction to object-oriented programming-Features of Java – Data types, variables and arrays –Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces – Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling.

UNIT – III
JDBC

JDBC Overview – JDBC implementation – Connection class – Statements - Catching Database Results, handling database Queries. Networking– InetAddress class – URL class- TCP sockets – UDPsockets, Java Beans –RMI.

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UNIT – IV
APPLETS

Java applets- Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. Event Handling. Introducing AWT: Working with Windows Graphicsand Text. Using AWT Controls, Layout Managers and Menus. Servlet – life cycle of a servlet. The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction toJSP.

UNIT – V

XML AND WEB SERVICES

Xml – Introduction-Form Navigation-XML Documents- XSL – XSLT- Web services- UDDI-WSDL-Javaweb services – Web resources.

TEXT BOOKS:
1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How To Program 5th Edition.
2. Herbert Schildt, Java - The Complete Reference, 7th Edition. Tata McGraw- Hill Edition.
3. Michael Morrison XML Unleashed Tech media SAMS.

REFERENCE BOOKS:
1. John Pollock, Javascript - A Beginners Guide, 3rd Edition –- Tata McGraw-Hill Edition.
2. Keyur Shah, Gateway to Java Programmer Sun Certification, Tata McGraw Hill, 2002.

Course Outcomes:
- Design web pages.
- Use technologies of Web Programming.
- Apply object-oriented aspects to Scripting.
- Create databases with connectivity using JDBC.
- Build web-based application using sockets.

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IMAGE PROCESSING (Professional Elective – I)

B.Tech. III Year I Sem. **L T P C**

3 0 0 3

Prerequisites

- Students are expected to have knowledge in linear signals and systems, Fourier Transform, basic linear algebra, basic probability theory and basic programming techniques; knowledge of digital signal processing is desirable.
- A course on "Computational Mathematics"
- A course on "Computer Oriented Statistical Methods"

Course Objectives

- Provide a theoretical and mathematical foundation of fundamental Digital Image Processing concepts.
- The topics include image acquisition; sampling and quantization; preprocessing; enhancement; restoration; segmentation; and compression.

UNIT - I

Digital Image Fundamentals: Digital Image through Scanner, Digital Camera. Concept of Gray Levels.Gray Level to Binary Image Conversion. Sampling and Quantization. Relationship between Pixels.Imaging Geometry. 2D Transformations-DFT, DCT, KLT and SVD.

UNIT - II

Image Enhancement in Spatial Domain Point Processing, Histogram Processing, Spatial Filtering, Enhancement in Frequency Domain, Image Smoothing, Image Sharpening.

UNIT - III

Image Restoration Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT - IV

Image Segmentation Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Oriented Segmentation.

UNIT - V

Image Compression Redundancies and their Removal Methods, Fidelity Criteria, Image

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Compression Models, Source Encoder and Decoder, Error Free Compression, Lossy Compression.

TEXT BOOK:

1. Digital Image Processing: R.C. Gonzalez & R. E. Woods, Addison Wesley/ PearsonEducation,2nd Ed, 2004.

REFERENCE BOOKS:

1. Fundamentals of Digital Image Processing: A. K. Jain, PHI.
2. Digital Image Processing using MAT LAB: Rafael C. Gonzalez, Richard E. Woods, StevenL.Eddins: Pearson Education India, 2004.
3. Digital Image Processing: William K. Pratt, John Wilely, 3rd Edition, 2004.

Course Outcomes

- Demonstrate the knowledge of the basic concepts of two-dimensional signal acquisition, sampling, and quantization.
- Demonstrate the knowledge of filtering techniques.
- Demonstrate the knowledge of 2D transformation techniques.
- Demonstrate the knowledge of image enhancement, segmentation, restoration andcompression techniques.

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COMPUTER GRAPHICS (Professional Elective – I)

B.Tech. III Year I Sem.   **L T P C**

                                                                   3 0 0 3

Prerequisites

1. Programming for problem solving and Data Structures

Course Objectives

- Provide the basics of graphics systems including Points and lines, line drawing algorithms, 2D,3D objective transformations

UNIT - I

Introduction: Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random-scan systems, graphics monitors and work stations and input devices

Output primitives: Points and lines, line drawing algorithms (DDA and Bresenham's Algorithm) circle- generating algorithms and ellipse - generating algorithms

Polygon Filling: Scan-line algorithm, boundary-fill and flood-fill algorithms

UNIT - II

2-D geometric transformations: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems

2-D viewing: The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, clipping operations, point clipping, Line clipping-Cohen Sutherland algorithms, Polygon clipping- Sutherland Hodgeman polygon clipping algorithm.

UNIT - III

3-D object representation: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B- Spline surfaces, Polygon rendering methods, color models and color applications.

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UNIT - IV

3-D Geometric transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations.

3-D viewing: Viewing pipeline, viewing coordinates, projections, view volume and general projection transforms and clipping.

UNIT - V

Computer animation: Design of animation sequence, general computer animation functions, raster animations, computer animation languages, key frame systems, motion specifications.

Visible surface detection methods: Classification, back-face detection, depth- buffer method, BSP- tree method, area sub-division method and octree method.

TEXT BOOKS:

1. "Computer Graphics C version", Donald Hearn and M. Pauline Baker, Pearson Education

REFERENCE BOOKS:

1. Procedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.
2. Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
3. Principles of Computer Graphics, Shalini Govil, Pai, 2005, Springer.
4. "Computer Graphics Principles & practice", second edition in C, Foley, Van Dam, Feiner andHughes, Pearson Education.
5. Computer Graphics, Steven Harrington, TMH.

Course Outcomes

- Explore applications of computer graphics
- Understand 2D, 3D geometric transformations and clipping algorithms
- Understand 3D object representations, curves, surfaces, polygon rendering methods, colormodels
- Analyze animation sequence and visible surface detection methods

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INTRODUCTION TO DATA SCIENCE USING R LAB

B.Tech. III Year I Sem.   **L T P C**

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Pre-requisites: Any programming language.

Course Objectives:

- Familiarize with R basic programming concepts, various data structures for handling datasets, various graph representations and Exploratory Data Analysis concepts

LIST OF EXPERIMENTS:

1. Download and install R-Programming environment and install basic packages usinginstall.packages() command in R.

2. Learn all the basics of R-Programming (Data types, Variables, Operators etc,.)

3. Write R command to
i) Illustrate summation, subtraction, multiplication, and division operations on vectors using vectors.
ii) Enumerate multiplication and division operations between matrices and vectors in R console

4. Write R command to
i) Illustrates the usage of Vector subsetting and Matrix subsetting
ii) Write a program to create an array of 3×3 matrices with 3 rows and 3 columns.

5. Write an R program to draw i) Pie chart ii) 3D Pie Chart, iii) Bar Chart along with chart legend byconsidering suitable CSV file

6. Create a CSV file having Speed and Distance attributes with 1000 records. Write R program to draw
i) Box plots
ii) Histogram

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iii) Line Graph
iv) Multiple line graphs
v) Scatter plot
to demonstrate the relation between the cars speed and the distance.

7. Implement different data structures in R (Vectors, Lists, Data Frames)

8. Write an R program to read a csv file and analyze the data in the file using EDA (Explorative DataAnalysis) techniques.

9. Write an R program to illustrate Linear Regression and Multi linear Regression considering suitable CSV file.

TEXT BOOKS:

1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Norman Matloff Cengage Learning India.

REFERENCE BOOKS:

1. Hadley Wickham, Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition, O'Reilly
2. Tilman M. Davies, The book of R a first course in programming and statistics, no starch press

Course Outcomes:

- Setup R programming environment.
- Understand and use R – Data types and R – Data Structures.
- Develop programming logic using R – Packages.
- Analyze data sets using R – programming capabilities

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COMPUTER NETWORKS LAB

B.Tech. III Year I Sem.   **L T P C**
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Course Objectives

- To understand the working principle of various communication protocols.
- To understand the network simulator environment and visualize a network topology andobserve its performance
- To analyze the traffic flow and the contents of protocol frames

List of Experiments

1. Implement the data link layer framing methods such as character, character-stuffing and bitstuffing.
2. Write a program to compute CRC code for the polynomials CRC-12, CRC-16 and CRC CCIP
3. Develop a simple data link layer that performs the flow control using the sliding windowprotocol, and loss recovery using the Go-Back-N mechanism.
4. Implement Dijsktra's algorithm to compute the shortest path through a network
5. Take an example subnet of hosts and obtain a broadcast tree for the subnet.
6. Implement distance vector routing algorithm for obtaining routing tables at each node.
7. Implement data encryption and data decryption
8. Write a program for congestion control using Leaky bucket algorithm.
9. Write a program for frame sorting techniques used in buffers.
10. Wireshark

    i.   Packet Capture Using Wire shark
    ii. Starting Wire shark
    iii. Viewing Captured Traffic
    iv. Analysis and Statistics &

    Filters.How to run Nmap scan
    Operating System Detection using
    NmapDo the following using NS2

B. Tech-Artificial Intelligence & Data Science –

Simulator

    i.   NS2 Simulator-Introduction

    ii.   Simulate to Find the Number of Packets Dropped

    iii.   Simulate to Find the Number of Packets Dropped by TCP/UDP

    iv.   Simulate to Find the Number of Packets Dropped due to Congestion

    v.   Simulate to Compare Data Rate & Throughput.

    vi.   Simulate to Plot Congestion for Different Source/Destination

    vii.   Simulate to Determine the Performance with respect to Transmission of Packets

TEXT BOOK:

1. Computer Networks, Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI.

REFERENCE BOOKS:

1. An Engineering Approach to Computer Networks, S. Keshav, 2nd Edition, Pearson Education.
2. Data Communications and Networking – Behrouz A. Forouzan. 3rd Edition, TMH.

Course Outcomes

- Implement data link layer farming methods
- Analyze error detection and error correction codes.
- Implement and analyze routing and congestion issues in network design.
- Implement Encoding and Decoding techniques used in presentation layer
- To be able to work with different network tools

B. Tech-Artificial Intelligence & Data Science –

GURU NANAK INSTITUTIONS TECHNICAL CAMPUS (AUTONOMOUS)
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(Applicable for the Batch admitted from 2022-2023)

ETL- KAFKA/TALEND

B.Tech. III Year I Sem.   **L T P C**

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Course Objectives:

- Develop a comprehensive understanding of Extract, Transform, Load (ETL) processes usingApache Kafka and Talend.
- Understand how to scale Kafka clusters seamlessly to handle growing data volumes,ensuring optimal performance for ETL operations.

LIST OF EXPERIMENTS:

1. Install Apache Kafka on a single node.
2. Demonstrate setting up a single-node, single-broker Kafka cluster and show basic operationssuch as creating topics and producing/consuming messages.
3. Extend the cluster to multiple brokers on a single node.
4. Write a simple Java program to create a Kafka producer and Produce messages to a topic.
5. Implement sending messages both synchronously and asynchronously in the producer.
6. Develop a Java program to create a Kafka consumer and subscribe to a topic and consumemessages.
7. Write a script to create a topic with specific partition and replication factor settings.
8. Simulate fault tolerance by shutting down one broker and observing the cluster behavior.
9. Implement operations such as listing topics, modifying configurations, and deleting topics.
10. Introduce Kafka Connect and demonstrate how to use connectors to integrate with externalsystems.
11. Implement a simple word count stream processing application using Kafka Stream
12. Implement Kafka integration with the Hadoop ecosystem.

TEXT BOOK:

1. Neha Narkhede, Gwen Shapira, Todd Palino, Kafka – The Definitive Guide: Real-time dataand stream processing at scale, O'Reilly

Course Outcomes:

1. Learn to design and deploy fault-tolerant Kafka clusters, ensuring data integrity andavailability in real-world scenarios.
2. Gain practical experience in cluster management, topic creation, and basic operations suchas producing and consuming messages.

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

AUTOMATA THEORY AND COMPILER DESIGN

B.Tech. III Year II Sem.   **L T P C**
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Course Objectives

- To introduce the fundamental concepts of formal languages, grammars and automata theory.
- To understand deterministic and non-deterministic machines and the differences betweendecidability and undecidability.
- Introduce the major concepts of language translation and compiler design and impart theknowledge of practical skills necessary for constructing a compiler.
- Topics include phases of compiler, parsing, syntax directed translation, type checking use ofsymbol tables, intermediate code generation

UNIT - I

Introduction to Finite Automata: Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems.
Nondeterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automatawith Epsilon-Transitions.
Deterministic Finite Automata: Definition of DFA, How A DFA Process Strings, The language ofDFA, Conversion of NFA with €-transitions to NFA without €-transitions. Conversion of NFA to DFA

UNIT - II

Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions.

Pumping Lemma for Regular Languages:
Statement of the pumping lemma, Applications of the Pumping Lemma.
Context-Free Grammars: Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.

UNIT - III

Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA,

B. Tech-Artificial Intelligence & Data Science –

Equivalenceof PDA's and CFG's, Acceptance by final state.

Turing Machines:

Introduction to Turing Machine, Formal Description, Instantaneous description, The language of a Turing machine

Undecidability:

Undecidability, A Language that is Not Recursively Enumerable, An Undecidable Problem That isRE, Undecidable Problems about Turing Machines

UNIT - IV

Introduction: The structure of a compiler
Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, TheLexical- Analyzer Generator Lex

Syntax Analysis: Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom- Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers

UNIT - V

Syntax-Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's. **Intermediate-Code Generation:** Variants of Syntax Trees, Three-Address Code

Run-Time Environments: Stack Allocation of Space, Access to Nonlocal Data on the Stack, HeapManagement.

TEXT BOOKS:

1. Introduction to Automata Theory, Languages, and Computation, 3rd Edition, John E.Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.

2. Theory of Computer Science- Automata languages and computation, Mishra and Chandrashekaran, 2nd Edition, PHI.

REFERENCE BOOKS:

1. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry

   D. Ullman, 2nd Edition, Pearson.
2. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
3. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
4. lex & yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly
5. Compiler Construction, Kenneth C. Louden, Thomson. Course Technology.

Course Outcomes

- Able to employ finite state machines for modeling and solving computing problems.
- Able to design context free grammars for formal languages.

B. Tech-Artificial Intelligence & Data Science –

- Able to distinguish between decidability and undecidability.
- Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis.
- Acquire skills in using lex tool and design LR parsers

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

MACHINE LEARNING

B.Tech. III Year II Sem.   **L T P C**

3 0 0 3

Course Objectives:
- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques

UNIT - I

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

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

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 meansAlgorithms

UNIT - IV

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis –

B. Tech-Artificial Intelligence & Data Science –

Locally Linear Embedding – Isomap – Least Squares Optimization
Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators –
Using Genetic Algorithms

UNIT - V

Reinforcement Learning – Overview – Getting Lost Example
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.

REFERENCE BOOKS:

1. Tom M Mitchell, ―Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make
   Sense of Data‖,First Edition, Cambridge University Press, 2012.
3. Jason Bell, ―Machine learning – Hands on for Developers and Technical
   Professionals‖, First Edition, Wiley, 2014
4. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation
   and Machine Learning Series), Third Edition, MIT Press, 2014.

Course Outcomes:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Understand algorithms for building classifiers applied on datasets of non- linearly
  separable classes
- Understand the principles of evolutionary computing algorithms
- Design an ensembler to increase the classification accuracy

B. Tech-Artificial Intelligence & Data Science –

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

BIG DATA ANALYTICS

B.Tech. III Year II Sem.   **L T P C**

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Course Objectives

- Provide the knowledge of principles and techniques for Big data Analytics and give anexposure of the frontiers of Big data Analytics

UNIT - I

Types of Digital data: Classification of Digital Data,
Introduction to Big Data: Evolution of Big Data, definition of big data, Traditional Business Intelligence vs BigData, Coexistence of Big Data and Data Warehouse.
Big Data Analytics: introduction to Big Data Analytics, What Big Data Analytics Isn't, Sudden Hype Around Big Data Analytics, Classification of Analytics, Greatest Challenges that Prevent Business from Capitalizing Big Data, Top Challenges Facing Big Data, Big Data Analytics Importance, Data Science, Terminologies used in Big Data Environments.

UNIT - II

Hadoop: Features of Hadoop, Key advantages of hadoop, versions of hadoop, overview of hadoop ecosystem, Hadoop distributions. Need of hadoop, RDBMS vs Hadoop, Distribution computing challenges, History of hadoop, Hadoop overview,HDFS

UNIT - III

Processing data with hadoop, introduction to mapreduce programming, mapper, reducer, combiner, partitioner
NoSQL: Types of NoSQL Databases, advantages of NoSQL, Use of NoSQL in industry, SQL vsNoSQL, newSQL, comparison of Nosql, sql and newsql

UNIT - IV

MongoDB, necessity of mongodb, terms used in mongodb and RDBMS, datatypes in mongoDB, mongodb query language

UNIT - V

Introduction to R programming, operators, control statements and functions, interfacing

B. Tech-Artificial Intelligence & Data Science –

with R, vectors, matrices, lists, data frames, factors and tables, accessing input and output, graphs in R, R apply family

TEXT BOOKS:

1. Big Data Analytics, Seema Acharya, Subhashini Chellappan, Wiley 2015.
2. R programming for beginners, sandhya arora, latesh malik, university press.

REFERENCE BOOKS:

1. chandramouli subramanian, Asha A Geroge, C R Rene Robin, big data analytics, Universitypress.
2. 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.
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.

Courses Outcomes

- Understand the importance of big data analytics and its types
- Perform analytics on big data
- Proficiency in big data storage and processing in Hadoop
- Data analytics through MongoDB
- Data analytics through R

B. Tech-Artificial Intelligence & Data Science –

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COURSE STRUCTURE
Applicable for the Batch admitted from 2022-2023)

SOFTWARE TESTING METHODOLOGIES (Professional Elective – II)

B.Tech. III Year II Sem.   **L T P C**

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Prerequisites

1. Software Engineering

Course Objectives

- To provide knowledge of the concepts in software testing such as testing process, criteria, strategies, and methodologies.
- To develop skills in software test automation and management using the latest tools.

UNIT - I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: transaction flows, transaction flow testing techniques. Data Flow testing: Basics of data flow testing, strategies in data flow testing, application of data flowtesting.
Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfacestesting, domain and interface testing, domains and testability.

UNIT - III

Paths, Path products and Regular expressions: path products & path expression, reduction procedure,applications, regular expressions & flow anomaly detection. Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications.

B. Tech-Artificial Intelligence & Data Science –

UNIT - IV

State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like Jmeter/selenium/soapUI/Catalon).

TEXT BOOKS:

1. Software Testing techniques - Baris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech.

REFERENCE BOOKS:

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing Techniques – SPD(Oreille)
3. Software Testing in the Real World – Edward Kit, Pearson.
4. Effective methods of Software Testing, Perry, John Wiley.
5. Art of Software Testing – Meyers, John Wiley.

Course Outcomes:

- Understand purpose of testing and path testing
- Understand strategies in data flow testing and domain testing
- Develop logic-based test strategies
- Understand graph matrices and its applications
- Implement test cases using any testing automation tool

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023) INFORMATION

RETRIEVAL SYSTEMS (Professional Elective – II)

B.Tech. III Year I Sem.   **L T P C**

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Prerequisites:

- Data Structures

Course Objectives:

- To learn the concepts and algorithms in Information Retrieval Systems
- To understand the data/file structures that are necessary to design, and implement informationretrieval (IR) systems.

UNIT - I

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities

UNIT - II

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models.

UNIT - III

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages
Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters

B. Tech-Artificial Intelligence & Data Science –

UNIT - IV

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of BooleanSystems, Searching the INTERNET and Hypertext Information Visualization: Introduction to Information Visualization, Cognition and Perception,Information Visualization Technologies

UNIT - V

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems
Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non- Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval

TEXT BOOK:

1. Information Storage and Retrieval Systems – Theory and Implementation, Second Edition, Gerald J. Kowalski, Mark T. Maybury, Springer

REFERENCE BOOKS:

1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms,
2. Prentice Hall, 1992.
3. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons.
4. Modern Information Retrieval By Yates and Neto Pearson Education.

Course Outcomes:

- Ability to apply IR principles to locate relevant information large collections of data
- Ability to design different document clustering algorithms
- Implement retrieval systems for web search tasks.
- Design an Information Retrieval System for web search tasks.

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023) PATTERN

RECOGNITION (Professional Elective – II)

B.Tech. III Year II Sem.   **L T P C**

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Prerequisites:

- Programming for problem solving
- Computer Oriented Statistical Methods

Course Objectives:

- Introducing fundamental concepts, theories, and algorithms for pattern recognition andmachine learning.

UNIT - I

Introduction: Pattern Recognition, Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition. Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature Extraction, Feature Selection, Evaluation of Classifier, Evaluation of Clustering.

UNIT - II

Nearest Neighbor Based Classifier: Nearest Neighbor Algorithm, Variants of the NN Algorithm, use of the Nearest Neighbor Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection. Bayes Classifier: Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with the NNC, Naïve Bayes Classifier, Bayesian Belief Network.

UNIT - III

Hidden Markov Models: Markov Models for Classification, Hidden Morkov Models, Classification using HMMs. Decision Trees: Introduction, Decision Tree for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Overfitting and Pruning, Examples of Decision Tree Induction.

B. Tech-Artificial Intelligence & Data Science –

UNIT - IV

Support Vector Machines: Introduction, Learning the Linear Discriminant Functions, Neural Networks, SVM for Classification. Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers.

UNIT - V

Clustering: Importance of clustering, Hierarchical Algorithms, Partitional Clustering, Clustering Large Data Sets. An Application-Hand Written Digit Recognition: Description of the Digit Data, Preprocessing of Data, Classification Algorithms, Selection of Representative Patterns, Results.

TEXT BOOK:

1. Pattern Recognition: An Algorithmic Approach: Murty, M. Narasimha, Devi, V. Susheela,Spinger Pub, 1st Ed.

REFERENCE BOOKS:

1. Machine Learning - Mc Graw Hill, Tom M. Mitchell.
2. Fundamentals Of Speech Recognition: Lawrence Rabiner and Biing- Hwang Juang.PrenticeHall Pub.

Course Outcomes:

- Understand the importance of pattern recognition and its representation
- Analyza the variants of NN algorithm
- Understand the necessity of Hidden markov models, decision tree and SVM for classification
- Understand different types of clustering algorithms

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

COMPUTER VISION AND ROBOTICS (Professional Elective – II)

B.Tech. III Year II Sem.   **L T P C**

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Pre-Requisites: Linear Algebra and Probability.

Course Objectives:
- To understand the Fundamental Concepts Related To sources, shadows and shading
- To understand the The Geometry of Multiple Views

UNIT - I

CAMERAS: Pinhole Cameras

Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases

Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models
Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT - II

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates
Edge Detection: Noise, Estimating Derivatives, Detecting Edges

Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

B. Tech-Artificial Intelligence & Data Science –

UNIT - III

The Geometry of Multiple Views: Two Views

Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras
Segmentation by Clustering: Segmentation, Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels,Segmentation by Graph-Theoretic Clustering,

UNIT - IV

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations
Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization

UNIT - V

Introduction to Robotics: Social Implications of Robotics, Brief history of Robotics, Attributes of hierarchical paradigm, Closed world assumption and frame problem, Representative Architectures, Attributes of Reactive Paradigm, Subsumption Architecture, Potential fields and Perception

Common sensing techniques for Reactive Robots: Logical sensors, Behavioural Sensor Fusion, Pro- prioceptive sensors, Proximity Sensors, Topological Planning and Metric Path Planning

TEXT BOOKS:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.
2. Robin Murphy, Introduction to AI Robotics, MIT Press

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REFERENCE BOOKS:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier(Academic Press), 4th edition, 2013.
2. The Robotics premier, Maja J Matari, MIT Press
3. Richard Szeliski "Computer Vision: Algorithms and Applications" Springer- Verlag LondonLimited 2011.

Course Outcomes:

- Implement fundamental image processing techniques required for computer vision
- Implement boundary tracking techniques
- Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipsedetections.
- Apply 3D vision techniques and Implement motion related techniques.
- Develop applications using computer vision techniques.

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

DATA WAREHOUSING AND BUSINESS INTELLIGENCE (Professional Elective – II)

B.Tech. III Year II Sem.   **L T P C**

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Course Objectives:

- This course is concerned with extracting data from the information systems that deal with the day-to-day operations and transforming it into data that can be used by businesses to drive high-level decision making
- Students will learn how to design and create a data warehouse, and how to utilize the process of extracting, transforming, and loading (ETL) data into data warehouses.

UNIT - I

Data Warehouse, Data Warehouse Modelling, OLAP operations, Data Qube Computation methods

UNIT - II

Business Intelligence Introduction – Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Life Cycle. Data for BI - Data Issues and Data Quality for BI.

UNIT - III

BI Implementation - Key Drivers, Key Performance Indicators and Performance Metrics, BI Architecture/Framework, Best Practices, Business Decision Making, Styles of BI-vent-Driven alerts-A cyclic process of Intelligence Creation. The value of Business Intelligence-Value driven and Informationuse.

UNIT - IV

Advanced BI – Big Data and BI, Social Networks, Mobile BI, emerging trends, Description of different BI-Tools (Pentaho, KNIME)

B. Tech-Artificial Intelligence & Data Science –

UNIT - V

Business Intelligence and integration implementation-connecting in BI systems- Issues of legality- Privacy and ethics- Social networking and BI.

TEXT BOOKS:

1. Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE KAMBER, Elsevier, 4th Edition.
2. Rajiv Sabherwal "Business Intelligence" Wiley Publications, 2012.

REFERENCE BOOKS:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and BusinessIntelligence Systems, 9th Edition, Pearson Education, 2009.
2. David Loshin, Business Intelligence - The Savy Manager's Guide Getting Onboard withEmerging IT, Morgan Kaufmann Publishers, 2009.
3. Philo Janus, Stacia Misner, Building Integrated Business Intelligence. Solutions with SQLServer, 2008 R2 & Office 2010, TMH, 2011.
4. Business Intelligence Data Mining and Optimization for decision making [Author: Carlo-Verellis] [Publication: (Wiley)]
5. Data Warehousing, Data Mining & OLAP- Alex Berson and Stephen J. Smith- Tata McGraw- Hill Edition, Tenth reprint 2007
6. Building the Data Warehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd.
7. Data Mining Introductory and Advanced topics – Margaret H Dunham, PEA.

Course Outcomes:

- Understand architecture of data warehouse and OLAP operations.
- Understand Fundamental concepts of BI
- Application of BI Key Performance indicators
- Understand Utilization of Advanced BI Tools and their Implementation.
- Implementation of BI Techniques and BI Ethics.

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

FUNDAMENTALS of AI (Open Elective – I)

B.Tech. III Year II Sem.   **L T P C**

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Course Objective:

- To learn the difference between optimal reasoning Vs human like reasoning
- To understand the notions of state space representation, exhaustive search, heuristic searchalong with the time and space complexities
- To learn different knowledge representation techniques
- To understand the applications of AI namely, Game Playing, Theorem Proving, ExpertSystems, Machine Learning and Natural Language Processing

UNIT – I

Foundations of AI: Introduction to AI, History of AI, Strong and Weak AI, The State of the Art, Risksand Benefits of AI

Philosophy, Ethics and Safety of AI: The Limits of AI, Machine thinking capability, The Ethics of AI

Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Natureof Environments, The Structure of Agents.

UNIT – II

Solving Problems by Searching: Problem – Solving Agents

Uninformed Search Strategies: Best-First Search, Breadth-First Search, Uniform-Cost Search,Depth-First Search, Iterative Deepening Search and Bidirectional Search
Informed Search Strategies: Greedy Best-First Search, A* Search

B. Tech-Artificial Intelligence & Data Science –

UNIT – III

Logical Agents: Knowledge-based agents, Propositional Logic, Propositional Theorem Proving
First-Order Logic: Syntax and Semantics of First-Order Logic

Inference in First-Order Logic: Propositional Vs. First-Order Inference, Unification and First-OrderInference, Forward Chaining, Backward Chaining

Knowledge Representation: Ontological Engineering, Categories and Objects, Events

UNIT – IV

Quantifying Uncertainty: Basic Probability Notation, Inference Using Full-Joint Distributions,Independence, Bayes' Rule and its Use, Naive Bayes Models
Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The semantics ofBayesian Networks, Exact Inference in Bayesian Networks

UNIT – V

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, ModelSelection, Linear Regression and Classification, Ensemble Learning **Natural Language Processing:** Language Models, Grammar, Parsing, Complications of Real NaturalLanguage, Natural Language Tasks

Robotics: Robots, Robot Hardware, Kind of Problems solved, Application Domains
Computer Vision: Simple Image Features, Using Computer Vision

TEXT BOOKS:

1. "Artificial Intelligence a Modern Approach", Fourth Edition, Stuart J. Russell & Peter Norvig – Pearson

B. Tech-Artificial Intelligence & Data Science –

REFERENCE BOOKS:

1. "Artificial Intelligence", Elaine Rich, Kevin Knight & Shivashankar B Nair – McGraw Hill Education.
2. Artificial Intelligence, 3rd Edn, E. Rich and K. Knight (TMH)
3. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
4. Artificial Intelligence, Shivani Goel, Pearson Education.
5. Artificial Intelligence and Expert systems – Patterson, Pearson Education

Course Outcomes:

- Gain the knowledge of what is AI, risks and benefits of AI, limits of AI and the ethics involvedin building an AI application.
- Understand the nature of environments and the structure of agents.
- Possess the ability to select a search algorithm for a problem and characterize its time andspace complexities.
- Possess the skill for representing knowledge using the appropriate technique
- Gain an understanding of the applications of AI

B. Tech-Artificial Intelligence & Data Science –

GURU NANAK INSTITUTIONS TECHNICAL CAMPUS (AUTONOMOUS)

SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE
COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023) MACHINE

LEARNING BASICS (Open Elective – I)

B.Tech. III Year II Sem.   **L T P C**

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Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques

UNIT - I

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

Multi-layer Perceptron– Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation

UNIT - III

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms

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UNIT - IV

Support Vector Machines

Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

UNIT - V

Reinforcement Learning – Overview – Getting Lost Example

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo

– Hidden Markov Models

TEXT BOOKS:

1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective,
   Second Edition, Chapman and Hall/CRC Machine Learning and Pattern
   Recognition Series, 2014.

REFERENCE BOOKS:

1. Tom M Mitchell, ―Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make
   Sense of Data‖,First Edition, Cambridge University Press, 2012.
3. Jason Bell, ―Machine learning – Hands on for Developers and Technical
   Professionals‖, FirstEdition, Wiley, 2014
4. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation
   and MachineLearning Series), Third Edition, MIT Press, 2014

Course Outcomes:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Understand algorithms for building classifiers applied on datasets of non-
  linearly separableclasses
- Understand the principles of evolutionary computing algorithms
- Design an ensembler to increase the classification accuracy

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COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023)

MACHINE LEARNING LAB

B.Tech. III Year II Sem.   **L T P C**
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Course Objective:

- The objective of this lab is to get an overview of the various machine learning techniques andcan demonstrate them using python.

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 BOOK:

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

Course Outcomes:

- Understand modern notions in predictive data analysis
- Select data, model selection, model complexity and identify the trends
- Understand a range of machine learning algorithms along with their strengths andweaknesses
- Build predictive models from data and analyze their performance

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GURU NANAK INSTITUTIONS TECHNICAL CAMPUS (AUTONOMOUS) SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE
COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023) BIG

DATA ANALYTICS LAB

B.Tech. III Year II Sem.   **L T P C**

                                                    0 0 3 1.5

Course Objectives

- Provide knowledge of Big data Analytics principles and techniques.
- Designed to give an exposure of the frontiers of Big data Analytics

List of Experiments

1. Create a Hadoop cluster
2. Implement a simple map-reduce job that builds an inverted index on the set ofinput documents (Hadoop)
3. Process big data in HBase
4. Store and retrieve data in Pig
5. Perform data analysis using MongoDB
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

TEXT BOOKS:

1. Big Data Analytics, Seema Acharya, 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.

B. Tech-Artificial Intelligence & Data Science –

REFERENCE BOOKS:

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.

Course Outcomes

- Use Excel as an Analytical tool and visualization tool.
- Ability to program using HADOOP and Map reduce
- Ability to perform data analytics using ML in R.
- Use MongoDB to perform data analytics

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GURU NANAK INSTITUTIONS TECHNICAL CAMPUS (AUTONOMOUS) SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE
COURSE STRUCTURE
(Applicable for the Batch admitted from 2022-2023) UI

DESIGN-FLUTTER

B.Tech. III Year II Sem.   **L T P C**

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Course Objectives:

- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widges and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data

List of Experiments: Students need to implement the following experiments

1. a) Install Flutter and Dart SDK.
   b) Write a simple Dart program to understand the language basics.

2. a) Explore various Flutter widgets (Text, Image, Container, etc.).
   b) Implement different layout structures using Row, Column, and Stack widgets.

3. a) Design a responsive UI that adapts to different screen sizes.
   b) Implement media queries and breakpoints for responsiveness.

4. a) Set up navigation between different screens using Navigator.
   b) Implement navigation with named routes.

5. a) Learn about stateful and stateless widgets.
   b) Implement state management using set State and Provider.

6. a) Create custom widgets for specific UI elements.
   b) Apply styling using themes and custom styles.

7. a) Design a form with various input fields.
   b) Implement form validation and error handling.

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8. a) Add animations to UI elements using Flutter's animation framework.
    b) Experiment with different types of animations (fade, slide, etc.).

9. a) Fetch data from a REST API.
    b) Display the fetched data in a meaningful way in the UI.

10. a) Write unit tests for UI components.
    b) Use Flutter's debugging tools to identify and fix issues.

TEXT BOOK:

1.Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.

Course Outcomes:

- Implements Flutter Widgets and Layouts
- Responsive UI Design and with Navigation in Flutter
- Create custom widgets for specific UI elements and also Apply styling using themes and custom styles.
- Design a form with various input fields, along with validation and error handling
- Fetches data and write code for unit Test for UI components and also animation

B. Tech-Artificial Intelligence & Data Science –