



**Course Name:** Data Structures and Algorithms  
**Course Code:** DS-301  
**(Semester- III)**  
**Course Broad Category:** Program Core (PC)

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**1. Course Prerequisite: Programming for Problem Solving using C**

**2. Course Learning Objectives:**

- i. To learn the basics of abstract data types.
- ii. To learn the principles of linear and nonlinear data structures.
- iii. To build an application using sorting and searching

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Mid-Term Exam (40 Marks)- Formative Assessment [Continuous Assessment 1 (CIA-1)]
- B. Internal Assessment (40 Marks)- Formative Assessment [Continuous Assessment 2(CIA-2)]
- C. End-Semester Exam (60 Marks)- Summative Assessment.

**4. Course Content:**

**Course Name:** Data Structures and Algorithms  
**Course Code:** DS-301

**Hours per Week:** 3L: 0T: 0P

**Credits:** 3

Module	Topics	45L
1.	Introduction: Design of algorithm to solve a problem, Concept of static and dynamic memory allocation, Abstract Data Type (ADT)	3L
3.	Array, Single and multi-dimensional array, Memory representation (row major and column major) of array, Insertion, and deletions in array, Advantages and disadvantages of array	2L

Module	Topics	45L
4.	Linked list as an ADT, Memory allocation and deallocation for a linked list, Linked list versus array, Types of linked lists: singly linked list, doubly linked list and circular linked list, Operations on linked list: creation, display, insertion and deletion (in different positions), summation, average, maximum, minimum etc. Application of linked list: representations and operations on polynomials, sparse matrices.	5L
5.	Stack as an ADT, Main operations (push and pop), auxiliary operations and axioms, Array implementation of stack, Limitation of array implementation, Linked list implementation of stack, Applications of stack: Recursion, Function call, Evaluation of postfix expression using stack, Conversion of infix to postfix using stack.	5L
6.	Queue as an ADT, Main operations (enqueue and dequeue), Auxiliary operations and axioms, Array implementation of queue, Limitation of array implementation and Circular queue, Linked list implementation of queue, Double ended queue (dequeue) Priority queue and its applications.	7L
7.	Binary Tree, Definition and properties, Representation of binary tree in memory: linked representation, array representation, Binary tree traversal, Preorder, Inorder and Postorder, Expression tree, Heap and its applications.	5L
8.	Search trees: Binary search tree, Balanced binary search tree, AVL tree, Red Black tree, M-way tree, M-way search tree, B tree, B+ Tree.	5L
9.	Searching: Linear search and binary search.	2L
10.	Sorting: Bubble sort, Selection sort, Insertion sort, Quick Sort, Merge sort, Heap sort	6L
11.	Hashing: Hash functions. Collision, Collision resolution techniques: linear probing, quadratic probing, double hashing, chaining, Rehashing	3L
12.	Graph: Degree, Connectedness, Representation using matrix, Adjacency list, Directed Graphs, Directed Acyclic Graph	2L

## 5.

### Text Book:

1. Debasis Samanta, *Classical Data Structures*, PHI
2. Robert L. Kruse, Bruce P. Leung, *Data Structures and Program Design in C*, Pearson

3. R.S. Salaria, Data Structure & Algorithms Using C, Khanna Publishing House .
4. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, *Fundamentals of Data Structures of C*, Universities Press
5. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, *Data Structures in C*, PHI

**Reference Books:**

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, MIT Press.
2. Yashwant Kanetkar, *Data Structures through C*, BPB Publications.
3. R.B Patel, *Expert Data Structures with C++*, Khanna Publishing House.

**6. COURSE OUTCOMES (COs)**

On completion of the course students will be able to

Course Outcomes	Details	Action Verb	Knowledge Level
DS-301.CO1	Construct algorithms from problems.	Construct	Level 4- Analyze
DS-301.CO2	Understand the basics of Stack, Queue.	Understand	Level 2- Understand
DS-301.CO3	Categorize the necessarily of linked list and array implementation.	Categorize	Level 4- Analyze
DS-301.CO4	Learn the real life use of Tree and graph.	Learn	Level 3- Apply
DS-301.CO5	Compare different sorting and searching methods.	Compare	Level 4- Analyze
DS-301.CO6	Understand the implementation mechanism of sorting and searching.	Understand	Level 2- Understand

**7.Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	2		-	-	3	3
3	-	-	3	-		-
4	-	2	3	-	-	-
5	-	-	-	3	-	-

6	-	-	-	3	-	-
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### 8. Mapping of the Course outcomes to Program Outcomes (PO)

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
<b>CO1</b>	3	3	3	3	2	1	1	1	1	1	2	2
<b>CO2</b>	3	2	3	3	-	1	1	1	1	1	2	2
<b>CO3</b>	3	3	3	2	-	-	-	-	1	1	-	2
<b>CO4</b>	3	2	3	3	-	-	-	-	1	1	-	2
<b>CO5</b>	3	3	2	3	-	-	-	-	1	1	-	2
<b>CO6</b>	3	3	3	3	-	-	-	-	1	1	-	2

### 9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3	PSO4
<b>CO1</b>	1	2	3	2
<b>CO2</b>	2	2	2	3
<b>CO3</b>	2	2	2	3
<b>CO4</b>	2	3	2	2
<b>CO5</b>	2	2	3	2
<b>CO6</b>	2	3	2	2

Reference: NIT Durgapur



**Course Name: Principles of Data Science**

**Course Code: DS-302**

**(Semester- III)**

**Course Broad Category: Program Core (PC)**

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**1. Course Prerequisite:**

Students are expected to have basic knowledge of algorithms and reasonable programming experience (like programming in C --Files concepts) of B. Tech 1st Year is sufficient to cope up this subject, and some familiarity with basic linear algebra (e.g. solution of linear systems and eigenvalue/vector computation) and basic probability and statistics.

**2. Course Learning Objectives:**

By the end of this course, students will be able to:

- **Understand the Foundations of Data Science**  
Explain the core concepts, roles, and processes in data science, including the data science lifecycle.
- **Apply Data Wrangling Techniques**  
Perform data cleaning, transformation, and integration using appropriate tools and techniques.
- **Conduct Exploratory Data Analysis (EDA)**  
Use statistical and visualization techniques to discover patterns, trends, and relationships in data.
- **Implement Basic Machine Learning Algorithms**  
Apply supervised and unsupervised learning models to solve real-world problems.
- **Evaluate Model Performance**  
Assess and interpret the results of data models using performance metrics and validation techniques.
- **Utilize Data Science Tools and Programming**  
Use programming languages such as Python along with libraries (e.g., Pandas, Scikit-learn, Matplotlib) to perform data analysis and modeling.
- **Communicate Data Insights Effectively**  
Present findings and recommendations clearly through reports, dashboards, and visualizations.
- **Apply Ethical Practices in Data Science**  
Recognize and address ethical, legal, and privacy issues associated with data science.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** –Lectures and Presentations, Learning Management System(LMS), Interactive Discussions and Case Studies, Industry Lectures.

### Evaluation System –

- A. Mid-Term Exam (40 Marks)- Formative Assessment(CIA-1)  
[Continuous Assessment 2 (CIA-2)]
- B. Internal Assessment (40 Marks)- Formative Assessment  
[Continuous Assessment 2 (CIA-2)]
- C. End-Semester Exam (60 Marks)- Summative Assessment.

### 4. Course Content:

**Course Name:** Principles of Data Science

**Course Code:** DS-302

**Hours per Week:** 3L:0T:0P

**Credits:** 3

Module	Topics	45L
1.	<b>Introduction to Data Science:</b> What is Data Science? Brief History of Data Science, Data Science and Related Terminologies, Applications of Data Science. <b>Toolboxes (Python):</b> Integrated development environment (IDE). Data types, Operators, Function, Python Libraries, NumPy Libraries, Pandas Library, File Handling (Reading, Writing, Appending), Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking.	7L
2.	<b>Exploratory Data Analysis (EDA):</b> Steps in Data Preprocessing, Understanding and Looking at the Data, Visualizing and Dealing with Outliers of Data (Barplot). <b>Standardizing Data:</b> Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p values. <b>Data Visualization:</b> Importance of Data Visualization, Data Visualization Techniques using Python: Matplotlib Library (Histogram, Scatter Plot, Pie Chart, Area Chart, Meshgrid, Quiver Plot, Contour Plot), Seaborn Library (Count Plot, Bar Plot, Point Plot, Violin Plot, Swarm Plot, Rug Plot, Cat Plot, Dist Plot, Joint Plot, Rel Plot, Pair Plot).	8L
3.	<b>Dimensionality Reduction Techniques:</b> Dimensionality Reduction, Independent and Dependent variables, Correlation, Multicollinearity, Factor Analysis. <b>Types of Machine Learning Algorithms:</b> Introduction to machine learning, Supervised and Unsupervised Learning Algorithms, Feature Space, Underfitting and Overfitting, Life cycle of Machine Learning, Evaluation Metrics, Training, Testing and Cross Validation, Application of machine learning. <b>Unsupervised Learning:</b> Association Rule Mining, Conjoint Analysis, Clustering: Types, Distance Measures: Euclidean, Manhattan, Minkowski. K-means, DbScan, Hierarchical clustering.	7L
4.	<b>Supervised Learning Algorithms (Linear and Logistic Regression):</b>	10L

	<p>Simple Linear Regression: Building, Interpretation of Coefficients, and Validation, Multiple</p> <p>Linear Regression: Dummy Variable, Interpretation of Coefficients, Coefficient of Determination, Model Performance Measures,</p> <p>Logistic Regression: Binary Logistic Regression, Sigmoid Curve, Building Logistic Regression Model, Variable Selection, Threshold Value, Model Performance Measures.</p> <p><b>Supervised Learning Algorithms (Decision Tree and Random Forest):</b></p> <p>Decision Tree: Tree Structure, Criteria for Splitting Decision Node, Control Parameters, Pruning the Tree, Model Performance Measure, Insights from Decision Rules,</p> <p>Random Forest: Control Parameters, Out of Bag Error Rate, Tuning the Random Forest, Variable Importance Plot, Model Performance Measures.</p>	
5.	<p><b>Supervised Learning Algorithms (KNN, Naïve Bayes):</b></p> <p>K-Nearest Neighbors: Similarity Based on Distance Function, Select Appropriate K Value, KNN Model Building, Model Performance Measures</p> <p>Naïve Bayes Algorithm: Types of Naïve Bayes Theorem, Building Naïve Bayes Classifier, Model Performance Measure.</p> <p><b>Support Vector Machines (SVM) and Artificial Neural Network (ANN):</b></p> <p>Support Vector Machine: Hyperplanes and Support Vectors, Hyperparameter in SVMs, Support Vector Machine Model Building, Model Performance Measures.</p> <p>Artificial Neural Networks: Application of ANNs, ANN Model Building, Steps in ANN Model Building, Model Performance Measures, Types of Artificial Neural Networks.</p>	8L
6.	<p><b>Data Science and Ethical Issues-</b> Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists.</p> <p><b>Miscellaneous:</b> Introduction to Deep learning, Convolutional Neural Networks, Natural Language Processing (NLP), Large Language Model (LLM), Time Series Analysis</p>	5L

## 5. References:

### Text Book:

- B. Uma Maheswari, R.Sujatha, "Introduction to Data Science", Wiley
- Sinan Ozdemir, "Principles of Data Science", Packt.
- Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014

### Reference Books:

- Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 1st Edition, 2014.

## 6. Course Outcomes (CO):

On completion of the course students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
DS-302.CO1	Describe what Data Science is and the skill sets needed to be a data scientist	Remembering	Level 1 - Remember
DS-302.CO2	Ability to learn the Python programming	Apply	Level 3- Apply
DS-302.CO3	Illustrate the significance of exploratory data analysis (EDA) in data science.	Understanding, Analyzing	Level 2- Understand, , Level 4 –Analyze
DS-302.CO4	Understand the various tools for Data Science and its Analysis.	Creating	Level 6-Create
DS-302.CO5	Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN),k-means, Naive Bayes) for predictive modeling.	Understand, Evaluation	Level 2 - Understand, Level 5- Evaluate
DS-302.CO6	Identify common approaches used for Feature Generation. Identify basic Feature Selection algorithms (Filters, Wrappers, Decision Trees, Random Forests) and use in applications.	Understand, Evaluation	Level 2- Understand, Level 5 -Evaluate

## 7.Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	2		-	-	3	3
3	-	-	3	-		-
4	-	2	3	3	-	3
5	-	-	-	3	3	-
6	1	-	2	-	1	1

### 8. Mapping of the Course outcomes to Program Outcomes (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	1	-	2	2	3	2	3	-	2
CO2	3	2	1	1	2	-	-	3	3	1	1	3
CO3	3	2	3	1	1	-	-	2	3	2	2	2
CO4	3	3	3	2	-	-	-	3	3	2	2	2
CO5	3	2	1	1	3	-	-	2	3	1	2	2
CO6	3	2	2	1	-	-	-	2	2	-	2	1

### 9. Mapping to Program Specific Outcome (PSO)

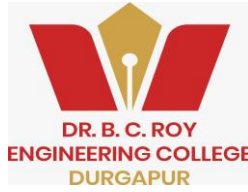
	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	2
CO2	2	2	2	3
CO3	2	2	2	3
CO4	2	3	2	2
CO5	2	2	3	2
CO6	1	2	1	2

\*\*\* End of Syllabus\*\*\*

**REFERENCE**

[www.andhrauniversity.edu.in](http://www.andhrauniversity.edu.in)





**Course Name: Comprehensive Guide to DBMS and Query Optimization**

**Course Code: DS-303**

**(Semester- IV)**

**Course Broad Category: Program Core (PC)**

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**1. Course Prerequisite:**

Concepts of computer programming (like programming in C --Files concepts).

The course introduced under the subject “C Programming” and “Computer Programming and Data Structures” of B.Tech 1st Year is sufficient to cope up with this subject.

**2. Course Learning Objectives:**

This course introduces the core principles and techniques required in the design and implementation of database systems. This course focus on relational database management systems, including database design theory: E-R modeling, data definition and manipulation languages, database security and administration. It also covers essential DBMS concepts such as: Transaction Processing, Concurrency Control and Recovery and various types of databases like distributed database, and intelligent database, Client/Server. Students undertake a semester project to design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS. It also provides students with theoretical knowledge and practical skills in the use of databases and database management systems in information technology applications.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology –**

Lectures and Presentations, Learning Management System(LMS), Interactive Discussions and Case Studies, Industry Lectures.

**Evaluation System –**

- A. Mid-Term Exam (20 Marks)- Formative Assessment (CIA-1)
- B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 2 (CIA-2)]
- C. End-Semester Exam (60 Marks)- Summative Assessment.

**4. Course Content:**

**Course Name:** Comprehensive Guide to DBMS and Query Optimization

**Course Code:** DS-303

**Hours per Week:** 3L:0T:0P

**Credits:** 3

<b>Module</b>	<b>Topics</b>	<b>45L</b>
1.	<b>Introduction to DBMS:</b> Concept & Overview of DBMS, Applications, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.	3L
2.	<b>Entity-Relationship Model:</b> Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features	5L
3.	<b>Relational Model:</b> Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.	5L
4.	<b>SQL and Integrity Constraints:</b> Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.	6L
5.	<b>Index Structures:</b> Necessity of index structures, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+tree .	4L
6.	<b>Normalization:</b> Functional Dependency, Anomalies in a Database, The normalization process: Conversion to first normal form, Conversion to second normal form, Conversion to third normal form and BCNF, Fourth Normal form and fifth normal form, normalization and database design, Denormalization, Loss-less join decomposition, Dependency preservation.	6L
7.	<b>Transaction processing:</b> Introduction of transaction processing, advantages and disadvantages of transaction processing system, online transaction processing system, serializability and recoverability, view serializability.	4L
8.	<b>Concurrency Control:</b> Serializability: Enforcing, Serializability by Locks, Locking Systems With Several, Lock Modes, Architecture for a Locking Scheduler Managing Hierarchies of Database Elements, Concurrency Control by Timestamps, Concurrency Control by Validation.	4L
9.	<b>Database recovery management:</b> Deferred database modification Vs. Immediate database modification, Check point technique.	3L

10.	<b>Query Optimization:</b> Heuristics in Query Optimization, Converting Query Tree to Query Evaluation Plan.	3L
11.	<b>Distributed Database (DDB):</b> Introduction of DDB, DDBMS architectures, Homogeneous and Heterogeneous databases, Distributed Data storage, Advantages of Data Distribution, Disadvantages of Data Distribution Distributed transactions, Commit protocols, Data Replication, Data Fragmentation. Distributed database transparency features.	2L

## 5. References:

### Text Book:

- R. Elmasri & S. B. Navathe, “Fundamentals of Database Systems”, Pearson Education 7th Edition, 2017.
- “Database System Concepts” , 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
- “Distributed Databases Principles & Systems”, Stefano Ceri and Giuseppe Pelagatti, McGraw-Hill International Editions.

### Reference Books:

- An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition for UNIT III.
- D Raghu Ramakrishnan and Johannes Gehrke, “ Database Management Systems” , Mc Graw Hill, 2014
- “Fundamentals of Database Systems”, Ramez Elmasri and Shamkant B. Navathe, Addison-Wesley.

## 6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
<b>DS-303.CO1</b>	To introduce students to the fundamentals of Database Systems.	Recognize	Level 1- Remember
<b>DS-303.CO2</b>	To train students to apply logical database design principles, including E-R diagrams and database normalization.	Explain	Level 2- Understand
<b>DS-303.CO3</b>	To focus on Relational data model concepts.	Illustrate	Level 3-Apply
<b>DS-303.CO4</b>	To enable students to construct simple and moderately advanced database queries using structured Query Language (SQL).	Organize	Level 4- Analyze
<b>DS-303.CO5</b>	To become familiar with the basic issues of transaction processing and concurrency control.	Determine	Level 5- Evaluate

<b>DS-303.CO6</b>	To encourage students to design and implement a small database project	Construct	Create
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### 7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	2	-	-	-	-	1
2	-	2	-2	1-	-	1
3	-	-	-	-	1	1
4	-	3	2	-	-	1
5	-	-	-	2	-	1
6	-	-	-	1		1

### 8. Mapping of the Course outcomes to Program Outcomes (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
<b>CO1</b>	1	2	2	2	1	-	-	-	-	-	-	1
<b>CO2</b>	2	1	2	2	1	-	-	-	1	-	-	1
<b>CO3</b>	2	2	2	1	1	-	1	1	-	-	-	1
<b>CO4</b>	2	1	1	1	1	-	-	-	-	-	-	1
<b>CO5</b>	1	1	2	1	2	-	-	-	-	-	-	1
<b>CO6</b>	-	-	-	-	-	-	-	-	-	-	-	1

### 9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3	PSO4
<b>CO1</b>	2			
<b>CO2</b>		1	2	
<b>CO3</b>	1		1	
<b>CO4</b>		1		1
<b>CO5</b>	1			
<b>CO6</b>		1	1	

\*\*\* End of Syllabus\*\*\*

### **REFERENCES:**

**NIT Durgapur/CSE/DBMS Syllabus**

**IEST Shibpur/CSE/ DBMS Syllabus**

**Jadavpur University/CSE/ DBMS Syllabus**



**Course Name:** Computer Organization and Architecture

**Course Code:** DS-304

**(Semester- III)**

**Course Broad Category: Program Core (PC)**

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**1. Course Prerequisite: Knowledge of computer basics and digital logic.**

**2. Course Learning Objectives:**

- i. To learn how Computer Systems work & the basic principles.
- ii. To learn Instruction Level Architecture and Instruction Execution.
- iii. To learn the current state of art in memory system design.
- iv. To learn how I/O devices are accessed and its principles.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Learning Management System (LMS), Interactive Discussions and Case Studies, Industry Lectures.

**Evaluation System –**

- A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
- B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
- C. End-Semester Exam (60 Marks)- Summative Assessment.

**4. Course Content:**

**Course Name: Computer Organization and Architecture**

**Course Code: DS-304**

**Hours per Week: 3L: 0T: 0P**

**Credits: 3**

<b>Module</b>	<b>Topics</b>	<b>45L</b>
1.	<b>Introduction:</b> Evolution of computers, Basic Structure of Computers: Basic Operational Concepts, GPR based and stack based organisation. Bus Structures, Performance Measurement: Processor Clock, Basic Performance Equation, Clock Rate, Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output	10L

Module	Topics	45L
	Operations, Encoding of Machine Instructions (Huffman encoding etc)	
2.	<b>Fundamental concepts of the processing Unit:</b> Fetching and Storing words, Register Transfer, Execution of instruction, Arithmetic Operations: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Combinational and Sequential ALU, ALU expansion strategies, Design of Multipliers and Dividers, Wallace tree and Booth's Multipliers, Floating Point Numbers (IEEE754), Floating Point Operations, Multiplication of Positive Numbers, Signed Operand Multiplication (Booth's Multiplication etc.), Fast Multiplication, Integer Division.	10L
3.	<b>Computer Organization and Design (Data path and control path):</b> Instruction codes, computer registers, computer instructions, timing & control, instruction cycle, memory reference instructions, Hard-wired Control, Micro programmed Control: Micro instruction, Microprogram sequencing, Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, Bus Arbitration schemes, USB. (Brief overview of 8085/8086 microprocessor).	10L
4.	<b>Memory System:</b> Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, page mode access, interleaved access. Performance Considerations, Virtual Memories, Secondary Storage.	10L
5.	<b>Basic concepts of pipelining:</b> The instruction pipeline – pipeline hazards – instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC. Introduction to GPP, ASIP and ASIC etc.	5L

### 5. Text Book:

1. David A Patterson, John L Hennessy, "Computer Organization and Design", (The Hardware/Software Interface) Morgan Kaufmann.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill.

### Reference Books:

1. William Stallings, "Computer Organization and Architecture".
2. Nicholas P Carter, "Computer Architecture & Organisation".



## 9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	2
CO2	2	2	2	3
CO3	2	2	2	3
CO4	2	3	2	2
CO5	2	2	3	2

\*\*\* End of Syllabus\*\*\*

### REFERENCES:

NIT Durgapur/CSE/ Computer Organization and Architecture Syllabus  
IEST Shibpur/CSE/ Computer Architecture and Organization Syllabus



**Course Name: Probability and Statistics for Data Science**

**Course Code: DS-305**

**(Semester III)**

**Course Broad Category: Basic Science (BS)**

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**1. Course Prerequisite:**

Mathematics in B. Tech 1<sup>st</sup> year standard.

**2. Course Learning Objectives:**

The objective of these courses to familiarize the prospective engineers with techniques in probability and statistics. It aims to equip the students with standard concepts and tools at an intermediate to advance level that will serve them well towards tackling more advance level of mathematics and applications that they would find useful in their disciplines.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

**Evaluation System –**

- A. Mid-Term Exam (40 Marks)- Formative Assessment [Continuous Assessment 1 (CIA-1)]
- B. Internal Assessment (40 Marks)- Formative Assessment [Continuous Assessment 2 (CIA-2)]
- C. End-Semester Exam (60 Marks)- Summative Assessment.

**4. Course Content:**

**Course Name: Probability and Statistics for Data Science**

**Course Code: DS-305**

**Hours per Week: 3L: 0T: 0P**

**Credits: 3**

<b>Module</b>	<b>Topics</b>	<b>42L</b>
1.	<b>Probability:</b> Review on Basic Probability theory, Random Variable, Discrete and continuous random variables, Mathematical expectation, properties of expectation and variance, Discrete (Binomial and Poisson's distribution) and Continuous Probability Distribution (Normal and exponential distribution). Continuous and Discrete Bivariate distributions and their properties, Conditional and Marginal densities.	12L

<b>Module</b>	<b>Topics</b>	<b>42L</b>
2.	<b>Stochastics Process:</b> Definition, classification, and examples of stochastic processes; stationary and autoregressive processes; discrete-time Markov chains; continuous-time Markov chains; martingales; Brownian motion and its applications; renewal processes; Branching processes.	8L
3.	<b>Basic Statistics and Sampling Distribution:</b> Correlation and regression – Rank correlation, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Law of large numbers, central limit theorem, sampling distributions, chi square distribution, Student's 't' distribution, F distribution.	8L
4.	<b>Inferential Statistics:</b> Estimation of Parameters: Point estimation: sufficiency, unbiased estimation, maximum likelihood estimation, confidence intervals for mean, Hypothesis testing: type-I and type-II errors, One and two tailed tests. Test for single mean, difference of means, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	8L
5.	<b>Applied Statistics:</b> Analysis of variance: one-way and two-way classifications. Estimation of main effects, interactions and analysis of $2^k$ factorial experiment in general with particular reference to $k = 2, 3$ and 4 factorial experiments.	6L

## 5. References:

### Text Book:

- Kapoor, V.K., and Gupta, S.C.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Kapoor, V.K., and Gupta, S.C.: Fundamentals of Applied Statistics, Sultan Chand & Sons.
- Medhi, J.: Stochastic Processes, New Age International Publishers.

### Reference Books:

- Mukhopadhyay, P.: Mathematical Statistics, New Central Book Agency.
- Dreyfus, S.E.: The Art and Theory of Dynamic Programming: Theory and Applications, Academic Press.
- Goon, A.M., Gupta, M.K., and Dasgupta, B.: Outlines of Statistics, Vol. II, The World Press Private Ltd.
- Hoel, P.G.: Introduction to Mathematical Statistics, John Wiley & Sons.
- Hogg, R.V., Tanis, E.A., and Rao, J.M.: Probability and Statistical Inference (7th Edition), Pearson.

## 6. Course Outcomes (CO):



## 9. Mapping to Program Specific Outcome (PSO)

	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
<b>CO1</b>	1	2	3	2
<b>CO2</b>	2	2	2	3
<b>CO3</b>	2	2	2	3
<b>CO4</b>	2	3	2	2
<b>CO5</b>	2	2	3	2
<b>CO6</b>	1	2	2	3

**\*\*\* End of Syllabus\*\*\***



**Course Name: Effective Technical Communication**

**Course Code: DS-306**

**(Semester 3)**

**Course Broad Category: Humanities**

.....  
**1. Course Prerequisite: Basic knowledge in LSRW Skills.**

**2. Teaching methodology and evaluation system for the course:**

**Teaching methodology:**

Lectures and Presentations, Interactive Discussions and Case Studies,

**Evaluation System –**

A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)

B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]

C. End-Semester Exam (60 Marks)- Summative Assessment.

**3. Course Content:**

**Course Name: Effective Technical Communication**

**Course Code: DS-306**

**Hours per Week: 3 L: 0T: 0P**

**Credits: 3**

	<b>Topics</b>	<b>36 L</b>
1	Business Communication – Definition, Nature, Process, Model, Types of Communication, Levels of Communication. Difference between General and Technical Communication. Grapevine Communication.	<b>6</b>
2	Business Correspondence – Scope and Importance of Writing Technical Documents. Importance of Writing Formal Business letters, Minutes of a Meeting, Proposal Writing. Report writing, E mail Writing (E-mail Etiquette and tips for Writing Effective Mails. Job Application Letter with Resume Telephone Etiquette	<b>6</b>
3	Effective Presentation, Organizing data, Visual Aid and delivery. Group discussion and Public Speaking practice.	<b>6</b>
4	Kinesics and Nonverbal Communication	<b>6</b>

5	<b>Ethics in Communication</b> -Confidentiality Transparency Legality. <b>Conflict Management</b> - From External Sources Types, Strategies Conflict Management at Workplace <b>Time Management and team work</b>	6
6	Grammar / Verbal aptitude practice. (essay, Comprehension, Precise, Paragraph writing)	6

#### 4. References:

- \* Communication Skills for Engineers and Scientists by Sangeeta Sharma and Binod Mishra ( PHI Learning Private limited).
- \* Professional writing skills by Chan Janis Fisher and Diane Lutovich.
- \* Business Correspondence & Report Writing, *Authors:* R. C. Sharma and Krishna Mohan  
*Publisher:* Tata McGraw Hill Publishing Company Ltd.
- \* Effective Business Communication, *Author:* M.V. Jain, *Publisher:* McGraw Hill Education
- \* Business Communication, *Author* Kaul, *Publisher:* Prentice Hall of India Pvt. Ltd

#### 5. Course Outcomes (CO):

<b>DS-306.CO1</b>	Acquire basic proficiency in English, including reading, listening comprehension, writing, and speaking skills, and demonstrate a basic understanding of English grammar, vocabulary, and syntax.
<b>DS-306.CO2</b>	Communicate confidently in English, using appropriate grammar, vocabulary, and syntax, and demonstrate effective speaking and presentation skills in different contexts.
<b>DS-306.CO3</b>	Communicate appropriately in professional and social situations, using appropriate language and tone, and demonstrate effective communication skills in group activities like group discussions, case studies, role Communicate appropriately in professional and social situations, using appropriate language and tone, and demonstrate effective communication skills in group activities like group discussions, case studies, role play, etc
<b>DS-306.CO4</b>	Improve teamwork, leadership skills, and problem-solving skills through group activities like group discussions, case studies, role play, etc.
<b>DS-306.CO5</b>	Organize and write business correspondence properly and correctly, using appropriate formats, grammar, vocabulary, and syntax, and demonstrate effective writing and editing skills.
<b>DS-306.CO6</b>	Develop active listening skills, including effective listening strategies, note-taking, and summarizing, and apply these skills to different listening contexts

## 6. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1
3	2	3	3	2	-	1
4	3	-	-	2	-	1
5	2	-	-	1	3	1
6	2	1	-	-	-	2

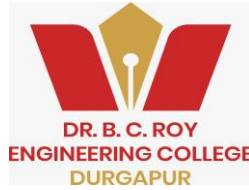
## 7. Mapping of the Course outcomes to Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	1	1	1	1	1	1	3	1	3
CO2	3	2	2	1	1	1	1	1	3	3	2	3
CO3	1	2	2	1	1	1	1	3	3	3	1	2
CO4	3	3	3	3	1	2	1	2	3	3	3	3
CO5	2	3	3	2	2	2	2	2	3	3	3	3
CO6	3	3	3	2	1	1	1	1	2	3	2	3

## 8. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	2
CO2	2	2	2	3
CO3	1	3	2	2
CO4	2	2	3	2
CO5	2	3	2	2
CO6	2	2	3	2

\*\*\* End of Syllabus\*\*\*



**Course Name: Data Structures and Algorithms Lab**  
**Course Code: DS-391**  
**(Semester– III)**  
**Course Broad Category: Skill Enhancement Courses**

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**1. Course Prerequisite:**

- Basic knowledge of Computer Science.
- And/ Or Programming for Problem Solving Lab (ESC-CS 292)

**2. Course Learning Objectives:**

- To implement fundamental data structures and algorithms using C/Python.
- To develop problem-solving skills through hands-on programming experiments.
- To analyze and compare the efficiency of various algorithms.
- To apply data structures to solve real-world computational problems.
- To understand and implement algorithmic paradigms like divide and conquer, dynamic programming, and greedy algorithms.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology: Instruction:** This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

**Evaluation System –**

A. **Internal Assessment (60 Marks)**- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

**End-Semester Exam (40 Marks)**- Summative Assessment.

**4. Course Content:**

**Course Name: Artificial Intelligence Lab**

**Course Code: DS-391**

**Hours per Week: 0L: 1T: 2P**

**Credits: 2**

<b>Experiment Number</b>	<b>Title</b>
1	Insertion and deletion in arrays using dynamic memory allocation.
2	Linear search, Binary search (recursive, non-recursive).
3	Memory allocation and deallocation for linked list.
4	Operations on linked list: creation, display, insertion and deletion (in different positions), summation, average, maximum, minimum etc.
5	Array implementation of stack and queue.
6	Linked implementation of stack and queue
7	Evaluation of postfix expression using stack.
8	Conversion of infix expression to its postfix version using stack.
9	Linked implementation of binary tree and preorder, inorder and postorder traversal on binary tree.
10	Implementation of binary search tree and operations on it (searching, insertion, deletion).
11	Implementation of height-balanced binary search tree (AVL tree).
12	Implementation of sorting algorithms: Selection sort, insertion sort, bubble sort, quick sort, heap sort, merge sort, radix sort.
13	Implementation of few basic graph operations (such as breadth first and depth first traversal, finding minimum spanning tree, shortest path) on graph.

## **5. References:**

### **Textbooks:**

1. Debasis Samanta, *Classical Data Structures*, PHI.
2. E. Horowitz, S. Sahni, S. Anderson-Freed, *Fundamentals of Data Structures in C*, Universities Press; Second edition (2008).
3. E. Balagurusamy, *Programming in ANSI C*, McGraw Hill Education India Private Limited, Seventh edition (2017).

**Reference Books:**

1. Robert L. Kruse, Bruce P. Leung, *Data Structures and Program Design in C*, Pearson
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, *Fundamentals of Data Structures of C*, Universities Press
3. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, *Data Structures in C*, PHI

**6. Course Outcomes (CO):**

After going through this course the Students will be able to:

Course Outcomes	Details	Action Verb	Knowledge Level
DS-391.CO1	Implement fundamental data structures and algorithms.	Implement, Construct	Level 2- Understand, Level 3-Apply
DS-391.CO2	Develop efficient solutions for computational problems.	Design, Develop	Level 3-Apply, Level 4-Analyze
DS-391.CO3	Analyze and compare algorithm efficiency	Analyse, Compare, Evaluate	Level 4-Analyze, Level 5-Evaluate
DS-391.CO4	Apply algorithmic paradigms to solve problems.	Apply, Implement, Solve	Level 3-Apply
DS-391.CO5	Demonstrate hands-on proficiency in data structures	Demonstrate, Solve	Level -2- Understand, Level 3-Apply

**7. Mapping of course outcomes to Experiments**

Experiment	Title	CO1	CO2	CO3	CO4	CO5
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No.						
1	Insertion and deletion in arrays using dynamic memory allocation.	✓				✓
2	Linear search, Binary search (recursive, non-recursive)	✓				✓
3	Memory allocation and deallocation for linked list	✓				✓
4	Operations on linked list: creation, display, insertion and deletion (in different positions), summation, average, maximum, minimum etc.	✓	✓			✓
5	Array implementation of stack and queue	✓	✓			✓
6	Linked implementation of	✓	✓			✓

	stack and queue					
7	Evaluation of postfix expression using stack	✓	✓			✓
8	Conversion of infix expression to its postfix version using stack	✓				✓
9	Linked implementation of binary tree and preorder, inorder and postorder traversal on binary tree	✓				✓
10	Implementation of binary search tree and operations on it (searching, insertion, deletion)	✓				✓
11	Implementation of height-balanced binary search tree (AVL tree)	✓	✓		✓	
12	Implementation of sorting algorithms : Selection	✓				

	sort, insertion sort, bubble sort, quick sort, heap sort, merge sort					✓
13	Implement ation of few basic graph operations (such as breadth first and depth first traversal, finding minimum spanning tree, shortest path) on graph		✓		✓	

### 8. Mapping of the Course outcomes to Program Outcomes (PO)

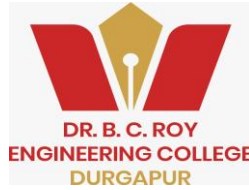
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	1	-	-	-	-	-	-	-
CO2	3	2	2	-	1	-	-	-	-	-	-	-
CO3	-	2	-	2	1	-	-	-	-	-	-	-
CO4	2	1	-	-	1	-	-	-	-	-	-	2
CO5	-	-	-	-	1	-	-	-	2	1	-	-

### 9. Mapping to Program Specific Outcome (PSO)

	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
<b>C01</b>	2	-	1	-
<b>C02</b>	-	1	2	-
<b>C03</b>	2	2	-	-
<b>C04</b>	-	1	-	1
<b>C05</b>	2	-	1	1

Reference: NIT Durgapur

\*\*\* End of the Syllabus \*\*\*



**Course Name: Algorithms for Data Science Lab**

**Course Code: DS-392  
(Semester- III)**

**Course Broad Category: Program Core (PC)**

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**1. Course Prerequisite:** Knowledge of algorithms, concept of graph, basic idea of programming language.

**2. Course Learning Objectives:**

By the end of this course, students will be able to:

- Implement fundamental algorithms used in data science, including sorting, searching, and graph-based algorithms, File Handling.
- Design and test efficient algorithms for data-centric tasks such as clustering, classification, and regression.
- Use data structures (e.g., arrays, linked lists, Set, Tuple, Dictionary, hash tables, trees, graphs) to solve computational problems efficiently.
- Utilize programming languages and tools (e.g., Python, NumPy, SciPy) to implement and validate algorithms.
- Work collaboratively in teams to develop, test, and present solutions to data science problems.
- Interpret and communicate results of algorithmic solutions using appropriate visualizations and technical documentation.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology –Practical**

**Evaluation System**

**A. Internal Assessment (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

**B. End-Semester Exam (40 Marks)-** Summative Assessment.

**4. Course Content:**

**Course Name:** Algorithms for Data Science Lab

**Course Code:** DS-392

**Hours per Week:** 0L: 1T: 2P

**Credits:** 2

<b>Exp. No</b>	<b>Title</b>
1.	Interactive commands in Python, data operations, simple programs for writing into files and reading from files. Data file manipulations programs.
2.	Familiarization with IDE in Python
3.	Writing programs for standard algorithms of sorting and searching in Python.
4.	Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
5.	Apply and explore various plotting functions on UCI data sets. a. Normal curves b. Density and contour plots c. Correlation and scatter plots d. Histograms
6.	Plotting the data using X-Y graph, Bar- chart, and using other plotting techniques
7.	Write programs to perform exploratory data analysis: variance, standard derivation, summarization, distribution, and statistical inference.
8.	Plotting the various distributions for given data sets.
9.	Write programs for performing Support Vector Machine for given data sets.
10.	Write programs for performing logistic regression for given data sets.
11.	Write programs for k-means clustering and presentation for given data sets.
12.	Write programs for k- nearest neighbors clustering and presentation for given data sets.

## 5. References:

### Text Book:

1. Python programming using problem solving approach, Reema Thareja, Oxford publishers

## 6. Course Outcomes (CO):

<b>Course Outcomes</b>	<b>Details/Statement</b>	<b>Action Verb</b>	<b>Knowledge Level</b>
DS-392.CO1	Write python programs to handle data using Numpy and Pandas	Understand Apply	Level 1- Understand, Level 3- Apply
DS-392.CO2	Perform descriptive analytics	Apply	Level 3- Apply
DS-392.CO3	Perform data exploration using Matplotlib	Apply	Level 3- Apply

<b>DS-392.CO4</b>	Perform inferential data analytics	Apply	Level 3- Apply
<b>DS-392.CO5</b>	Design models of predictive analytics	Design	Level 5- Create

### 7. Mapping of course outcomes to experiments

<b>EXP No</b>	<b>CO1</b>	<b>CO2</b>	<b>CO3</b>	<b>CO4</b>	<b>CO5</b>
EXP1	3	3	0	0	0
EXP2	0	2	2	0	0
EXP3	2	2	0	0	0
EXP4	0	0	2	2	0
EXP6	2	2	0	0	0
EXP7	2	2	0	0	0
EXP 8	0	2	2	2	0
EXP 9	2	2	0	0	2
EXP 10	2	0	2	0	0
EXP 11	0	0	0	0	3
EXP 12	0	0	0	0	0

### 8. Mapping of the Course outcomes to Program Outcomes (PO)

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>
<b>CO1</b>	2	-	-	3	-	-	-	-	-	-	-	-
<b>CO2</b>		2	-	-	2	-	-	-	1	-	3	
<b>CO3</b>	2	-	-	2	-	-	-	-	-	-	-	2
<b>CO4</b>	3	2	1	-	-	-	-	-	-	-	-	2
<b>CO5</b>	3	2	2	2	-	-	1	-	-	-	-	2

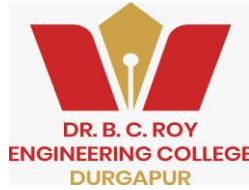
### 9. Mapping to Program Specific Outcome (PSO)

	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
<b>CO1</b>	1	2	3	2
<b>CO2</b>	3	3	2	3
<b>CO3</b>	3	3	3	3
<b>CO4</b>	2	2	2	3
<b>CO5</b>	2	3	3	3

References:

NIT Durgapur

\*\*\* End of the Syllabus \*\*\*



**Course Name: Comprehensive Guide to DBMS and Query Optimization Lab**  
**Course Code: DS-393**  
**(Semester –IV)**  
**Course Broad Category: Program Core (PC)**

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**1. Course Prerequisite:**

- Students must know about the Relational Database Model, familiarization with languages like SQL, and normalization.
- Installation of ORACLE / MYSQL DB

**2. Course Learning Objectives:**

1. To explain basic database concepts, applications, data models, schemas and instances.
2. To demonstrate the use of constraints and relational algebra operations and also to become familiar with the basics of SQL and construct queries using SQL.
3. To emphasize the importance of normalization in databases.
4. To facilitate students in Database design
5. To familiarize issues of concurrency control and transaction management

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies, LMS, Industry Talk.

**Evaluation System –**

- A. Internal Assessment (60 Marks)- Formative Continuous Assessment
- B. End-Semester Exam (40 Marks)- Summative Assessment.

**4. Course Content:**

**Course Name: Comprehensive Guide to DBMS and Query Optimization Lab**

**Course Code: DS-393**

**Hours per Week: 0L: 0T: 4P**

**Credits: 2**

<b>Unit/Lab</b>	<b>Content</b>
1	Students should decide on a case study and formulate the problem statement.
2	Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.) Note: Students are required to submit a document by drawing an ER Diagram to the Lab teacher.
3	Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) Note: Students are required to submit a document showing the database tables created from ER Model.
4	Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables
5	Practicing DML commands- Insert, Select, Update, Delete
6	Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc.
7	Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi)
8	Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping
9	Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger
10	Procedures- Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure
11	Cursors & Package - Declaring Cursor, Opening Cursor, Fetching the data, closing the cursor.
12	View and Partition - Simple View, Complex View, Materialized View, Horizontal Partitioning, Vertical Partitioning, Range Partitioning, DCL (Data Control Language)

## **5. References:**

### **Text & References Books:**

- "Database System Concepts" – Abraham Silberschatz, Henry F. Korth, and S. Sudarshan
- "Fundamentals of Database Systems" – Ramez Elmasri and Shamkant B. Navathe
- "SQL: The Complete Reference" – James R. Groff and Paul N. Weinberg
- "Oracle PL/SQL Programming" – Steven Feuerstei

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details	Action Verb	Knowledge Level
DS 393.CO1	Apply the basic concepts of Database Systems and Applications.	Familiarize, Solve	L-2
DS 393.CO2	Use the basics of SQL and construct queries using SQL in database creation and interaction.	Develop	L-3
DS 393.CO3	Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.	Implement, Solve	L-3
DS 393.CO4	Analyze and Select storage and recovery techniques of database systems.	Implement, Solve	L-3
DS 393.CO5	Students will be able to design and implement database applications on their own.	Implement, Develop	L-6

## 7. Mapping of course outcomes to module / course content

Lab Experiments	CO1	CO2	CO3	CO4	CO5
1	2	1	-	-	1
2	-	2	-	-	-
3, 4, 5	-	2	1	-	-
6, 7	-	-	2	2	-
8, 9, 10	-	-	-	-	1
11, 12	1	-	1	-	-

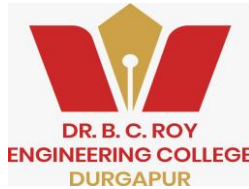
## 8. Mapping of the Course outcomes to Program Outcomes (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	2	-	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	1	2	2	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	2	1	1	2	-	-	-	-	1	-	-	1

## 9. Mapping to Program Specific Outcomes (PSO)

	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
<b>CO1</b>	2	2	2	1
<b>CO2</b>	1	1	-	-
<b>CO3</b>	1	-	-	-
<b>CO4</b>	2	-	1	2
<b>CO5</b>	1	-	1	-

**\*\*\* End of Syllabus\*\*\***



**Course Name: Probability and Statistics for Data Science using R**  
**Course Code: DS-395**  
**(Semester III)**  
**Course Broad Category: Basic Science (BS)**

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**1. Course Prerequisite:**

**Mathematics in B. Tech standard.**

**2. Course Learning Objectives:**

The objective of these courses to familiarize the prospective engineers with techniques in probability and statistics. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced levels of mathematics and applications that they would find useful in their disciplines.

**3. Teaching methodology and evaluation system for the course:**

Teaching methodology – Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

**Evaluation System –**

- A. Internal Assessment (60 Marks)- Formative Continuous Assessment [Continuous Assessment; Lab Copy (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
- B. End-Semester Exam (40 Marks)- Summative Assessment.

**4. Course Content:**

**Course Name: Probability and Statistics for Data Science using R**

**Course Code: DS-395**

**Hours per Week: 0L:0T:2P**

**Credits: 1**

Data Set: Data sets of Kaggle.com can be used for practice. For example, few of the them are: Iris Dataset; flights.csv Dataset; Sustainable Development Data; Credit Card Fraud Detection; Employee dataset; Heart Attack Analysis & Prediction Dataset; Dataset for Facial recognition; Chest X-ray Dataset; Groceries dataset; Financial Fraud and Non- Fraud News Classification; IBM Transactions for Anti Money Laundering

Module	Topics	P
1.	<p>Understanding data with Data types, Measurement of scales, descriptive statistics and data pre-processing steps.</p> <p>Data Visualization: Drawing One dimensional diagram (Pictogram, Pie Chart, Bar Chart), two-dimensional diagrams (Histogram, Line plot, frequency curves &amp; polygons, ogive curves, Scatter Plot), other diagrammatic / graphical representations like, Gantt Chart, Heat Map, Box-Whisker Plot, Area Chart, Correlation Matrices.</p> <p>Generation of population and random samples from the Binomial, Poisson, Normal, Exponential distributions.</p> <p>Confidence interval Estimation for the parameters in Poisson, Normal and Exponential distribution using pivot method.</p> <p>Applying the modelling process, Model evolution, Curve fitting-linear and nonlinear.</p> <p>Parametric tests (z-test, <math>\chi^2</math> test, t-test, F-tests), Correlation &amp; Regression etc.</p> <p>Non-Parametric tests (Sign test, Median, Wilcoxon sign rank).</p> <p>Analysis of variance for one-way classification and two-way classification</p> <p>Analysis of Variance for <math>2^3</math> and <math>2^4</math> factorial experiments.</p> <p>Data interpretation and Report writing.</p>	22
2.	<p><b>Introduction to software packages:</b> Matlab, R/ SPSS software</p>	10

## 5. References:

### Text books:

1. Zar, J.H.: Biostatistical Analysis (Pearson Education): A comprehensive textbook that covers statistical methods, tests, and data analysis techniques, including those in SPSS and R.
2. James, G., Witten, D., Hastie, T., and Tibshirani, R.: An Introduction to Statistical Learning with Applications in R (Springer), Focuses on statistical learning techniques, model fitting, and applying them with R.

3. Groeneveld, R.A., and Meeden, G.: *Introductory Statistics with R* (Springer) Provides a hands-on approach to data analysis, descriptive statistics, and visualization using R.
4. Field, A.: *Discovering Statistics Using SPSS* (Sage Publications) A popular and user-friendly textbook for learning statistical methods and data analysis using SPSS.
5. Sullivan, M.: *Statistics: Informed Decisions Using Data* (Pearson Education) Focuses on statistics and data analysis methods using software such as SPSS, with clear explanations and examples.
6. Montgomery, D.C.: *Design and Analysis of Experiments* (Wiley) Comprehensive coverage of experimental design, ANOVA, and modeling, applied with R or SPSS.
7. Gelman, A., Carlin, J., Stern, H., Dunson, D., Vehtari, A., and Rubin, D.: *Bayesian Data Analysis* (CRC Press): A reference book on Bayesian analysis methods using R.

#### **Reference Books:**

1. Wickham, H.: *ggplot2: Elegant Graphics for Data Analysis* (Springer) Focuses on data visualization using R, including creating advanced plots and charts.
2. Bennett, J.O., Briggs, W.L., and Triola, M.F.: *Elementary Statistics* (Pearson Education)  
**Offers a clear introduction to statistical concepts, including hypothesis testing, ANOVA, and regression, useful for SPSS and R users.**
3. JMP Software Documentation: *JMP: A Guide to the Software* (SAS Institute) A reference guide for data analysis with JMP software, useful for statistical modeling, tests, and visualizations.
4. NIST/SEMATECH: *e-Handbook of Statistical Methods* (NIST) An online reference resource for statistical methods, including distribution modeling, tests, and data interpretation.
5. Pallant, J.: *SPSS Survival Manual* (McGraw-Hill Education) A hands-on guide for learning SPSS, focusing on data analysis techniques, tests, and visualizations.
6. Hastie, T., Tibshirani, R., and Friedman, J.: *The Elements of Statistical Learning* (Springer)  
**A more advanced reference on statistical learning and model fitting, with application to R.**
7. Khan, M. S.: *Applied Statistics with R* (Springer): Covers a variety of statistical methods and techniques, including tests, confidence intervals, and analysis of variance using R.

## 6. Course Outcomes (CO):

<b>Course Outcomes</b>	<b>Details/Statement</b>	<b>Action Verb</b>	<b>Knowledge Level</b>
<b>DS-395.CO1</b>	Learn to apply the manual procedures of data analysis and also their implementation using R.	Identify	Level 1-Remember
<b>DS-395.CO2</b>	Understand and apply the concept of stochastics process for generation of random samples from any distribution.	Explain	Level 2-Understand
<b>DS-395.CO3</b>	Understand an appropriate probability distribution to the given data and draw the probability distribution curves with stating its nature of the distributional curve properties for the given data sets.	Implement	Level 3-Apply
<b>DS-395.CO4</b>	Apply the concept of Statistical inference to help researchers and statisticians make decisions and predictions.	Organize	Level 4-Analyze
<b>DS-395.CO5</b>	Apply concept of ANNOVA to examine the combined effects of age, income and education level on consumer purchasing habits.	Assess	Level 5-Evaluate
<b>DS-395.CO6</b>	Apply data science technique for a wide range of applications, including predictive analytics, machine learning, data visualization, recommendation systems, fraud detection, sentiment analysis, and decision-making in various industries like healthcare, finance, marketing, and technology etc.	Construct	Level 6-Create

### 7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1

### 8. Mapping of the Course outcomes to Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	1	1	2	-	-	-	-	-	-	1
CO2	1	2	3	1	-	-	-	-	-	-	-	1
CO3	1	2	2	1	1	-	-	-	-	-	-	1
CO4	1	2	1	1	2	-	-	-	-	-	-	2
CO5	2	2	2	2	3	-	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	-	1

### 9. Mapping to Program Specific Outcome (PSO):

	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	1
CO2	2	3	1	1
CO3	1	2	3	2
CO4	1	2	3	1
CO5	1	2	3	2
CO6	1	2	3	1

\*\*\* End of the Syllabus \*\*\*