

Curriculum for UG & PG Programmes (2024-25 Onwards)



**Swami Keshvanand Institute of Technology,
Management & Gramothan**

(An Autonomous Institute, Affiliated to Rajasthan Technical University, Kota)

(Accredited by NAAC with A ++ Grade)

Approved by AICTE, Ministry of Education, Government of India

Recognized by UGC under Section 2(f) of the UGC Act, 1956

B. Tech. in Computer Science and Engineering (Data Science)

Teaching and Examination Scheme

II Year III Semester: B.Tech. CSE(DS)

| Sr. No. | Course Code | Course Name | Category | Teaching Scheme | | | Exam Hrs. | Marks | | | Credit |
|--------------|---|---|----------|-----------------|---|---|-----------|-------|-----|-------|--------|
| | | | | L | T | P | | CIE | SEE | Total | |
| 1 | HSUL301/ HSUL302 | Managerial Economics and Financial Accounting / Technical Communication | HSMC | 1 | 0 | 0 | 3 | 40 | 60 | 100 | 1 |
| 2 | MAUL301 | Statistics and Probability Theory | BSC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 3 | CDUL301/ CSUL301/ CAUL301/ CIUL301/ ITUL301 | Data Structures and Algorithms | PCC | 3 | 1 | 0 | 3 | 40 | 60 | 100 | 4 |
| 4 | CDUL302 | Foundation of Data Science | PCC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 5 | CDUL303/ CSUL303/ CAUL303/ CIUL303/ ITUL303 | Software Engineering and Project Management | PCC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 6 | CSUL304/ CAUL304/ CDUL304/ CIUL304/ ITUL304 | Digital Electronics | ESC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 7 | CDUP320 | Data Structures and Algorithms Lab | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 8 | CDUP321 | Programming in Java Lab | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 9 | CDUP322 | Python for Data Science Lab | PCC | 0 | 0 | 3 | 2 | 60 | 40 | 100 | 1.5 |
| 10 | CDUP323 | Digital Electronics Lab | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 11 | CDUT330 | Industrial Training | PSIT | 0 | 0 | 1 | 2 | 60 | 40 | 100 | 1 |
| 12 | CDUA300 | Social Outreach, Discipline and Extra Curricular Activities | SODECA | - | - | - | - | - | - | 100 | 0.5 |
| 13 | NU99.4/ NU99.5 | Audit Course | | - | - | - | 3 | 60 | 40 | 100 | 0 |
| Total Credit | | | | | | | | | | | 23.5 |

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| | | |
|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Managerial Economics and Financial Accounting | Course Code: HSUL301 | Credit: 1 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 1L+0T+0P | |

| Module No. | Contents | Hours |
|------------|--|-------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite | 1 |
| 2 | Basic economic concepts: Meaning, nature and scope of managerial economics, deductive vs inductive methods, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement. | 4 |
| 3 | Demand and Supply analysis: Demand-types of demand, determinants of demand, demand function, demand forecasting –purpose, determinants, elasticity of demand Supply-determinants of supply, supply function, elasticity of supply. | 3 |
| 4 | Production and Cost analysis: Theory of production- production function, production optimization, least cost combination of inputs, isoquants, law of variable proportions, laws of returns to scale. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation. | 3 |
| 5 | Financial statement analysis: Capital and accounting, profit and loss statement and related concepts, balance sheet and related concepts, financial ratio analysis . | 4 |
| Total | | 15 |

Text Books:

1. D. N. Dwivedi, *Managerial Economics*, 10th ed. New Delhi, India: Vikas Publishing House, 2024.
2. M. R. Agarwal, *Financial Management*, 2020 ed. Garima Publications, 2020

Reference Books:

1. R. L. Varshney and K. L. Maheshwari, *Managerial Economics*, 22nd ed. New Delhi, India: Sultan Chand & Sons, 2014.
2. A. R. Aryasri, *Managerial Economics and Financial Analysis*, 3rd ed. New Delhi, India: McGraw-Hill Education, 2008.

Prerequisite:

1. Knowledge of basic mathematics & business economics.

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Technical Communication | Course Code: HSUL302 | Credit: 1 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3hrs | Teaching Scheme: 1L+0T+0P | |

| Module No. | Contents | Hours |
|------------|--|-------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Basics of Technical Communication: Meaning, aspects and style of technical communication, Reading Strategies: Skimming, Scanning, SQ3R, ERRQ. | 2 |
| 3 | Advanced Grammar: Articles, Prepositions, Conditionals, Common Errors. | 6 |
| 4 | Technical Writing: Business Letters, E-mail Writing, Minutes of Meeting, Resume Writing. | 4 |
| 5 | Advanced Technical Writing: Technical Reports, Technical Proposals. | 2 |
| Total | | 15 |

Text Books:

1. Technical Communication: Principles and Practice by Meenakshi Raman and Sangeeta Sharma. Third Edition. New Delhi: OUP. 2017

Reference Books:

1. M. A. Rizvi, *Effective Technical Communication*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005.
2. Effective Technical Communication edited by G. Venkatraman, Pearson, 2024
3. Technical Communication: Process and Product by Sharon Gerson and Steven Gerson, Pearson, 2014

Prerequisite:

1. Basics of Technical Communication

- a) Introduction to technical communication
- b) knowledge of technical documents
- c) use of tools for reading and writing

2. Advanced Grammar

Basic Strategies of Grammar

3. Technical Writing

Differentiating between technical and creative writing

4. Advanced Technical Writing

- a) Knowing the basics of advance writing strategies.
- b) Knowing the part of language in advance writing

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Statistics and Probability Theory | Course Code: MAUL301 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Probability: Sample space, events, algebra of events, conditional probability, Baye's law, Bernoulli's trials. | 7 |
| 3 | Discrete and continuous random variables: Random variables, probability mass and density functions, cumulative distribution function, probability generating function, expectation, moments, moments generating function, cumulant generating function. Bivariate random variable, marginal distribution, conditional distribution. | 10 |
| 4 | Discrete and continuous probability distribution: Bernoulli distribution, Binomial distribution, Poisson distribution, Normal distribution, rectangular distribution, exponential distribution and their probability density function, moments, moments generating function. | 10 |
| 5 | Correlation and Regression Analysis: Correlation, rank correlation, linear regression, method of least square: fitting of straight lines, parabola. | 8 |
| 6 | Queuing Theory: Pure birth process, Pure death process, birth-death process, Queuing model with finite & infinite capacitys. M/G/1 queuing model, discrete parameter Markov chain. | 9 |
| Total | | 45 |

Text Books:

1. T. Veerarajan, Probability, Statistics and Random Processes, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2008.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 12th ed. New Delhi, India: Sultan Chand & Sons, 2020.
3. M. Spiegel, J. Schiller, and R. Srinivasan, Schaum's Outline of Probability and Statistics, 4th ed. New York, NY, USA: McGraw-Hill, 2013.

Reference Books:

1. J. Johnston and J. Dinardo, Econometric Methods, 4th ed. New York, NY, USA: McGraw-Hill, 1997.
2. J. R. Benjamin and C. A. Cornell, Probability, Statistics, and Decision for Civil Engineers. New York, NY, USA: McGraw-Hill, 1970.
3. W. W. Hines and D. C. Montgomery, Probability and Statistics in Engineering and Management Science, 3rd ed. New York, NY, USA: John Wiley & Sons, 1990.
4. J. E. Freund, Mathematical Statistics, 5th ed. Englewood Cliffs, NJ, USA: Prentice Hall, 1992.

Prerequisite:

1. Basic knowledge of sets, sets operations, inclusion exclusion principle.
2. Basic knowledge of probability upto senior secondary level.
3. Knowledge of variable and random variable upto senior secondary level.

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Data Structures and Algorithms | Course Code: CDUL301 | Credit: 4 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 3L+1T+0P | |

| Module No. | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Introduction to Data Structures and Algorithms: Data Structures operations, Complexity of Algorithms, Asymptotic Notations. Stack: Stack operations, Array and Linked Representation of Stack, Application of Stack: Recursion, Reversing List, Polish Notations: Expression evaluation, Conversion of Infix to Prefix and Postfix Expressions, Tower of Hanoi. Queue: Queue operations, Array and Linked representation of queues, Circular queues, D-queues and Priority Queue. | 10 |
| 3 | Linked List: Linked List operations, Representation of Linked Lists in Memory, Singly Linked List and its operations, Circular Linked List and its operations, Doubly Linked List and its operations, Header Linked List, Polynomial Representation of Linked List. | 8 |
| 4 | Searching, Sorting and Hashing: Searching: Linear Search and binary search, Applications: Finding the square root of 'n', Longest Common Prefix. Sorting: Insertion sort, Selection sort, Bubble sort, Counting Sort, Quick sort, Merge sort, Heap Sort, Application: Finding the 'n' closest pair'. Hashing: Hash function, Address calculation techniques, Common hashing functions. | 9 |
| 5 | Trees: Introduction, Binary Tree: Terminology and Properties, Tree Traversals, Expression Trees, Binary Search Trees, operations in BST: insertion, deletion, finding min and max, Finding the kth minimum element in a BST, Applications: Dictionary. AVL trees: Terminology, basic operations (rotation, insertion and deletion), B Tree and its operations. | 9 |
| 6 | Graphs: Definition and Terminology, Representation of Graph, Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS). Minimum Spanning Tree: Prim's, Kruskal's, Single Source Shortest Path: Dijkstra's Algorithm. | 8 |
| Total | | 45 |

Text Books:

1. S. Lipschutz, *Data Structures with C*, 1st ed. New York, NY, USA: McGraw-Hill, 2017
2. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, *Introduction to Algorithms*, Third edition, MIT Press, 2009.
3. Mark A. Weiss, *Data Structures & Algorithm Analysis in C++*, 3rd edition, 2008, PEARSON

Reference Books:

1. Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Structures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008.
2. Horowitz, Sahni, and S. Anderson-Freed , Fundamentals of Data Structures in C UNIVERSITIES PRESS, Second Edition, 2008

Prerequisite:

1. Basic knowledge of one programming language (C, C++)
2. Basic knowledge of common programming concepts, including loops, arrays and recursion
3. Basic knowledge of mathematics

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Foundation of Data Science | Course Code: CDUL302 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|------------|--|-------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite | 1 |
| 2 | Fundamentals of Data Science: Introduction to Data Science, Terminologies related with Data Science, Types of Data, Data Science Process, Data Science Project's Lifecycle, Data Science Toolkits, Applications. | 8 |
| 3 | Data Collection and Management: Introduction, Sources of data, Data Collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources. | 8 |
| 4 | Data Analysis and algorithms: Introduction, Role of Statistics, Types of Statistics, Central Tendency and its measures, Normal Distribution Curve, Variations, Standard Deviation, Z-Scores and Normalization, Samples/CLT. Basic Machine Learning Algorithms, Linear Regression, SVM, Naïve Bayes. | 10 |
| 5 | Data Visualization: Introduction to Data Visualization and its importance, types of Data Visualization, various Visualization Techniques, Retinal Variables, Mapping variables to Encodings. | 9 |
| 6 | Recent Trends in Data Science: Applications of Data Science, Technologies for Visualization, Recent Trends in various Data Collection and Analysis Techniques, Bokeh (Python), Application Development Methods used in Data Science. | 9 |
| Total | | 45 |

Textbooks:

1. C. O'Neil and R. Schutt, Doing Data Science: Straight Talk from the Frontline, 1st ed., O'Reilly Media, 2013.
2. D. Cielen, A. D. B. Meysman, and M. Ali, Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, 1st ed., Manning Publications, 2016.
3. R. D. Peng and E. Matsui, The Art of Data Science, Leanpub, 2015.

Reference Books:

1. J. Leskovec, A. Rajaraman, and J. D. Ullman, Mining of Massive Datasets, 3rd ed., Cambridge University Press, 2020.
2. J. Grus, Data Science from Scratch: First Principles with Python, 2nd ed., O'Reilly Media, 2019.
3. G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning: With Applications in R, 2nd ed., Springer, 2021.

Prerequisite:

1. Data science often involves complex mathematical concepts and techniques so it is crucial to have solid foundation in mathematics particularly linear algebra, calculus and statistics.
2. Proficiency in programming languages commonly used in data science such as Python or R is essential.

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Software Engineering and Project Management | Course Code: CDUL303 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|------------|---|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Introduction: Introduction to Software Engineering, Software Development Life Cycle (SDLC), SDLC models: Waterfall Model, Prototype Model, Evolutionary Development Models, Incremental, Spiral Model, RAD, Agile Methodology. | 9 |
| 3 | Requirement Analysis: Requirement Elicitation, Analysis, and Specification, Formal Requirements Specification, Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Analysis Modeling for Function-oriented and Object-oriented software development, Use case Modeling, System and Software Requirement Specifications and Validation. | 9 |
| 4 | Software Design: Design concepts, Cohesion and Coupling, Types of cohesion and coupling, Architectural design: software architecture, data design, architectural styles and patterns, UML: basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams. | 8 |
| 5 | Software Testing: Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Black-Box Testing, White-Box Testing and Unit Testing, Testing Frameworks, Integration Testing, System Testing and other Specialized Testing, Test Plan, Test Metrics, Testing Tools. | 9 |
| 6 | Software Project Management: Introduction, Project and Importance of Project, LOC and FP estimation, effort estimation, COCOMO Model and types, Risk analysis and management: risk identification, projection, risk refinement, risk monitoring and management, Project scheduling and tracking, software quality assurance, software configuration management. | 9 |
| Total | | 45 |

Text Books:

1. R. S. Pressman and B. R. Maxim, Software Engineering: A Practitioner's Approach, 9th ed. New York, NY, USA: McGraw-Hill, 2019.
2. I. Sommerville, Software Engineering, 10th ed. Boston, MA, USA: Pearson Education, 2015.
3. K. Schwaber, Agile Project Management with Scrum. Redmond, WA, USA: Microsoft Press, 2004.



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Reference Books:

1. Managing global software Projects, Ramesh, TMH, 2001.
2. Software Project management, Walker Royce, Addison Wesley, 1998

Prerequisite: Basic Knowledge of Computer functions and applications. Understanding of programming concepts.

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Digital Electronics | Course Code: CDUL304 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Number Systems, Basic Logic Gates & Boolean Algebra: Binary Arithmetic & Radix representation of different numbers. Fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion. Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vice-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion. | 9 |
| 3 | Minimization Techniques: Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic functions with K-map, conversion of truth tables in POS and SOP form. Incomplete specified functions. Variable mapping. Quine McCluskey minimization techniques. | 8 |
| 4 | Combinational Systems: Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders. BCD adder. Binary multiplier. Decoder: Binary to Gray decoder, BCD to decimal, BCD to 7-segment decoder. Multiplexer, Demultiplexer, Encoder. Octal to binary, BCD to excess-3 encoder. Diode switching matrix. Design of logic circuits by multiplexers, encoders, decoders and demultiplexers. Introduction to Programmable Logic Devices (PLD's) – Programmable ROM (PROM) – Programmable Logic Array(PLA) – Programmable Array Logic(PAL). | 9 |
| 5 | Sequential Systems: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops. Counters: Asynchronous (ripple), synchronous and synchronous decade counter, Modulus counter, skipping state counter, counter design. Ring counter. Counter applications. Registers: buffer register, shift register. Synchronous Sequential Circuit Design: Models – Moore and Mealy, State diagram and State Tables, Design Procedure, Sequence generator and detector. Asynchronous Sequential Circuit Design: Analysis, procedure, applications. | 9 |
| 6 | Digital Logic Gate Characteristics: TTL logic gate characteristics. Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies. MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, CMOS & MOSFET. Interfacing logic families to one another. | 9 |
| Total | | 45 |

Textbooks:

1. M. M. Mano, Digital Logic and Computer Design, 1st ed., Pearson, 2016.
2. R. P. Jain and K. Sarawadekar, Modern Digital Electronics, 5th ed., McGraw-Hill, 2021.

Reference Books:

1. S. Salivahanan, N. S. Kar, and V. S. V., Digital Circuit Design, Vikas Publishing, 2007.
2. A. Anandkumar, Fundamentals of Digital Circuits, 2nd ed., PHI, 2009.
3. H. Taub and D. L. Schilling, Digital Integrated Electronics, Tata McGraw-Hill, 1986.

Prerequisite:

1. Knowledge of basic electronics.
2. Understanding of the core concepts of computers.
3. Knowledge in basic mathematics, basic calculus and linear algebra will be added advantage.

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Data Structures and Algorithms Lab | Course Code: CDUP320 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 0L+0T+3P | |

All experiments should be implemented using the C++ programming language.

| S. No. | Experiments |
|--------|--|
| 1 | Write a menu driven Program in C++ for the following Array operations a. Creating an Array of N Integer Elements b. Display the Array Elements c. Inserting an Element at a given valid Position d. Deleting an Element at a given valid Position e. Exit |
| 2 | Write a Program for the following String operations (without using built-in functions) a. Input a main sentence, a word or phrase to find, and a replacement word or phrase. b. Search through the main sentence for the word or phrase to find. If found, replace it with the replacement. If not found, let the user know. |
| 3 | Implement a stack data structure and demonstrate its operations including push, pop, overflow, and underflow. |
| 4 | Implement a Program for converting an Infix Expression to Postfix Expression. |
| 5 | Implement a Program for evaluating a Postfix Expression. |
| 6 | Implement a menu driven Program for the following operations on Singly Linked List (SLL) a. Create a SLL of N Students Data. b. Display the status of SLL and count the number of nodes. c. Perform Insertion at the beginning /end of SLL. d. Perform Deletion at the beginning /end of SLL. |
| 7 | Implement queue data structure and demonstrate its operations including enqueue, dequeue. |
| 8 | Implement a stack using Queue and vice versa. |
| 9 | Implement a Binary tree and perform various traverse using recursion and without recursion. |
| 10 | Implement inorder, Preorder Morris traversal in Binary Tree |
| 11 | Implement a Binary search tree and print Top View, front View, Left view of a tree |
| 12 | Implement different Sorting and Searching Techniques. |



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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Programming in Java Lab | Course Code: CDUP321 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 0L+0T+3P | |

| S. No. | Experiments |
|--------|---|
| 1 | Develop depth understanding of programming in Java: bytecode, data types, variables, arrays, operators, Decision and Control statements. |
| 2 | Develop Object Oriented programs in Java: Objects, Classes constructors, returning and passing objects as parameter. |
| 3 | Inheritance, Access Control, using super, final with inheritance Overloading and overriding methods, Abstract classes, Extended classes. |
| 4 | Develop understanding to Packages & Interfaces in Java: Package, concept of CLASSPATH, access modifiers, importing package, Defining and implementing interfaces. |
| 5 | Develop understanding to developing Strings handling: String constructors, special string operations, character extraction, searching and comparing strings, string Buffer class. |
| 6 | Exception handling fundamentals, Exception types, uncaught exceptions, try, catch and multiple catch statements. Usage of throw, throws and finally. |
| 7 | Develop applications involving file handling: File Class, I/O streams, File I/O. |
| 8 | Multithreading fundamentals: Introduction to Thread class, runnable interface, priority and applying synchronized block. |

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|--|----------------------------------|----------------------|
| Name of the Programme: B.Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Python for Data Science Lab | Course Code: CDUP322 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 0L+0T+3P | |

| S. No. | Experiments |
|--------|--|
| 1. | Download, Install and Explore the features of NumPy, SciPy, Jupyter, Statsmodels, and Pandas packages. Also, create and manipulate arrays using NumPy to understand array-based computations and mathematical operations. |
| 2. | Working with Pandas DataFrames and Reading Data from text files, Excel, and the web. Perform descriptive analytics on the Iris dataset using relevant commands, including value counts, groupby operations, and basic data wrangling. |
| 3. | Use the Diabetes Dataset from UCI and Pima Indians Diabetes Dataset to perform: <ul style="list-style-type: none"> Univariate Analysis: Frequency, mean, median, mode, variance, standard deviation, skewness, and kurtosis Bivariate Analysis: Linear and logistic regression modeling Multiple Regression Analysis Comparison of Analysis Results between the two datasets |
| 4. | Apply and Explore Various Plotting Functions on UCI datasets: <ul style="list-style-type: none"> Normal curves Density and contour plots Correlation and scatter plots Histograms 3D plotting using matplotlib's mplot3d and plotly for interactive charts |
| 5. | Visualizing Geographic Data with Basemap – Plot maps and regional distributions of health metrics using Basemap, GeoPandas, and Folium. |
| 6. | Time Series Analysis – Use datasets with date-time indexes to identify trends, seasonality, and forecasting using ARIMA, Moving Averages, and Decomposition. |
| 7. | Data Cleaning and Preprocessing – Perform missing data handling, outlier detection, normalization, encoding categorical variables, and feature scaling using Pandas and Scikit-learn. |

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|---|----------------------------------|----------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: III |
| Course Name: Digital Electronics Lab | Course Code: CDUP323 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 0L+0T+3P | |

| S. No. | Experiments |
|--------|---|
| 1. | To verify the truth tables of logic gates: AND, OR, NOR, NAND, NOR, Ex-OR, Ex-NOR (For 2, 3, & 4 inputs using gates with 2, 3, & 4 inputs). Also verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR realized using NAND & NOR gates. |
| 2. | To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables. |
| 3. | To realize a 4-bit ripple adder/ Subtractor using basic Half adder/ Subtractor & basic Full Adder/ Subtractor. |
| 4. | To verify the truth table of 4-to-1 multiplexer and 1-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8-to-1 multiplexer and 1-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demultiplexer |
| 5. | Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -312 seven-segment display. |
| 6. | Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table. |
| 7. | Construct a divide by 2,4 & 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop. |
| 8. | Perform input/output operations on parallel in/Parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer |
| 9. | To realize the functionality of 4 bit Arithmetic Logic Unit (ALU) using IC 74181. |
| 10. | VHDL implementation of full adder, 4 bit magnitude comparator/ VHDL implementation of various combinational circuits. |
| 11. | Implementation of Mini Project using digital integrated circuits and other components. |
| 12. | To design Binary to Gray and Gray to Binary Converter. Also Verify the truth table of various combinations. |
| 13. | To verify the truth table of one bit and two bit comparator using logic gates. |

Note: Any two experiments from above list should also be performed by students on Virtual Lab.

Teaching and Examination Scheme II Year IV Semester: B.Tech. CSE(DS)

| Sr. No. | Course Code | Course Name | Category | Teaching Scheme | | | Exam Hrs. | Marks | | | Credit |
|--------------|---|---|----------|-----------------|---|---|-----------|-------|-----|-------|--------|
| | | | | L | T | P | | CIE | SEE | Total | |
| 1 | HSUL401/ HSUL402 | Managerial Economics and Financial Accounting / Technical Communication | HSMC | 1 | 0 | 0 | 3 | 40 | 60 | 100 | 1 |
| 2 | MAUL402 | Discrete Mathematics and Linear Algebra | BSC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 3 | CDUL401/ CAUL401/ CSUL401/ CIUL401/ ITUL401 | Database Management System | PCC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 4 | CDUL402/ CAUL402 | Full Stack Development | PCC | 2 | 0 | 0 | 3 | 40 | 60 | 100 | 2 |
| 5 | CDUL403/ CSUL403/ CIUL403/ CAUL403/ ITUL403 | Computer Network | PCC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 6 | CDUL404/ CSUL302/ CAUL404/ CIUL404/ ITUL302 | Operating System | PCC | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 3 |
| 7 | CSUL405/ CAUL405/ CDUL405/ CIUL405/ ITUL405 | Computer Architecture and Microprocessor | ESC | 2 | 0 | 0 | 3 | 40 | 60 | 100 | 2 |
| 8 | CDUP420 | Database Systems Lab | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 9 | CDUP421 | Full Stack Development Lab | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 10 | CDUP422 | Microprocessor Lab | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 11 | CDUP423 | R-Programming for Data Science | PCC | 0 | 0 | 3 | 3 | 60 | 40 | 100 | 1.5 |
| 12 | CDUA400 | Social Outreach, Discipline and Extra Curricular Activities | SODECA | - | - | - | - | - | - | 100 | 0.5 |
| | NU99.4/ NU99.5 | Audit Course | | - | - | - | 3 | 60 | 40 | 100 | 0 |
| Total Credit | | | | | | | | | | | 23.5 |

| | | |
|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Managerial Economics and Financial Accounting | Course Code: HSUL401 | Credit: 1 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 1L+0T+0P | |

| Module No. | Contents | Hours |
|------------|--|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Basic economic concepts: Meaning, nature and scope of managerial economics, deductive vs inductive methods, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement. | 4 |
| 3 | Demand and Supply analysis: Demand-types of demand, determinants of demand, demand function, demand forecasting –purpose, determinants, elasticity of demand Supply-determinants of supply, supply function, elasticity of supply. | 3 |
| 4 | Production and Cost analysis: Theory of production- production function, production optimization, least cost combination of inputs, isoquants, law of variable proportions, laws of returns to scale. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation. | 3 |
| 5 | Financial statement analysis: Capital and accounting, profit and loss statement and related concepts, balance sheet and related concepts, financial ratio analysis . | 4 |
| Total | | 15 |

Text Books:

1. D. N. Dwivedi, *Managerial Economics*, 10th ed. New Delhi, India: Vikas Publishing House, 2024.
2. M. R. Agarwal, *Financial Management*, 2020 ed. Garima Publications, 2020

Reference Books:

1. R. L. Varshney and K. L. Maheshwari, *Managerial Economics*, 22nd ed. New Delhi, India: Sultan Chand & Sons, 2014.
2. A. R. Aryasri, *Managerial Economics and Financial Analysis*, 3rd ed. New Delhi, India: McGraw-Hill Education, 2008.

Prerequisite:

1. Knowledge of basic mathematics & business economics.

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Technical Communication | Course Code: HSUL402 | Credit: 1 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3hrs | Teaching Scheme: 1L+0T+0P | |

| Module No. | Contents | Hours |
|------------|--|-------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Basics of Technical Communication: Meaning, aspects and style of technical communication, Reading Strategies: Skimming, Scanning, SQ3R, ERRQ. | 2 |
| 3 | Advanced Grammar: Articles, Prepositions, Conditionals, Common Errors. | 6 |
| 4 | Technical Writing: Business Letters, E-mail Writing, Minutes of Meeting, Resume Writing. | 4 |
| 5 | Advanced Technical Writing: Technical Reports, Technical Proposals. | 2 |
| Total | | 15 |

Text Books:

1. Technical Communication: Principles and Practice by Meenakshi Raman and Sangeeta Sharma. Third Edition. New Delhi: OUP. 2017

Reference Books:

1. M. A. Rizvi, *Effective Technical Communication*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005.
2. Effective Technical Communication edited by G. Venkatraman, Pearson, 2024
3. Technical Communication: Process and Product by Sharon Gerson and Steven Gerson, Pearson, 2014

Prerequisite:

1. Basics of Technical Communication

- d) Introduction to technical communication
- e) knowledge of technical documents
- f) use of tools for reading and writing

2. Advanced Grammar

Basic Strategies of Grammar

3. Technical Writing

Differentiating between technical and creative writing

4. Advanced Technical Writing

- c) Knowing the basics of advance writing strategies.
- d) Knowing the part of language in advance writing

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Discrete Mathematics and Linear Algebra | Course Code: MAUL402 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 hrs | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|------------|---|-------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Set, Relations & Functions: Definitions, type of sets, set operations, inclusion-exclusion, general, types of relation, pictorial representation of relation, matrix representation of relations, equivalence relation. Types of functions (Injective, surjective, bijective functions) Lattices: Partial ordered relation, Hasse diagram, properties of lattices, bounded lattice, complimented lattice. | 9 |
| 3 | Algebraic Structure: Definition, properties, Groups, abelian group, subgroup, cyclic group, cosets, factor group, permutation group, normal subgroup, homomorphism and isomorphism of groups, examples and standard results. Propositional logics: Proposition, first order logic, basic logical operations, truth tables, tautologies, contradictions, algebra of proposition, logical implication, logical equivalence, predicates and quantifiers, rules of inference. | 9 |
| 4 | Proving Techniques: Mathematical induction, proof by contradiction, Pigeonhole principle, generalized Pigeonhole principle. Combinatorics: introduction, permutation, combination, binomial theorem, generating function, recurrence relation, homogeneous and constant coefficient recurrence relation, homogeneous solution, particular solution, solution by generating function. Graph Theory: Introduction of graph, types of graph, weighted graph, shortest path problem, graph coloring, chromatic number. | 9 |
| 5 | Linear Algebra I: Eigen value, Eigen vector, Eigen value decomposition, LU Decomposition, Singular value decomposition, Minimal polynomial, Jordan canonical form. | 8 |
| 6 | Linear Algebra II: Vector space, Linear combination, Linear independent and dependent vectors, spans, Basis, Dimension, Gram Schmidt process, Linear transformation, rank, nullity. | 9 |
| Total | | 45 |

Text Books:

1. Discrete Mathematics: Lipschutz, Schaum's Outlines, TMH, 2011
2. Discrete Mathematical Structures: V. B.L. Chaurasia and A. Srivastava, Genius Publications, 2007.
3. Linear Algebra Lipschutz, Schaum's Outlines, TMH, 2019.

Reference Books:

1. Discrete Mathematical Structures, Kolman et.al, Pearson, 2001.
2. A Text book of Discrete Mathematics, Swapan Kumar Sarkar, S.Chand Publ., 2021.
3. Discrete Mathematics and its applications, K .H. Rosen, McGraw Hill, 2011.
4. Linear Algebra, K. Hoffman and R. Kunze, PHI, 2013
5. Linear Algebra An Introduction, B. Richard and C. Gabriel, Elsevier, 2011

Prerequisite:

1. Basic knowledge of sets, sets operations.
2. Basic knowledge of counting techniques.
3. Basic knowledge of Matrices and determinants.

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Database Management System | Course Code: CDUL401 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Introduction to Database Systems: Overview of DBMS, File System v/s DBMS, Advantage of DBMS, Data Abstraction levels, Data Independence, Three tier schema architecture, Database users and Administrator, Structure of a DBMS. Entity Relationship model: Overview of Data Design Entities, Attributes and Entity Sets, Relationship and Relationship Sets, Features of the ER Model- Key Constraints, Participation Constraints, Weak Entities, Class Hierarchies, Aggregation, Reduction of ER-schema into Relational Model, Conceptual Design for a Large Enterprise. | 9 |
| 3 | Relational Algebra and Calculus: Relational Algebra- Select, Project, Cartesian Product, Union, Set Difference, Rename, Natural Join, Outer Join, Division, Relational Calculus- Tuple Relational Calculus and Domain Relational Calculus. Relational Model: Introduction to relational model- Concepts of domain, attribute, tuple, relation, importance of null values, constraints and their importance, Queries in SQL- Basic SQL Query, Null Values, Embedded SQL, Dynamic SQL, JDBC, ODBC, Triggers, SQL Injection. | 10 |
| 4 | Schema refinement and Normal forms: Introductions to Schema Refinement Normalization, Concept of Functional Dependencies- Attribute closure, functional dependency closure, finding candidate keys, Surrogate key, Types of decomposition, Normal Forms (1NF, 2NF, 3NF), Boyce-codd normal form(BCNF), Goals of Normalization, Fourth normal form(4NF), Canonical cover. | 9 |
| 5 | Transaction Processing: Transaction properties, Transaction model, Transaction states, Concurrent Executions, Need of Serializability, Conflict vs, View Serializability, Testing for Serializability, Recoverable Schedules, Cascadeless Schedules. | 8 |
| 6 | Concurrency Control: Implementation of Concurrency: Lock-based protocols, Graph based protocols, Timestamp-based protocols, Validation-based protocols, Deadlock handling. Database Failure and Recovery: Database Failures, Recovery Schemes: Shadow Paging, Log-based Recovery, Check Points, Database modifications, Recovery with Concurrent transactions. | 8 |
| Total | | 45 |

Textbooks:

1. A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 7th ed., McGraw-Hill, 2019.
2. R. Ramakrishnan and J. Gehrke, *Database Management Systems*, 3rd ed., McGraw-Hill, 2003.

Reference Books:

1. R. Elmasri and S. B. Navathe, *Fundamentals of Database Systems*, 7th ed., Pearson, 2015.

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2. C. J. Date, *An Introduction to Database Systems*, 8th ed., Pearson Education, 2003.
 3. J. R. Groff, P. N. Weinberg, and A. Oppel, *The Complete Reference SQL*, 3rd ed., McGraw-Hill, 2004.

Prerequisite:

1. Fundamentals of Data Structures – Understanding of arrays, linked lists, stacks, queues, trees, and graphs.
2. Mathematical and Logical Foundations – Concepts of set theory, relational algebra, and basic discrete mathematics.

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|---|---------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: III | Semester: IV |
| Course Name: Full Stack Development | Course Code: CDUL402 | Credit: 2 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 2L+T+0P | |

| Module No. | Contents | Hours |
|--------------|--|-------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Introduction to Internet & World Wide Web: History of the Internet & World- Wide Web, Web Browsers, Web Servers, Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Categories of Web Applications, Characteristics of Web Applications, Tiered Architecture HTML: Hypertext Mark Up Language (HTML) and Cascading Style Sheets (CSS) Basic HTML page, Text Formatting, Table, Headers, Linking, Images, List, Meta Elements, Cascading Style Sheets: Inline, Internal and External Style Sheet, Tailwind - CSS, CSS forms, CSS components drop down | 7 |
| 3 | Introduction of Java Script: Objects in JavaScript, Dynamic HTML with JavaScript, JS Alert, JS Button, JS popover, AJAX for data exchange with the server, Manipulating Document Object Model (DOM) with JavaScript, jQuery Framework, jQuery events, JSON data format, working with ES6 | 7 |
| 4 | Introduction to ReactJS: Understanding React Functional Component, Defining a Component, Component Rendering, Understanding JSX, React Router and Single Page Applications, React Forms, Introduction to Redux, Client-Server Communication | 5 |
| 5 | Understanding Node JS and Express JS: Getting started with Node JS, Interactive node with REPL, Node Module System, File system & streams, Building APIs in Node JS, Understanding Sockets in Node.js, Express Middleware, Form data, Providing static files, RESTful APIs, | 6 |
| 6 | MongoDB: Database Integration using MongoDB, CRUD with Mongoose & MongoDB | 4 |
| Total | | 30 |

Text Books:

- [1] M. Haverbeke, *Eloquent JavaScript: A Modern Introduction to Programming*, 3rd ed. San Francisco, CA: No Starch Press, 2018.
- [2] D. Crockford, *JavaScript: The Good Parts*. Sebastopol, CA: O'Reilly Media, 2008.
- [3] A. Banks and E. Porcello, *Learning React: Modern Patterns for Developing React Apps*, 2nd ed. Sebastopol, CA: O'Reilly Media, 2020.

Reference Books:

- [1] K. C. Joshi, *Learning React JavaScript Library from Scratch*, 1st ed. Birmingham, U.K.: Packt Publishing, 2017.
- [2] T. A. Powell, *HTML & CSS: The Complete Reference*, 5th ed. New York, NY: McGraw-Hill Education, 2017.
- [3] T. A. Powell, *JavaScript: The Complete Reference*, 6th ed. New York, NY: McGraw-Hill Education, 2013.

Prerequisite: Basic knowledge of HTML, CSS, Java

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Computer Networks | Course Code: CDUL403 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 3L+0T+0P | |

| Module No. | Contents | Hours |
|--------------|---|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Introduction to Data Communications: Signal propagation, Signal types, Signal parameters, Switching & forwarding, Transmission impairments, Attenuation, Delay distortion, Noise, Effects of limited bandwidth, Data rate limits-Nyquist's theorem and Shannon's theorem, Topologies, OSI Model, Layers in OSI model, TCP/IP protocol Suite Physical Layer: Computer Network & types of networks (LAN, MAN, WAN), topology & types of topologies, Ad-Hoc Networks, modes of communications (simplex, half duplex, full duplex), Protocols, Networking models, OSI Reference Model, Internet Model (TCP/IP), Types of media: wired and wireless media | 9 |
| 3 | Data Link Layer: Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms). | 8 |
| 4 | Network Layer: Network Service Model, Data gram & Virtual Circuit, Routing Principles, The Internet Protocol (IPv4 & IPv6), IP addressing and sub netting, Basic Internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Static and dynamic routing Algorithms, Unicast Routing Protocols: RIP, OSPF, BGP, Multicast Routing Protocols : MOSPF, DVMRP. | 10 |
| 5 | Transport Layer: Transport-Layer Services, User Datagram Protocol, port addressing, Multiplexing and Demultiplexing, Principles of Reliable Data Transfer, Congestion Control, TCP's Congestion Control, Quality of Service. | 9 |
| 6 | Application Layer: Principles of Application Layer Protocols, The Web and HTTP, FTP, Telnet, Electronic Mail in the Internet (SMTP, MIME, POP3, IMAP), DNS, Introduction to SNMP. | 8 |
| Total | | 45 |

Textbooks:

1. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 5th ed., Pearson India, 2013.
2. L. L. Peterson and B. S. Davie, *Computer Networks: A Systems Approach*, 5th ed., Elsevier India, 2011.
3. F. Halsall, *Data Communications, Computer Networks, and Open Systems*, Pearson Education, 2008.

Reference Books:

1. J. F. Kurose and K. W. Ross, *Computer Networking: A Top-Down Approach*, 6th ed., Pearson, 2017.
2. D. E. Comer, *Internetworking with TCP/IP Vol. 1*, 6th ed., Pearson, 2015.
3. S. Keshav, *An Engineering Approach to Computer Networking*, 1st ed., Pearson India, 2002.
4. B. A. Forouzan, *Data Communications and Networking*, 5th ed., Tata McGraw-Hill, 2013.

Prerequisite:

Data Communication Basics – Knowledge of transmission modes, protocols.

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Operating System | Course Code: CDUL404 | Credit: 3 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 2L+0T+0P | |

| Module No. | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Introduction and History of Operating systems: Introduction to OS, types of OS, Process concepts, process state, system call, process control block, scheduling queues, process scheduling, threads, multithreading. | 7 |
| 3 | Inter Process management: Process synchronization, critical sections, mutual exclusion, inter process communication, semaphores, wait and signal procedures, critical section problem, Peterson's solution, synchronization hardware, semaphores, classic problems of synchronization, readers and writers problem, dining philosophers problem, Sleeping Barber Problem. | 10 |
| 4 | Deadlocks: System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery from deadlock banker's algorithm. | 8 |
| 5 | Memory management: Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, Virtual memory, demand paging, allocation of frames, page-replacement algorithms, Optimal (OPT), First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU), thrashing. | 10 |
| 6 | File system interface: File Concept, Access Methods, Directory Structure, File System Structure, Allocation Methods, and Free-Space Management. System Protection: Goals, Principles, Domain of Protection, Access Matrix, Access Control I/O Management: Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms. | 9 |
| Total | | 45 |

Textbooks:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, *Operating System Concepts*, 10th ed., Wiley, 2018.
2. W. Stallings, *Operating Systems: Internals and Design Principles*, 9th ed., Pearson, 2018.
3. D. M. Dhamdhere, *Operating Systems: A Concept-Based Approach*, 3rd ed., Tata McGraw-Hill, 2017.

Reference Books:

1. S. Tanenbaum and H. Bos, *Modern Operating Systems*, 5th ed., Pearson, 2022.
2. S. Sinha, *Distributed Operating Systems: Concepts and Design*, 2nd ed., Prentice Hall, 2004.

Prerequisite:

1. Understanding of computer architecture, including memory management, CPU scheduling, file systems, and networking concepts, as operating systems interact with network protocols.
2. Proficiency in programming languages like C and C++, along with a solid grasp of algorithms and data structures, to comprehend OS design and implementation.

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Computer Architecture and Microprocessor | Course Code: CDUL405 | Credit: 2 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs. | Teaching Scheme: 2L+0T+0P | |

| Module No. | Contents | Hours |
|--------------|---|-----------|
| 1 | Introduction: Objective, Scope, Outcome of the Course and Prerequisite. | 1 |
| 2 | Microoperations, ALU Design: Functional units of a computer, Von Neumann and Harvard computer architectures, Fixed point representation, Floating point representation, Register Transfer language, Register Transfer, Bus, and Memory Transfers (Tree-State Bus Buffers, Memory Transfer), Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logical shift unit. Basic Computer Organization and Design Instruction codes, Computer registers, computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output, and interrupt, ALU Design, Data Path Design. Control Unit: Hardwired control Unit, Micro-programmed control unit. | 9 |
| 3 | Instruction Set Architecture & Pipelining: Two Pass Assembler, Instruction format, Addressing Modes, Reduced Instruction Set Computer (RISC), Complex Instruction Set Computer (CISC), Flynn's taxonomy, Parallel Processing, Pipelining, Instruction Pipeline, Pipeline Hazards. | 6 |
| 4 | I/O, Memory Organization: Synchronous vs. asynchronous I/O, Programmed I/O, Interrupt driven I/O, Direct Memory Access. Memory Hierarchy: Cache, Main Memory and Secondary Memory. | 6 |
| 5 | Fundamentals of 8085: 8085 & 8086 Microprocessor Architecture, pin description, Bus concept and organization; concept of multiplexing and de-multiplexing of buses, 8085 Instruction Set, instruction Format and timing, Instruction Cycle, Machine Cycle, T state, Timing Diagram, Addressing Modes in 8085. | 8 |
| Total | | 30 |

Textbooks:

1. M. M. Mano and C. R. Kime, *Computer System Architecture*, 3rd ed., Pearson, 2017.
2. R. S. Gaonkar, *Microprocessor Architecture, Programming, and Applications with the 8085*, 6th ed., Penram International, 2013.

Reference Books:

1. J. P. Hayes, *Computer Architecture and Organization*, 3rd ed., McGraw-Hill, 2017.
2. D. A. Patterson and J. L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, 6th ed., Morgan Kaufmann, 2020.

Prerequisite: Digital Electronics

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|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Database Systems Lab | Course Code: CDUP420 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 0L+0T+3P | |

| Exp No. | Experiments |
|---------|---|
| 1 | Introduction of latest DBMS tools and ER diagram design for Banking Management system, University database, Enterprise or a library management system using ER diagram design using any open-source tool. |
| 2 | Write SQL commands to perform various SQL Commands of DDL with constraints (create, alter, drop, truncate) |
| 3 | To perform various SQL Commands of DML (insert, update, delete, select, rename) |
| 4 | To execute Nested Queries, Join Queries, order-by, having clause and string operation |
| 5 | To perform set operations and aggregate functions |
| 6 | Write a PL/SQL block for transaction application using Triggers. |
| 7 | To perform Stored procedures and functions. |
| 8 | To perform commands related to database user management (create database user, delete user and assign privilege to user) and Import/Export database. |
| 9 | Create reports using database connectivity of Front end with back end like JAVA/PHP/Python or any other. |
| 10 | (a) Case Study of SQL Injection. (b) Case Study of MongoDB/NoSQL |

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|--|----------------------------------|---------------------|
| Name of the Programme: B.Tech. in Computer Science and Engineering (Data Science) | Year: III | Semester: IV |
| Course Name: Full Stack Development Lab | Course Code: CDUP421 | Credit: 1.5 |
| Max Marks: 100 | CIE: 40 | SEE: 60 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 0L+0T+3P | |

| S.No. | Experiments |
|-------|---|
| 1 | Develop a static HTML page with text formatting, tables, headers, links, images, and lists. |
| 2 | Create a webpage with internal and external CSS. Implement CSS for layout and design, including forms and dropdown components using Tailwind CSS. |
| 3 | Implement JavaScript to create interactive elements such as alerts, buttons, and popovers. Use AJAX to fetch and display data from an API. |
| 4 | Write a JavaScript program to manipulate the DOM. Update the content and style of HTML elements based on user interactions. |
| 5 | Use jQuery to handle user events and manipulate HTML elements. Work with JSON data and apply ES6 features. |
| 6 | Build a React functional component. Implement JSX, manage state, and handle events within the component. |
| 7 | Set up React Router to create a single-page application with multiple routes. Implement navigation between different views. |
| 8 | Develop a Node.js script to interact with the file system. Read, write, and manipulate files using Node's built-in modules. |
| 9 | Create a RESTful API using Express.js. Implement routes, middleware, and handle form data. |
| 10 | Connect a Node.js application to MongoDB using Mongoose. Perform CRUD operations (Create, Read, Update, Delete) on a sample dataset. |
| 11 | Build a full-stack application that integrates a React frontend with a Node.js backend and MongoDB database. Implement user authentication, data storage, and interactive features. |

| | | |
|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: Microprocessor Lab | Course Code: CDUP422 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 0L+0T+3P | |

Implement the following using assembly language programming

| S. No. | Experiments |
|--------|---|
| 1. | Access the data stored at memory locations to perform different arithmetic operations and finally show the results. |
| 2. | Illustrate the different data transferring operations between memory locations using microprocessor. |
| 3. | Perform different number system conversion operations on the data using microprocessor. |
| 4. | Perform sorting and ranking (minimum, maximum, median, etc.) operations on the data in an array using microprocessor. |
| 5. | Illustrate the generation of different waveforms on a serial data pin of a microprocessor. |
| 6. | Design and simulate a traffic light controller system on microprocessor. |
| 7. | Design and simulate a sensor interface on a microprocessor which can read the sensor data and display it on a screen. |

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| | | |
|---|----------------------------------|---------------------|
| Name of the Programme: B. Tech. in Computer Science and Engineering (Data Science) | Year: II | Semester: IV |
| Course Name: R-Programming for Data Science | Course Code: CDUP423 | Credit: 1.5 |
| Max Marks: 100 | CIE: 60 | SEE: 40 |
| End Term Exam Time: 3 Hrs | Teaching Scheme: 0L+0T+3P | |

| S.No. | Experiments |
|-------|---|
| 1 | Download and install R-Programming environment and install basic packages using install.packages() command in R. |
| 2 | Write a program to: Create variables and assign values to them. Use R operators to perform basic mathematical operations. |
| 3 | Write a program to use control flow statements to create conditional and iterative statements. |
| 4 | a) Write R functions to perform common tasks. b) Use various methods to Import and export data from various sources. |
| 5 | Demonstrate different methods to Clean and wrangle data to remove errors and inconsistencies. |
| 6 | Summarize data using descriptive statistics. |
| 7 | Create basic visualizations using R, such as bar charts, line charts, and scatter plots. |
| 8 | Create advanced visualizations using R, such as heatmaps, tree maps, and interactive visualizations. |
| 9 | Write R program for Regression Modeling. |
| 10 | Write R program to build classification model using KNN algorithm. |
| 11 | Write R program to build clustering model using K-mean algorithm. |
| 12 | Create An Interactive Web App Using Shiny Package In R. |
| 13 | Drawing three dimensional objects and Scenes using RGL Package. |