Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

(An Autonomous Institute)

Faculty of Science and Technology

Board of Studies

Artificial Intelligence and Data Science

Syllabus

Second Year B. Tech.
Artificial Intelligence and Data Science

(w.e.f. AY: 2025-26)

Syllabus: Second Year (SY B. Tech.) Artificial Intelligence and Data Science

w.e.f. AY:2025-2026

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credit Scheme			
		TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
AI24201	Data Structure	03	02	-	10	30	60	-	30	-	130	03	01	-	04
AI24202	Network of Things	03	02	-	10	30	60	-	30		130	03	01	-	04
AI24203	Discrete Mathematics	02	-	02	10	-	60	30	-		100	02	-	01	03
MD24051	Multi-disciplinary minor	03	02	-	10	30	60	30	-	-	130	03	01	-	04
OE240XX	Open Elective	02	-	-	10	-	60	-	-	-	70	02	-	-	02
HS24211	Environmental Studies	02	-	-	10	-	60	-	-	-	70	02	-	-	02
HS24201	Public Speaking And Aptitude	01	02	-	10	-		30		30	70	01	01	-	02
Total		**16**	**08**	**02**	**70**	**90**	**360**	**90**	**60**	**30**	**700**	**16**	**04**	**01**	**21**

Course Code	Course Name	Semester-IV													
		Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
BS24201	Advanced Statistics and Numerical Method	03	-	-	10	30	60	-	-	-	100	03	-	-	**03**
AI24211	Data Science	03	02	-	10	30	60	-	30	-	130	03	01	-	**04**
AI24212	Database Management System	03	02	-	10	30	60	-	30	-	130	03	01	-	**04**
AI24213	Operating System	03	02	-	10	30	60		30	-	130	03	01	-	**04**
AI24214	Community Engineering Project	-	04	-	10	-		30	-	30	70	-	02	-	**02**
MD24051	Multi-disciplinary minor	02	02	-	10	-	60	30	-	-	100	02	01	-	**03**
AI24215	VSEC		02	01	10	-	-	30	30	-	70	-	01	01	**02**
Total		**14**	**14**	**01**	**70**	**120**	**300**	**90**	**120**	**30**	**730**	**14**	**07**	**01**	**22**

Dept. Autonomy Coordinator
Mrs. R. S. NaiK

Dept. Academic Coordinator
Mr. P.N. Shendage

HOD, AI&DS
Dr. C.S. Kulkarni

Dean Autonomy
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Semester-I

Vidya Pratishthan's **Kamalnayan Bajaj Institute of Engineering and Technology, Baramati** **(Autonomous Institute)**		
AI24201- Data Structures		
Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks:10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Programming and Problem Solving

Course Objectives:

- To develop logical ability to solve the problems in time efficient way
- To use appropriate data structures and algorithms while solving a problem
- To do the theoretical analysis of the problem to be solved
- To understand the advanced data structures while solving complex problems
- To understand the standard and abstract data representation methods

Course Outcomes (COs): The students will be able to:
CO1: Design an algorithm for searching and sorting algorithms and do the time and space analysis
CO2: Apply basic data structures for solving a problem like expression evaluation
CO3: Develop an algorithm for efficient operations with linear data structures
CO4: Design and **Develop** algorithmic solutions with nonlinear data structures for time and space efficiency
CO5: Discriminate the usage of different nonlinear data structures for lowering the upper bound
CO6: Apply nonlinear data structures to solve the computationally complex problems

Course Contents

Unit I: Introduction to Algorithms and Complexity Theory (08 Hours)
Searching: linear and binary search algorithm. Searching using key-value in a sequence of records. Insertion, bubble, selection sort algorithms. Sort algorithms on a sequence of records using specified keys. Comparative analysis of various searching and sorting algorithms. Time Complexity Analysis. Characteristics of an algorithm. Analyzing programs. Frequency count. Time and space complexity. Big 'O' 'Ω, Θ, notation. Best, average and worst cases. Recurrence relations, Solving recurrence relations with Master Method

Unit II:Basic Data Structures (07 Hours)
Stacks and Queues: Stack and queue as ADT. Operations on stack and queue. Implementations using arrays and dynamic memory allocation. Application of stack for expression evaluation, expression conversion. Implementation of stack using queue and vice versa. Recursion and stacks. Problems like maze and knight's tour

Unit III: Linked Data Structures (07 Hour)
Linked List- Singly Linked List(SLL), Stack as SLL, Queue as SLL, Doubly Linked List, Circular Singly Linked List, finding a cycle in SLL, Operations on linked lists: insert, delete, traverse, search etc. Applications of linked list: Representation & manipulations of polynomials/sets using linked list concept

Unit IV: Trees (08 Hour)

Basic terminology. Binary Tree: Properties of a Binary Tree, ADT Binary trees and its representations, concept of Non- Linear Data Structures, Difference between Linear and Nonlinear data structure, Binary tree traversals (recursive and non-recursive) and various operations. Binary Search Tree(BST): Properties, Insertion and deletion of nodes. Complexity Analysis of all operations, Threaded BST

Unit V: Heaps (05 Hours)

Priority queues and Heap: Priority Queues. Max and Min Heap. Operations on heap, Heapsort. Applications of trees. AVL Trees: Introduction, Properties, Balance Factor, Operations like insert, rotate and delete, Red Black Trees: Properties, Operations like insert, delete and rotate

Unit VI: Graphs (05 Hours)

Representation of graphs using adjacency matrix, adjacency list. Implementation of algorithms for traversals; implementing Kruskal's or Prim's or Single source shortest paths using Dijkstra's algorithm. Applications of graphs for problems like shortest path on a map

Text Books:

1. "Fundamentals of Data Structures in C", E. Horowitz, S. Sahni, S. Anderson-freed, Second Edition, 2008, University Press, ISBN 978-81-7371-605-8
2. "Fundamentals of Data Structures in C++", Ellis Horowitz, S. Sahni, D. Mehta, 2nd Edition, 2008, University Press, ISBN-10: 8173716064
3. "An introduction to data structures with Applications", Jean-Paul Tremblay, Paul. G. Soresan, 2nd Edition, 1984, Tata Mc-Graw Hill International Editions, ISBN-0-07-462471- 7

Reference Books:

1. Peter Brass, "Advanced Data Structures", Cambridge University Press, ISBN: 978-1-10743982-5
2. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms", Pearson Education, 1998, ISBN-0-201-43578-0.

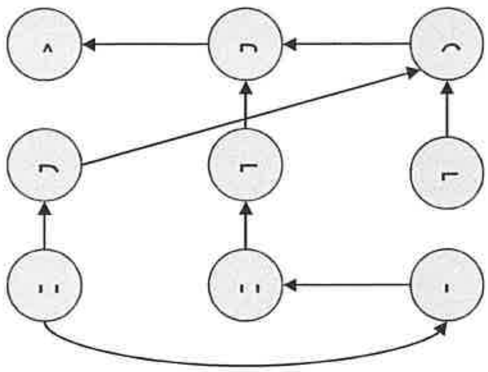
E-Resources:

1. **https://nptel.ac.in/courses/106102064_**
2. **https://archive.nptel.ac.in/courses/106/106/106106127/**
3. **https://onlinecourses.nptel.ac.in/noc22_cs26/preview**

List of Assignments

1. The mathematical expression, with operator precedence to be solved by computer, is given in infix form, convert it to the postfix form to make your computer understand the precedence and solve the expression.
2. Implement a knight tour of NxN size boards using stack as a data structure to keep track of the visited places.
3. A circular linked list, where the last node points to the first node, a mischievous guy disturbed the list and the last node points to the intermediate node. Write a program to find the intermediate node where last node points also correct the list and print

4. There is k sorted linked lists, each contains n elements, your task is to merge the linked list and return the single sorted linked list in O(nklogk) time
5. Write a program to construct a Binary Search Tree(BST) and find the post order predecessor of given key with a guarantee of preserving the worst case running time O(logn)
6. Write a non-recursive version of finding the least common ancestor(LCA) of any two nodes in the binary search tree and optimize your non recursive search by balancing the tree.
7. Write a program to convert any binary search tree to min heap as a complete binary tree, each node holding a higher than its parent, make a note of not exceeding the O(n) time.
8. The grid of 8x8 size, in which a mouse is located at 1x1 and needs to reach an 8x8 place, finds out the possible unique paths from its own location.
9. Priorities of the processes to be executed in computer are represented in following graph,



Construct the max heap for above represented graph and display the sequence of the executing the processes

10. Write a program to prepare a shortest path tour, in which it visits all the nodes only once except the starting node. You may represent a graph in terms of adjacency matrix storing non zero non negative values at $i \neq j$ if there exists a path.

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AI24202: Network of Things

Teaching Scheme:	Credits	Examination Scheme:
Theory: 3 Hours/Week Practical: 2 Hour/Week	04	Activity Marks: 10 Marks In Sem: 30 Marks End Sem: 60 Marks Practical: 30 Marks

Prerequisites: Programming and Problem Solving

Course Objectives:
- To understand the basic digital electronics and microprocessors.
- To understand the definition and significance of the Internet of Things.
- To gain a comprehensive understanding of various sensors, actuators and the fundamentals of IoT system development using Arduino and Raspberry Pi.
- To introduce the basic fundamentals of big data, data analytics and cloud computing.
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies.

Course Outcomes (COs): The students will be able to:

CO1: Have a thorough understanding of the structure, function and characteristics of computer systems and understand the structure of various number systems and its application in digital design.

CO2: Explain the concept of internet of things and identify the technologies that make up the internet of things.

CO3: Identify and describe different types of sensors, actuators and also develop the IoT applications using Arduino and RaspberryPi.

CO4:Analyze trade-offs in interconnected wireless embedded device networks. Select Appropriate protocols for IoT Solutions.

CO5: Explain the basics concept of Bigdata ,data analytics and cloud computing and its use in IoT

CO6: Identify the application of IoT in automation of commercial and real world examples

Course Contents

Unit I: Fundamentals of Computer Organization & Digital Electronics (07 Hours)
Basic organization of computers & computer Function, classification micro, mini, mainframe and super computer, system bus, I-Cycle, interrupt and class of interrupts, number systems, number conversion, 1's & 2's complement, introduction of microprocessor & microcontroller.

Unit II: Introduction of Internet of Things (06 Hours)
Introduction, definitions & characteristics of IoT, IoT architectures, Challenges, physical & logical design of IoT, Enabling Technologies in IoT, IoT decision framework, Asset management, IoT connectivity and management, Applications of IoT.

Unit III: IoT Physical Devices and Endpoints(06 Hours)
Definition, types of sensors, types of actuators, examples and working, building IoT with Arduino: Arduino–Interfaces-Arduino IDE–Programming. RaspberryPi: Introduction, about the RaspberryPi board: hardware layout, operating systems, and configuration. Programming RaspberryPi with Python.

Unit IV: IoT Systems, Network and Protocols(06 Hours)
Study of RFID, Types of RFID, Wireless networks; wireless Sensor Networking (WSN); cellular Machine-to Machine (M2M) application networks; computer connected to internet; network devices; Device configuration and management; exchange information in real time without human intervention; IoT Protocols, IoT Security & IoT Communication.

Unit V: Data Handling& Analytics: (06 Hours)
Introduction of bigdata, 3V's, Types of data, characteristics of big data, data handling technologies, Flow of data, data acquisition, data storage, introduction to hadoop. Introduction to data Analytics, types of data analytics, Introduction to cloud computing: definition, characteristics, deployment

model. Interfacing of NODEMCU with cloud database.

Unit VI: IOT Applications (06 Hours)

IoT Verticals; IoT Hosted Services; IoT Application development, IoT Software providers; Review of various IoT application domains including agriculture, healthcare, manufacturing, device management, and vehicle to vehicle communication and wearable computing devices.

Text Books:

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.
2. Olivier Hersent, David Boswarthick,
Omar Elloumi , "The Internet of Things: Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0

Reference Books:

1. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017
2. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345 3.
3. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014, ISBN: 978-1- 118-43063-7

E-Resources:

1. **https://onlinecourses.nptel.ac.in/noc22_cs53/preview**

List of Assignments

1. Study of Raspberry-Pi/ Beagle board/ Arduino and other microcontroller
2. Write a program using Arduino to control LED (One or more ON/OFF). Or Blinking
3. Create a program that illuminates the green LED if the counter is less than 100, illuminates the yellow LED if the counter is between 101 and 200 and illuminates the red LED if the counter is greater than 200
4. Create a program so that when the user enters 'b' the blue light blinks, 'g' the green light is illuminated 'y' the yellow light is illuminated and 'r' the red light is illuminated
5. Write a program that asks the user for a number and outputs the number squared that is entered.
6. Write a program to control the color of the LED by turning 3 different potentiometers. One will be read for the value of Red, one for the value of Green, and one for the value of Blue.
7. Understanding the connectivity of Raspberry-Pi /Beagle board circuit / Arduino with IR sensor. Write an application to detect obstacle and notify user using LEDs
8. Write an application to detect gas leakage and notify user using LEDs/buzzer
9. Write an application to detect soil moisture and notify user using LEDs/buzzer
10. Write a program using piezo element and use it to play a tune after someone knocks

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AI24203-Discrete Mathematics

Teaching Scheme:	Credits	Examination Scheme:
Theory: 2 Hours/Week **Tutorial: 2 Hours/Week**	**03**	**Activity: 10 Marks** **Term-Work: 30 Marks** **End-Sem Exam: 60 Marks**

Prerequisites: Basic Mathematics

Course Objectives:

- To provide students with a solid foundation in the theory and principles of discrete mathematics, including logic, set theory, combinatorics, and graph theory.
- To equip students with the necessary tools and techniques for solving problems related to artificial intelligence and data science, such as algorithm design, complexity analysis, and probability theory.
- To develop students' critical thinking and problem-solving skills through the application of discrete mathematics to real-world problems in artificial intelligence and data science.
- To prepare students for advanced courses in artificial intelligence, machine learning, and data science by laying a strong mathematical foundation in discrete mathematics

Course Outcomes (COs): The students will be able to learn:

CO1: Apply set theory concepts and propositional logic to solve problems involving set operations, logical expressions, and mathematical induction.

CO2:.Analyze relations and functions, and evaluate their properties, including equivalence relations and partial orderings.

CO3: Use counting principles, permutations, combinations, and binomial coefficients, to solve complex counting problems and derive combinatorial identities.

CO4: Apply graph and tree algorithms, including shortest paths, spanning trees, and Huffman coding, to solve related problems.

Course Contents

Unit I: Set Theory and Logic (06 Hours)

Sets- Naïve Set Theory (Cartesian Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principles of inclusion and exclusion. Types of Sets- Bounded and unbounded sets, Countable and uncountable sets, Finite and infinite sets, Countably infinite and uncountably infinite sets, Power set. Propositional Logic- logic, Propositional equivalences, Normal Forms, Application of propositional logic- Translating English sentences, Proof by mathematical induction.

Unit II: Relations and Functions (06 Hours)

Relations and their properties, n-ary relations and their applications, representing relations, closures of relations, equivalence relations, Partial orderings, Partitions, Hasse Diagram, Lattices, Chains and Anti-chains, Transitive closure and Warshall's algorithm.

Functions- Subjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and compositions of functions,

Unit III: Counting Principles (06 Hour)

The Basics of Counting, Rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations.

Unit IV: Graph and Trees (06 Hour)

Graph Terminologies, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, The Handshaking lemma, Single Source Shortest Path-Dijkstra's Algorithm, Planar Graphs and Graph Coloring, Introduction to Trees, Binary Search Tree, Tree Traversal, Decision Tree, Prefix Codes and

Huffman Coding, cut sets, Spanning Trees and Minimum Spanning Trees, Kruskal's and Prim's Algorithm, The Max Flow-Min Cut Theorem (Transport Network).

Text Books:

1. C. L. Liu, "Elements of Discrete Mathematics", TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8

Reference Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw-Hill, ISBN 978-0-07-288008-3
2. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures", Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.

E-Resources:

1. **https://archive.nptel.ac.in/courses/106/106/106106183/**
2. **https://archive.nptel.ac.in/courses/106/105/106105192/**
3. **https://archive.nptel.ac.in/courses/106/103/106103205/**

HS24211: Environmental Studies		
Teaching Scheme: **TH: 02 Hrs/Week**	**Credits:02**	**Examination Scheme:** **Course Activity: 10 Marks** **End-Semester Exam: 60 Marks**

Prerequisites:

Fundamentals of the environment.

Course Objectives:

1. Understand the fundamental concepts of environmental science and its relevance to engineering.
2. Analyze the environmental impact of various engineering industries.
3. Learn about sustainable engineering practices, pollution control, and waste management.
4. Study environmental laws in India and global initiatives for environmental conservation.

Course Outcomes

On completion of the course, learner will be able to:

CO-1: Understand the components of the environment and types of energy resources.

CO-2: Analyze the impact of engineering industries on the environment.

CO-3: Learn sustainable engineering solutions for mitigating environmental damage.

CO-4: Aware of Indian and global initiatives for environmental protection.

Course Contents

Unit I: Introduction to Environmental Studies **(6 Hrs)**

Importance of Environmental Studies, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere, Ecosystems and Biodiversity: Types, Importance, and Conservation, Sustainable Development Goals (SDGs) and Role of Engineers in Sustainability, Renewable and Non-Renewable Resources, Water Resources: Overuse, Pollution, and Engineering Solutions, Energy Resources: Fossil Fuels, Nuclear Power, and Renewable Energy Alternatives, Land Resources: Soil Degradation, Deforestation, and Urbanization.

Unit II: Impact of Engineering Industries on Environment **(7 Hrs)**

Manufacturing & Automobile Industry: Air pollution, Carbon emissions, Waste disposal, Chemical & Pharmaceutical Industry: Water and soil contamination, Hazardous waste, Construction & Infrastructure: Land degradation, Dust pollution, Waste generation,

- Central Pollution Control Board (CPCB) Reports (Website)

List of Activities for reference:

Perform any two activities of the following.

1. **Ecosystem Study Report** – Visit a local park, water body, or forested area and document its ecosystem components (flora, fauna, food chains).
2. **Sustainability Case Study** – Choose one of the Sustainable Development Goals (SDGs) and prepare a report on its implementation in India.
3. **Renewable vs. Non-Renewable Resources** – Prepare a comparative chart listing sources, usage, and sustainability factors.
4. **Water Conservation Survey** – Conduct a survey in your neighborhood or campus to assess water consumption and suggest conservation strategies.
5. **Industrial Impact Assessment** – Select an engineering industry (automobile, chemical, IT, etc.) and analyze its environmental impact.
6. **Carbon Footprint Calculation** – Calculate the carbon footprint of your daily activities (electricity, transportation, food, etc.) and suggest ways to reduce it.
7. **Climate Change Awareness Video** – Create a short video (2–3 min) explaining global warming and its impact.
8. **Case Study on Pollution Control Failures** – Research a real-world incident of industrial pollution (e.g., Bhopal Gas Tragedy, Minamata Disease) and analyze the causes and consequences.
9. **Waste Management Audit** – Conduct a waste audit in your college or home, classify the waste generated, and propose a waste management plan.
10. **E-Waste Collection Drive** – Organize a drive to collect and safely dispose of e-waste in your locality. Submit a report on the amount collected and its disposal method.
11. **Renewable Energy Model** – Create a working or conceptual model of a solar panel, wind turbine, or biomass plant.
12. **Green Building Analysis** – Identify a green building in your city (or college) and analyze its energy-efficient features.
13. **Report on National Environmental Policies** – Summarize key environmental laws in India and their effectiveness.
14. **International Climate Agreements Presentation** – Prepare a presentation on major agreements like the Paris Agreement, Kyoto Protocol, and their impact on India.
15. **NGO/CSR Initiative Study** – Research an NGO or corporate social responsibility (CSR) initiative focused on environmental protection and prepare a report.
16. **Swachh Bharat Implementation Review** – Visit a local area, document cleanliness conditions, and suggest improvements under Swachh Bharat Abhiyan.

PUBLIC SPEAKING AND APTITUDE	
Course Code: HS24201	**Credits:** 2:0:0
	Contact Hours: TH(1) PR(2)

Unit 1: Spoken English **(4 Hours)**

Pre-Assessment, Vocabulary made easy, the Power of Words, Introduction to Word Accent, Introduction to Rhythm: Intonation, Rising Intonation, Falling Intonation, Introduction & Specific scenarios: Telephone Skills: Taking & Making Calls, Voice, Intonation, and Language, Conversations: The Role of Questions

Unit 2: Impactful Presentations: **(4 Hours)**

Body Language: Introduction, Mechanics and Style
Voice Modulation: Voice Projection, replacing Fillers, and Emphasis
Power of Pause: Pause to engage audience in Conversation, Combine Pause & Repetition Techniques, Demonstrate Confidence & Control, establish Presence
Empathy: Essential Human Quality, Practice Heartful Communication, Impact of Communication, How to deliver memorable speech.

Unit 3: General Aptitude for all Competitive Exams **(6 Hours)**

Quantitative Aptitude
Data interpretation; data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.
Analytical Aptitude
Logic: deduction and induction, Analogy, Numerical relations and reasoning.
Spatial Aptitude
Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping paper folding, cutting, and patterns in 2 and 3 dimensions.

Textbooks

1. **"A Course in Phonetics and Spoken English"** – T. Balasubramanian
2. **"Effective Technical Communication"** – M. Ashraf Rizvi
3. **"Quantitative Aptitude for Competitive Examinations"** – R.S. Aggarwal

Reference Books

1. **"High School English Grammar & Composition"** – Wren & Martin
2. **"How to Speak, How to Listen"** – Mortimer J. Adler
3. **"Logical and Analytical Reasoning"** – A.K. Gupta

NPTEL Course:
1. **Mastering Speaking and Presentations: A case Based Approach** by Prof. Seema Singh, IIT Kharagpur **https://onlinecourses.nptel.ac.in/noc25_hs96/preview**

PUBLIC SPEAKING AND APTITUDE (Lab)	
Course Code: HS24201	**Credits:** 2:0:0
	Contact Hours: TH(1) PR(2)

Lab Session Plan

Session 1: Vocabulary & Word Accent Mastery

- Pre-Assessment: Conduct a quick spoken test to evaluate pronunciation and fluency.
- Vocabulary exercises using flashcards & interactive word-building games.

Session 2: Intonation & Rhythm in Speech

- Introduction to rising and falling intonation with examples.
- Roleplay exercises for practicing intonation in different scenarios (expressing surprise, asking questions, etc.).
- Rhythm practice: Reading passages with proper pauses and stress patterns.

Session 3: Telephone Skills & Professional Conversations

- Practicing making and taking calls with simulated dialogues.
- Focus on voice modulation, clarity, and polite expressions.

Session 4: Body Language & Stage Presence

- Mirror exercises to improve facial expressions and gestures.
- Practicing posture, movement, and eye contact while speaking.

Session 5: Voice Modulation & Power of Pause

- Exercises on voice projection and eliminating fillers.
- Practicing pauses strategically to enhance speech impact.
- Repetition and emphasis techniques using speech excerpts.

Session 6: Empathy & Heartfelt Communication

- Interactive storytelling to practice emotional connection.
- Exercises on active listening and empathetic responses.
- Speech practice: delivering a short talk with an emotional appeal.

Session 7: Quantitative Aptitude – Data Interpretation & Computation

- Solving numerical problems based on bar graphs, pie charts, and tables.
- Quick estimation exercises using ratios, percentages, and logarithms.
- Group challenges on permutations and combinations.

Session 8: Analytical Aptitude – Logical & Numerical Reasoning

- Deduction and induction puzzles.
- Solving analogy-based reasoning questions.
- Speed tests for numerical relations and reasoning.

Session 09: Spatial Aptitude – Shape & Pattern Recognition

- Hands-on paper folding and cutting exercises.
- Visualization tasks for rotation, scaling, and mirroring of shapes.
- Solving pattern-based problems in 2D and 3D space.

Session 10 : Mock test from online test series of companies like TCS, Infosys employability tests like CoCubes, AMCAT etc.

Dr. Anil Patil

Semester-II

BS24201- Advanced Statistics and Numerical Methods		
Teaching Scheme: **Theory: 3 Hours/Week**	**Credits** **03**	**Examination Scheme:** **Course Activity: 10 Marks** **In-Semester: 30 Marks** **End-Semester: 60 Marks** **Total: 100 Marks**

Prerequisites:

Basics of Statistics, Data Types, Measures of Central Tendency, Probability Theory. Conditional Probability, Bayes Theorem, Basics of Numerical Methods.

Course Objectives:

To make the students familiarize with concepts and techniques in Statistics and Probability Theory. The aim is to equip them with the techniques to understand advanced levels of mathematics, statistics and their applications that would enhance thinking and logical power, useful in their disciplines.

Course Outcomes (COs): The students will be able to learn:

CO1: Understand the concepts of dispersion, skewness and kurtosis, and use them to analyze a given data.

CO2: Understand and apply the theory of correlation and regression analysis for data predictions.

CO3: Classify various discrete probability distributions and apply them to analyze a particular data set.

CO4: Develop basic concepts of continuous probability distributions and use them in their field.

CO5: Learn the concepts of various sampling tests, the null and the alternative hypotheses useful for analyzing the population(s) under study.

CO6: Compute Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

Course Contents

Unit I: Measures of Dispersion, Moments, Skewness and Kurtosis (07 Hours)

Measures of Dispersion: Dispersion, Characteristics for an Ideal Measure of Dispersion, Range, Coefficient of Range, Quartile Deviation, Coefficient of Quartile Deviation, Mean Deviation about Mean, Variance, Standard Deviation and Coefficient of Variation.

Moments: Moments about an arbitrary value, Raw moments, Central Moments, Skewness and Kurtosis.

Unit II: Correlation and Regression (07 Hours)

Bivariate Data, Scatter Diagram, and Association between two variables, Correlation, Karl Pearson's coefficient of correlation, Regression: Regression lines, properties, Curve fitting: fitting of straight line, parabola and related curves.

Unit III: Probability and Discrete Probability Distributions (07 Hours)

Probability, Theorems on Probability, Random variables, Discrete Random variable: Probability mass function, Mathematical Expectation, Discrete Probability distributions: Binomial, Poisson, Poisson approximation to Binomial distribution.

Unit IV: Continuous Probability Distributions (07 Hours)

Continuous Random variable: Probability density function, properties, Mathematical Expectation, Continuous Probability distributions: Uniform distribution, Exponential distribution, Gaussian/Normal distribution, Chi-square distribution.

Unit V: Inferential Statistics: Tests For Hypothesis (07 Hours)

Statistical Hypothesis: Simple and Composite, Test of a Statistical Hypothesis, Critical Region, Two Types of Errors, Level of Significance, Power of the Test, Large Sample Tests: Test for Mean of a single Population, Test for the Equality of two Populations Means, Chi-square test for Goodness of fit.

Unit VI: Numerical Methods (07 Hours)

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formula, Numerical Differentiation.

Numerical Integration: Trapezoidal and Simpson's rules.

Solution of Ordinary differential equations: Runge-Kutta 4th order method.

Books and Other Resources

Reference Books:

1. Glen Cowan, "Statistical Data Analysis", University Of Siegen, Clarendon Press, Oxford, 1998, ISBN: 0198501552.
2. Ken Black, "Applied Business Statistics", Wiley, 7th Edition, ISBN: 9788126537075
3. Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor (Sultan Chand & Sons)
4. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press.
5. M. K. Jain, S. R. K. Iyengar And R. K. Jain1, "Numerical Methods for Scientific and Engineering Computation", 5e, New Age International Publication.

E-Books:

1. NIST/SEMATECH e-Handbook of Statistical Methods
2. Elements of Statistical Learning: data mining, inference, and prediction. 2nd Edition. (su.domains)

Course Coordinator | PAC Member 1 | PAC Member 2 | Dept. Autonomy Coordinator | BoS Chairman

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AI24211- Data Science

Teaching Scheme:	Credits	Examination Scheme:
Theory: 3 Hours/Week **Practical: 2 Hour/Week**	**04**	**Activity Marks:10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Discrete Mathematics

Course Objectives:

- To understand the need of Data Science.
- To understand computational statistics in Data Science
- To study and understand data analytics through machine learning algorithms
- To be conversant with time series analytics
- To learn model evaluation techniques
- To empower students with visualization tools and techniques used in data science

Course Outcomes (COs): The students will be able to:

CO1: Apply data pre-processing techniques
CO2: Apply statistics for Data Analytics
CO3: Implement Data Analytics using basic machine learning algorithms
CO4: Implement basic time series analysis techniques
CO5: Analyze and Apply evaluation techniques for the model
CO6: Implement data visualization using visualization tools in Python programming

Course Contents

Unit I: Introduction to Data Science (06 Hours)

Basics and need of Data Science, Applications of Data Science, Relationship between Data Science and Information Science, Business intelligence versus Data Science, Data: Data Types, Data Collection. Data Wrangling, Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Data Discretization.

Unit II: Statistical Inference (06 Hours)

Need of statistics in Data Science, Measures of Central Tendency: Mean, Median, Mode, Mid-range. Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation. Bayes theorem, Basics and need of hypothesis and hypothesis testing, Pearson Correlation, Sample Hypothesis testing, Chi-Square Tests, t-test.

Unit III: Predictive Data Analytics with Python (06 Hour)

Data Analytic Lifecycle, Analytics Types: Predictive, Descriptive and Prescriptive. Supervised, Unsupervised learning. Regression: Linear Regression, Logistic Regression. Classification: Naïve Bayes, Decision Trees, SVM. Introduction to Scikit-learn, Installations, Dataset, mat plotlib, filling missing values, Regression and Classification using Scikit-learn.

Unit IV: Forecasting and Time series Analysis (06 Hour)

Time Series Analysis vs Forecasting, Time Series Analysis-components, data types, stationarity and non-stationarity, Moving Average Methodology, Time series analysis using data science and machine learning, Auto-Regressive model: understanding ARMA and ARIMA.

Unit V: Model Evaluation and Selection (06 Hours)

Metrics for Evaluating Classifier Performance, Holdout Method, cross validation and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation, Metrics, Confusion matrix, sensitivity, specificity, precision, recall, F-measure, AUC-ROC Curves, Elbow plot.

Unit VI: Data Visualization (06 Hours)

Introduction to Data Visualization, Types of data visualization, Data Visualization Techniques, Tools used in Data Visualization, Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization, Data Visualization using Python: Line plot, Scatter plot, Histogram, Density plot, Box- plot, Bar plot, Pie chart, Heatmap, etc..

Text Books:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC Education services, Wiley publication, 2012, ISBN0-07-120413-X.
2. Jaiwei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
3. Thomas Nield, "Essential Math for Data Science", O'Reilly Media Inc., October 2022, ISBN: 9781098102869

Reference Books:

1. EMC Education Services, "Data Science and Big Data Analytics - Discovering, analyzing, visualizing and Presenting Data" 1st Edition Phil Hanna, JSP : Complete Reference, TATA McGraw-Hill Company
2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition.
3. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, (2020), ISBN: 978-1-108-47244-9
4. Wes McKinney, "Python for Data Analysis", O'Reilly media, ISBN: 978-1-449-31979-3
5. Trent Haunk, "Scikit-learn Cookbook", Packt Publishing, ISBN: 9781787286382

E-Resources:

1. **https://archive.nptel.ac.in/courses/106/106/106106179/**
2. **https://archive.nptel.ac.in/courses/106/106/106106212/**
3. **https://archive.nptel.ac.in/courses/106/105/106105174/**
4. **https://www.analyticsvidhya.com/blog/2021/10/a-comprehensive-guide-to-time-series-analysis/**

List of Assignments (Any 10)

1. Data Wrangling, I Perform the following operations using Python on any open source dataset
    1. Import all the required Python Libraries.
    2. Locate open source data from the web (e.g., https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site).
    3. Load the Dataset into pandas dataframe.
    4. Data Preprocessing: check for missing values in the data using pandas isnull(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc. Check the dimensions of the data frame.
    5. Data Formatting and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions.
    6. Turn categorical variables into quantitative variables in Python.

2. Data Wrangling II Create an "Academic performance" dataset of students and perform the following operations using Python.
    1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them.
    2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them.
    3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and

convert the distribution into a normal distribution.

3. Descriptive Statistics - Measures of Central Tendency and variability Perform the following operations on any open source dataset (e.g., data.csv)
    1. Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. For example, if your categorical variable is age groups and quantitative variable is income, then provide summary statistics of income grouped by the age groups. Create a list that contains a numeric value for each response to the categorical variable.
    2. Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of 'Iris-setosa', 'Iris-versicolor' and 'Iris-versicolor' of iris.csv dataset. Provide the codes with outputs and explain everything that you do in this step.

4. Data Analytics I
    1. Create a Linear Regression Model using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). The Boston Housing dataset contains information about various houses in Boston through different parameters.

5. Data Analytics II
    1. Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset.
    2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset

6. Data Analytics III
    1. Implement Simple Naïve Bayes classification algorithm using Python/R on iris.csv dataset.
    2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.

7. Calculate Moving Averages and predict the stock trends Reliance dataset.

8. Predict time series forecasting with Auto Regressive method using any standard stock dataset.

9. Predict future trends on a time series data using ARIMA model. Use an appropriate three level order p the autoregressive order; d the order of differencing, and q the moving average order.

10. Data Visualization I
    1. Use the inbuilt dataset 'titanic'. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. Use the Seaborn library to see if we can find any patterns in the data.
    2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram
    3. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names: 'sex' and 'age')
    4. Write observations on the inference from the above statistics.

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AI24212- Database Management System

Teaching Scheme:	Credits	Examination Scheme:
Theory: 3 Hours/Week **Practical: 2 Hour/Week**	**04**	**Activity Marks: 10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Discrete Mathematics , Data Structures and Algorithms

Course Objectives:

- To understand the fundamental concepts of database systems.
- To learn Database query language.
- To understand the basic issues of transaction processing and concurrency control.
- To learn unstructured data management.

Course Outcomes (COs): The students will be able to learn:

CO1: Visualize and build your database foundation with the ER model.
CO2: Transform raw data into meaningful insights with query languages.
CO3: Apply proven techniques to ensure data integrity and prevent anomalies.
CO4: Implement mechanisms to manage data changes seamlessly in real-time scenarios.
CO5: Use NoSQL databases for processing unstructured data
CO6: Understand databases connectivity

Course Contents

Unit I: Introduction to Database Management Systems and ER Model (06 Hours)

Introduction: Data, Types of Data, Database, Types of Database, Purpose of Database Systems, Database-System Applications, View of Data, Data Independence, Database System Structure. **ER Model**: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity-Relationship Model, Design Issues, Extended E-R Features, Converting ER and EER diagram into tables.

Unit II: SQL and PL/SQL (06 Hours)

Introduction to SQL: Database Languages ,Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Updating, **SQL DML Queries:** SELECT Query and clauses, Index and Sequence in SQL, **Views:** Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, SQL Functions, Nested Queries, **PL/SQL**: Stored Procedures & Functions, Cursors, Triggers, Assertions, Roles and Privileges

Unit III: Normalizations (06 Hours)

Relational Model: Basic concepts, Attributes and Domains, CODD's Rules. Relational Integrity: Domain, Referential Integrities, Enterprise Constraints. **Database Design:** Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF and 4NF.

Unit IV: Transaction Management (06 Hour)

Introduction to Database Transaction, Transaction states, ACID properties, Concept of Schedule, Serial Schedule. **Serializability:** Conflict and View, Cascaded Aborts, Recoverable and Nonrecoverable Schedules. **Concurrency Control:** Lock-based, Time-stamp based Deadlock handling. Recovery methods: Shadow-Paging and Log-Based Recovery, Checkpoints. **Log-Based Recovery:** Deferred Database Modifications and Immediate Database Modifications.

Unit V: NoSQL Databases (06 Hours)

Introduction to Distributed Database System- Advantages, disadvantages, CAP Theorem. **NoSQL Database**: Introduction, need, Features, Types of NoSQL Database, BASE Properties, **MongoDB (with syntax and usage)**: CRUD Operations, Indexing, Aggregation.

Unit VI: Database Connectivity (06 Hours)

Introduction: Database connectivity, Drivers, Steps of Database Connectivity, Database Connectivity with MySQL, DriverManager class, Connection interface, PreparedStatement interface, ResultSet interface, ResultSetMetaData Interface, DatabaseMetaData interface, Batch Processing.

Text Books:

1.Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020 ISBN 978-0-07-802215-9.

2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.

3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.

4. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN 10: 0321826620, 2013, ISBN 13:978-0321826626.

Reference Books:

1.Ramez Elmasri , Shamkant B. Navathe "FUNDAMENTALS OF Database Systems SEVENTH EDITION" ISBN-13: 978-0-13-397077-7, 2017.

2.R.P. Mahapatra, Database Management Systems,, Khanna Book Publishing 2016

E-Resources:

1. **https://archive.nptel.ac.in/courses/106/105/106105175/**

List of Assignments

1. Draw ER diagrams for different schemas & Convert them into tables (Assume any suitable schema). Display constraints.
2. SQL Queries: Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc.
3. SQL Queries: Write at least 10 SQL queries on the suitable database application using SQL DML statements.
4. SQL Queries – All types of Join, Sub-Query and View: Write at least10 SQL queries for suitable database application using SQL DML statements.
5. Unnamed PL/SQLcode block: Use of Control structure and Exception handling is mandatory
6. Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_Roll_Call with the data available in the table O_Roll_Call. If the data in the first table already exists in the second table then that data should be skipped.
7. Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators etc.).
8. MongoDB – Aggregation and Indexing: Design and Develop MongoDB Queries using aggregation and indexing with suitable example using MongoDB.
9. Exporting and Importing data: Design and develop SQL DML statements to demonstrate exporting/Importing tables to external files of different file formats ex. CSV, XLSX, TXT, etc.
10. Database Connectivity: Write a program to implement MySQL/Oracle database connectivity with any front end language to implement Database navigation operations (add, delete, edit etc.)

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AI24213: Operating System

Teaching Scheme:	Credits	Examination Scheme:
Theory: 3 Hours/Week **Practical: 2 Hour/Week**	**04**	**Activity Marks:10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Programming and Problem Solving

Course Objectives:

- To understand the fundamental concepts of operating systems, including their functions, evolution, and types.
- To study process management techniques, such as scheduling algorithms, inter-process communication, and multithreading.
- To analyze synchronization mechanisms and deadlock handling strategies for concurrent execution in operating systems.
- To explore memory management techniques, including paging, segmentation, and virtual memory concepts.
- To learn about I/O management and file system structures, focusing on disk scheduling and file organization.
- To introduce Linux operating system concepts, including kernel structure, process management, and shell utilities.

Course Outcomes (COs): The students will be able to:

CO1: Understand the fundamental functions, types, and design considerations of operating systems.

CO2: Analyze process scheduling techniques, inter-process communication, and multithreading models.

CO3:Apply synchronization techniques to ensure mutual exclusion and prevent deadlocks in concurrent systems.

CO4: Explain memory management techniques, including virtual memory and page replacement algorithms.

CO5: Describe disk scheduling policies, file system structures, and file management techniques.

CO6: Explore Linux system structure, process management, and shell utilities for efficient system operations.

Course Contents

Unit No.: I Fundamental Concepts of Operating system

Operating system functions and characteristics, historical evolution of operating systems, issues in operating system design, User's view of the OS, Types of OS: Batch, time sharing, multiprogramming, distributed, network and real-time systems, Operating-System Services, Types of System Calls, System Programs.

Unit No.: II Process Management

Process concept, Process Control Block(PCB), Process Operations, Process Scheduling: Types of process schedulers, Types of scheduling: Preemptive, Non preemptive. Scheduling algorithms: FCFS, SJF, RR, Priority, Inter process Communication (IPC). Threads: multithreaded model, implicit threads, threading issues

Unit No: III Synchronization and Deadlock

Principles of Concurrency, Requirements for Mutual Exclusion, Mutual Exclusion: Hardware Support, Operating System Support (Semaphores and Mutex), Programming Language Support (Monitors).Classical synchronization problems: Readers/Writers Problem, Producer and Consumer problem, Inter-process communication (Pipes, shared memory system), Deadlock: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Unit IV: Memory Management

Memory management: Background, Types of memory Logical Versus Physical Address space, Swapping Contiguous Allocation, Virtual Memory: Background, Demand paging, Page replacement, Page replacement algorithms, Allocation of frames, Thrashing (Only concept)

Unit V: I/O and File System

I/O Management: I/O Devices, Organization of I/O function, I/O Buffering, Disk Scheduling, Disk Scheduling policies like FIFO, LIFO, STTF, SCAN, C-SCAN **File Management:** File concept , File support, Access methods ,Allocation methods ,Directory systems ,File protection ,Free space management

Unit VI: Linux

Overview Of Linux - Linux Goals, Interfaces to Linux, The Shell, Linux Utility Programs, Kernel structure, Processes in Linux – Process management system calls in Linux, Implementation of process and threads in Linux, Process scheduling Linux, Booting

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, WILEY, ISBN978-1-118-06333-0, 9th Edition
2. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, ISBN-10: 0-13-380591-3, ISBN-13: 978-0-13-380591-8, 8th Edition
3. Andrew S. Tanenbaum & Herbert Bos, Modern Operating System, Pearson, ISBN-13: 9780133592221, 4th Edition
4. Unix Shell Programming – Yashwant Kanetkar, BPB publications.

Reference Books:

1. Tom Adelstein and Bill Lubanovic, Linux System Administration, O'Reilly Media, ISBN-10: 0596009526, ISBN-13: 978-0596009526
2. Harvey M. Deitel, Operating Systems, Prentice Hall, ISBN-10: 0131828274, ISBN-13: 978-0131828278
3. Thomas W. Doeppner, Operating System in depth: Design and Programming, WILEY, ISBN: 978-0-471-68723-8
4. Mendel Cooper, Advanced Shell Scripting, Linux Documentation Project

List of Assignments

1. Write a series of BASH shell commands for common system administration tasks, including file management, process control, disk usage monitoring, and system information retrieval.
2. Implement a program using fork(), exec(), and wait() system calls to create a child process, execute a new program in the child, and synchronize the parent process to wait for the child to complete.
3. Implement preemptive (Round Robin) and non-preemptive (FCFS, SJF, Priority) CPU scheduling algorithms, calculating and displaying waiting time, turnaround time, and CPU utilization for each.
4. Implement a simulation of virtual memory using demand paging, and apply page replacement algorithms such as FIFO (First-In-First-Out),LRU (Least Recently Used) and optimal to handle page faults and minimize them.
5. Implement various disk scheduling algorithms, including FIFO (First-Come-First-Serve),

SSTF (Shortest Seek Time First), SCAN, and C-SCAN, and evaluate their performance based on average seek time.

6. Build a basic file system that supports file creation, reading, writing, and deletion using low-level system calls such as open(), read(), write(), and close().
7. Implement the Banker's algorithm to avoid deadlock by analysing resource allocation and safely granting resource requests.
8. Write a program using semaphores to implement the Readers-Writers problem, ensuring mutual exclusion while allowing multiple readers and one writer to access a shared resource concurrently.
9. Write a C program to demonstrate mutual exclusion using mutex locks, solving the critical section problem.
10. Write a C program to dynamically adjust the priority of a process using the nice() system call and observe the impact on scheduling.

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AI242214-Community Engineering Project/Field Project

Teaching Scheme: PR: 4 Hours/Week	Credits 02	Examination Scheme: Activity: 10 Marks TW: 30 Marks OR: 30 Marks

Prerequisites: Foundational Knowledge in Programming languages, Data handling, and Project Management Principles.

Course Objectives:

- To Encourage students to develop critical thinking and problem-solving skills by exploring and proposing solutions to real-world and social problems.
- To Enable students to evaluate alternative approaches and justify the selection of the most appropriate tools and methods for problem-solving.
- To Immerse students in meaningful and real-world learning experiences.
- To Offer opportunities for students to work either individually or in groups, fostering teamwork, professionalism, and collaboration.

Course Outcomes (COs): The students will be able to learn:

CO1: Identify and address real-world problems based on societal needs.
CO2: Explore different solutions and approaches, critically assessing their feasibility and effectiveness, and select the most suitable one for the problem at hand.
CO3: Analyze and synthesize identified problems by applying relevant technological principles, methodologies, and tools.
CO4: Evaluate the proposed solutions against defined criteria to assess their effectiveness and appropriateness for the problem.

Course Contents

Preamble:

Community Engineering Project/Field Based is an instructional approach that enables students to develop both knowledge and skills through engaging, real-world challenges and problems. Rather than just completing isolated tasks, **Community Engineering Project** encourages students to investigate, respond to, and solve authentic, complex problems with sustained effort and attention. Essentially, Community Engineering Project is "learning by doing," where students actively engage in the process of inquiry and problem-solving.

In today's modern world, success is often measured by the ability to complete projects effectively, which is why it is essential to prepare students for a world driven by projects. Through this approach, students not only acquire academic knowledge but also develop critical thinking, collaboration, and problem-solving abilities.

Community Engineering Project also redefines the role of the teacher, shifting from a traditional lecture-based model to a more dynamic role as a mentor. While still imparting knowledge, teachers in a Community Engineering Project setting serve as facilitators who guide and support students in the collaborative process of knowledge transfer and development.

The Community Engineering Project model centers on an open-ended question, challenge, or problem, requiring students to conduct research and work toward a solution. Throughout the process, students will present their findings, research methods, and results, demonstrating the depth of their learning.

Successful Community Engineering Project implementation demands consistent mentoring from faculty throughout the semester to ensure the students' ideas and projects are progressing effectively. Each batch of students should be divided into smaller sub-groups of 3 to 4 members. Students will select real-life problems or complex assignments for their projects, and these will span the entire semester.

Project Execution Guidelines

1. **Group Formation:**

    - Each group will consist of **3-4 students**.
    - A **mentor/guide** will be assigned to each group.

2. **Mentor's Role:**

    - The mentor will **monitor** the group's progress, providing guidance and support.
    - The mentor will ensure the group stays on track to complete the project successfully.

Selection of Project/Problem:

The selection of a community project or problem will be guided by the following criteria to ensure relevance, feasibility, and impact:

1. **Community Needs Assessment:** Identify real-world challenges faced by the community through surveys, interviews, or consultations with stakeholders.
2. **Interdisciplinary Relevance:** Ensure the project allows for the integration of tools, data analytics, and software applications across multiple disciplines
3. **Ethical and Sustainable Impact:** Select projects that align with ethical standards and promote long-term sustainability.
4. **Feasibility and Resources:** Assess the availability of necessary resources, technical feasibility, and team expertise to implement the project effectively.
5. **Innovative and Scalable Solutions:** Prioritize challenges that can be solved through innovation, with a focus on solutions that have the potential for wide-scale application and scalability.
6. **Collaboration Opportunities:** Choose projects that encourage teamwork and engagement with community members, organizations, or local authorities.

Expected Project Domains

- Healthcare:
- Education:
- Agriculture:
- Social Welfare:
- Smart Cities:

Evaluation and Continuous Assessment

To ensure systematic progress and accountability, all activities must be recorded consistently. Regular assessments should be conducted, and proper documentation must be maintained at the college level by both students and mentors through the **Community Engineering Project/Field Project (Field-Based Learning) workbook**. Additionally, a **Continuous Assessment Sheet (CAS)** should be kept by mentors, departments, and institutions to track student performance and project progress.

Assessment Criteria and Weightage:

1. **Idea Inception & Awareness (10%)**

    - Consideration of environmental, social, ethical, safety, and legal factors.
    - Clarity and feasibility of the chosen problem.

2. **Problem-Solving & Project Outcomes (40%)**

    - Effectiveness of the solution in addressing the identified problem.
    - Individual and team contributions to project development.
    - Integration of tools, data analytics, and software applications.

3. **Documentation (15%)**

    - Requirement gathering, design, and system modeling.
    - Implementation, execution, and use of technology.
    - Quality and completeness of the final project report and supporting documents.

4. **Demonstration (20%)**

    - Clarity, organization, and effectiveness of the presentation.
    - User interface design, functionality, and usability.

5. **Contest Participation / Publication (15%)**

    - Engagement in competitions, conferences, or research paper publication.

The **Field Based Learning workbook** serves as a crucial tool for students, mentors, and project coordinators, ensuring documentation of work progress. It fosters **accountability, punctuality, technical writing skills, and workflow management**, providing a structured approach to project execution and assessment.

Project Milestones & Deliverables

Week	Task	Deliverables
Week 1-2	Problem identification & proposal submission	Problem Statement Document
Week 3-5	Data collection & preprocessing	Data Report
Week 6-8	Model Development & Testing	Model Report
Week 9-10	Implementation & Prototyping	Working Prototype
Week 11-12	Social Impact Assessment & Field Testing	Evaluation Report
Week 13-14	Final Presentation & Documentation	Project Report & Demo

Text Books:

1.A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

2.Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3.Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Capraro, Mary Margaret Capraro

Reference Books:

1.De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2.Gopalan," Project management core text book", 2 Indian Edition
3.James Shore and Shane Warden, "The Art of Agile Development"

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AI24214- VSEC- Python Workshop on High-Performance Data Tools

Teaching Scheme	Credits	Examination Scheme
Teaching Scheme: **Tutorial: 1 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **02**	**Examination Scheme:** **Activity Marks:10 Marks** **Term-Work: 30 Marks** **Practical: 30 Marks**

Prerequisites: Python Fundamentals

Course Objectives:
- To understand and identify insights for business data analytics
- To learn data manipulation techniques for big data
- To learn usage of platforms for building GenAI applications
- To learn designing of basic interface components for GenAI applications

Course Outcomes (COs): The students will be able to:
CO1: Demonstrate the data analysis through PowerBI dashboard
CO2: Learn and Analyze efficiency in big data manipulation
CO3: Construct GenAI applications using APIs
CO4: Build an efficient interface for GenAI applications

Course Contents

Unit I Power BI **(04 Hrs)**
Interactive Visuals and Slicers, Data Integration and Visualizations, Using Streaming data, Real-Time Dashboard, Integration with Python-Report Showcasing, DAX-Data Analysis Expressions

Unit II High Performance Data Manipulation in Python **(05 Hrs)**
Vaex - Efficient computation, Efficient utilization of memory, Dataframes. Virtual Columns, Statistics on N-d Grids, xarray, Group-by, Statistical performance, Visualization
Polars –Data Manipulation, Lazy Evaluation, Expressions, Query Optimization

Unit III Langchain using Pre-trained models **(05 Hrs)**
Langchain- Overview, API generation, Document loaders, HuggingFace-Chat Models, Pipeline, Embedding models, Prompt, Response generation through chain.

Unit IV Gradio Interface **(04 Hrs)**
Examples, Text, Chatbot, File Explorer, Image, ImageEditor

Text Books:

1. Brian Larson, "Data Analysis with Microsoft Power BI", McGraw-Hill, ISBN: 9781260458626, 2020
2. Jeroen Janssens, Thijs Nieuwdorp, "Python Polars: The Definitive Guide", O'Reilly Media, Inc, ISBN: 9781098156084, 2025
3. Wei-Meng Lee, "Hugging Face in Action", Oxford University Press, ISBN 9781633436718, 2024
4. Hunaidkhan Pathan, Nayankumar Gajjar, "Mastering LLM Applications with LangChain and Hugging Face: Practical insights into LLM deployment and use cases", ISBN 10: 9365891043, ISBN 13: 978-9365891041, 2024
5. Ben Auffarth, "Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT, and other LLMs", ISBN 10: 1835083463, ISBN 13: 978-1835083468

Reference Books:

1. Omar Sanseviero, Pedro Cuenca, Apolinário Passos, Jonathan Whitaker, "Hands-On Generative AI with Transformers and Diffusion Models", O'Reilly Media, Inc, ISBN: 9781098149246, 2024
2. Devin Knight, Brian Knight, Mitchell Pearson, Manuel Quintana, "Microsoft Power BI Complete Reference", Packt Publishing Limited, ISBN: 9781789950045, 2018
3. Academind by Maximilian Schwarzmüller, Manuel Lorenz, "Microsoft Power BI - A Complete Introduction [2023 EDITION]", ISBN: 9781789959031, 2022
4. Angelo Mozzillo, Luca Zecchini, Luca Gagliardelli, Adeel Aslam, Sonia Bergamaschi, Giovanni

Simonini, "Evaluation of Dataframe Libraries for Data Preparation on a Single Machine", Experiments & Analyses Paper, 2024
https://openproceedings.org/2025/conf/edbt/paper-96.pdf
5. Maarten A. Breddels and Jovan Veljanoski, "Vaex: big data exploration in the era of Gaia", 2018
https://doi.org/10.1051/0004-6361/201732493

E-Resources:

1. Microsoft Power BI Data Analyst Professional Certificate https://www.coursera.org/professional-certificates/microsoft-power-bi-data-analyst
2. Complete Generative AI Course With Langchain and Huggingface -

   https://www.udemy.com/course/complete-generative-ai-course-with-langchain-and-huggingface/
3. Data Analysis with Polars https://www.udemy.com/course/data-analysis-with-polars

List of Assignments

1. Health and Lifestyle Risk Assessment Dashboard: Analyze individual health metrics, lifestyle habits, and risk factors based on demographic and occupational data. This dashboard shall help in identifying health trends, assessing risk levels, and providing insights into preventive healthcare strategies.
2. Space Missions Analysis Dashboard: Analyze space missions conducted by different space agencies, examine rocket performance, mission success rates, budget allocation, and launch trends over time.
3. Customer Demographics and Recency Analysis Dashboard: Analyze customer demographics, income distribution, and recency of interactions to gain insights into customer segmentation and engagement patterns.
4. Vaex-fast processing of big dataset: Open the example dataset provided with Vaex. It contains 4,00,000 instances. Perform following operations: Calculate statistics on a regular (N-dimensional) grid, Perform group-by and aggregation functions, Visualize the data.
5. Kisan Call center data: Download kisan call center dataset from https://kcc-chakshu.icar.gov.in/ . It contains around 40 million farmers call log records. Open and read the data using Vaex tool. Analyze and visualize the data based on crop, query category, district of the farmer.
6. Polars- parallel computing and memory management: Using python polars tool, perform filtering, Grouping, Sorting, and Joining, on a specific column with inbuilt example dataset. Visualize the data using polars tool.
7. Text Generation: Complete the poem "Roses are Red ________". Identify and use pre-trained transformer model from HuggingFace and generate the response.
8. Text Summarization and Topic generation: Summarize the given document and generate a topic for the same. Identify and use pre-trained transformer model from HuggingFace and generate the response.
9. Language Translation: Extract the text from a document and convert into another language. Identify and use pre-trained transformer model from HuggingFace which will process English text, convert it into French and generate the response.
10. Design an interactive question answering(Chatbot) interface using Gradio python tool.