



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -  
VIZIANAGARAM**

**VIZIANAGARAM – 535 003 Andhra Pradesh (India)**

(Established by Andhra Pradesh Act No.22 of 2021)

**Department Of CSE (DATA SCIENCE)**

**COURSE STRUCTURE**

**(Applicable from the academic year 2023-24 onwards)**

**B. Tech – II Year I Semester**

S.No	Course Code	Title	L	T	P	Credits
1	1000232105	Discrete Mathematics & Graph Theory	3	0	0	3
2	1099232101	Universal Human Values 2-Understanding Harmony & Ethical Human Conduct	2	1	0	3
3	1044232101	Introduction to Data Science	3	0	0	3
4	1005232103	Advanced Data Structures & Algorithms Analysis	3	0	0	3
5	1005232102	Object-Oriented Programming Through JAVA	3	0	0	3
6	1044232110	Data Science Lab	0	0	3	1.5
7	1005232111	Object-Oriented Programming Through JAVA Lab	0	0	3	1.5
8	1005232180	Python programming	0	1	2	2
9	1000232125	Environmental Science	2	0	0	-
Total			15	2	10	20

**B. Tech– II Year II Semester**

S.No.	Course Code	Title	L	T	P	Credits
1	1099232201	Managerial Economics and Financial Analysis	2	0	0	2
2	1000232204	Statistical methods for Data science	3	0	0	3
3	1044232201	Data Engineering	3	0	0	3
4	1005232202	DBMS	3	0	0	3
5	1004232104	Digital Logic and Computer Organization	3	0	0	3
7	1044232210	Data Engineering Lab	0	0	3	1.5
8	1005232211	DBMS Lab	0	0	3	1.5
9	1044232280	Exploratory Data Analysis with Python	0	1	2	2
10	1002232220	Design Thinking & Innovation	1	0	2	2
Total			15	1	10	21
Mandatory Community Service Project Internship of 08weeksduration during summer Vacation						



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II Year I Semester	Discrete Mathematics & Graph Theory	L	T	P	C
Course Code: 1000232105		3	0	0	3

### DISCRETE MATHEMATICS & GRAPH THEORY

#### Course Objectives:

- To understand mathematical arguments using logical connectives and quantifiers and verify the validity of logical flow of arguments using propositional, predicate logic and truth tables.
- To expose the students to Binary relations, posets, Hasse diagram, lattice, and discuss various properties of relations.
- To introduce generating functions and recurrence relations.

#### Course Outcomes:

- Apply principles of mathematical logic to statement calculus and Predicate calculus(K3)
- Apply principles of mathematical logic to Predicate calculus(K3)
- Use and interpret the concepts of combinatorics, set theory, posets and lattices (K3)
- Use and interpret the concepts of algebraic structures (K3)
- Solve the recurrence relations by Method of substitution ,characteristic roots, Generating functions(K3)

#### Unit-I:

##### Mathematical Logic & Statement Calculus

Statements and Connectives: statements, connectives, compound statements (Formulas), well-formed formulas, truth tables, tautologies, equivalence of formulas, converse, contrapositives & inverse of an implication, duality law, tautological implications, Normal forms: Principal disjunctive and conjunctive normal forms; Statement calculus: Validity of an argument using truth tables and rules of inference, consistency of premises, indirect method of proof.

#### Unit-II:

##### Predicates & Predicate Calculus

Predicate calculus: Predicates, statement of functions, variables and quantifiers, predicate formulas, free and bound variables, universe of discourse, valid formulas and equivalences involving quantifiers, rules of inference, theory of inference for predicate calculus

#### Unit-III:

##### Combinatorics, Set Theory, Posets and Lattices

Combinatorics: Principles of counting (product and sum rules), Pigeonhole principle and its applications, Principle of Inclusion-Exclusion and its applications.

**Relations:** Binary relation, properties, equivalence relation, partition of a set, equivalence classes  
Partial ordering: Partial order relation, partially ordered set(poset), Hasse diagrams, Lattices.

#### Unit-IV:

##### Algebraic Structures

Algebraic Systems (Structures): Binary operation, algebraic structures such as Semigroup, Monoid, Group, commutative group with suitable examples, properties satisfied by the algebraic structures



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and the elements; Special group structures: Sub group and its criteria, order of an element, Cosets, index of sub group, properties of cosets, order of a group, Lagrange's theorem

**Unit-V:**

**Recurrence Relations & Generating Functions**

Recurrence Relations: Formation, iterative method of solving recurrence relations, solving homogeneous and non-homogeneous recurrence relations by characteristic roots method; Generating Functions: Generating functions of sequences, calculation of coefficients of expansions, solving recurrence relations by generating functions.

**Textbooks:**

1. J.P.Tremblay and R.Manohar, Discrete Mathematical Structures with Applications to CSc, TataMcGrawHill,1997
2. S. Santha and EV Prasad, Mathematical Foundations for Computer Science, CENG AGE Publishers

**Reference Books:**

1. Kenneth. H.Rosen,Discrete Mathematics and itsApplications,6/e, Tata McGraw-Hill, 2009.
2. Dr.DSChandrasekharaiah, Mathematical Foundations of Computer Science ,Prism Book Pvt Ltd.
3. Swapan Kumar Sarkar, Mathematical Foundation of Computer Science,9th Edition, SChand Publishers.

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<b>II Year I Semester</b>	Universal Human Values – Understanding Harmony & Ethical Human Conduct	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Course Code:</b> 1099232101		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

## UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

### Course Objectives:

- To develop a holistic perspective based on self exploration and value education.
- To understand method to fulfill human aspiration. .
- To understand harmony in human being, family and society.
- To understand harmony in nature and its existence.
- To understand holistic understanding of harmony on professional ethics.

### Course Outcomes:

- Describe the Value Education
- Illustrate Understanding the activities in the Self and the activities in the Body.
- Discuss Harmony in Nature: The Four Orders in Nature.
- Demonstrate Defects in Ethical Human Conduct.
- Generalize Competence in Professional Ethics.

### Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

**UNIT I** Introduction to Value Education (6 lectures and 3 tutorials for practice session)  
 Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)  
 Lecture 2: Understanding Value Education  
 Tutorial 1: Practice Session PS1 Sharing about Oneself  
 Lecture 3: self-exploration as the Process for Value Education



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Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

- UNIT II** Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
- Lecture 7: Understanding Human being as the Co-existence of the self and the body.
- Lecture 8: Distinguishing between the Needs of the self and the body
- Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
- Lecture 9: The body as an Instrument of the self
- Lecture 10: Understanding Harmony in the self
- Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
- Lecture 11: Harmony of the self with the body
- Lecture 12: Programme to ensure self-regulation and Health
- Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body
- UNIT III** Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
- Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
- Lecture 14: 'Trust' – the Foundational Value in Relationship
- Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
- Lecture 15: 'Respect' – as the Right Evaluation
- Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
- Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
- Lecture 17: Understanding Harmony in the Society
- Lecture 18: Vision for the Universal Human Order
- Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal
- UNIT IV** Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
- Lecture 19: Understanding Harmony in the Nature
- Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
- Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
- Lecture 21: Realizing Existence as Co-existence at All Levels
- Lecture 22: The Holistic Perception of Harmony in Existence
- Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence
- UNIT V** Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
- Lecture 23: Natural Acceptance of Human Values
- Lecture 24: Definitiveness of (Ethical) Human Conduct



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Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education

PS1 Sharing about Oneself

PS2 Exploring Human Consciousness

PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being

PS4 Exploring the difference of Needs of self and body

PS5 Exploring Sources of Imagination in the self

PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society

PS7 Exploring the Feeling of Trust

PS8 Exploring the Feeling of Respect

PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature

PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order

**Readings:**

**Textbook and Teachers Manual**

a. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2



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### Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

### Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than "extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

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II Year I Semester		L	T	P	C
Course Code: 1044232101	<b>Introduction to Data Science</b>	3	0	0	3

## INTRODUCTION TO DATA SCIENCE

**COURSE OBJECTIVES:** From the course the student will learn

- Knowledge and expertise to become a data scientist.
- Essential concepts of statistics and machine learning that are vital for data science.
- Significance of exploratory data analysis (EDA) in data science.
- Critically evaluate data visualizations presented on the dashboards
- Suitability and limitations of tools and techniques related to data science process

**Course Outcomes:**

After completion of the course the student will be able to -

- Discuss various types of data and the flow of data science process. (K2)
- Identify most important Python libraries for machine learning, types of machine learning techniques for handling large data. (K3)
- Explain big data technologies such as Hadoop and Spark and types of NoSQL databases. (K3)
- Apply the data science process to a recommender engine project with the graph database Neo4j. (K3)
- Make use of libraries like JQuery, Crossfilter.js, d3.js, dc.js and bootstrap to create a dashboard. (K3)

### UNIT I:

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science

**Data Science process:** Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them

### Unit II:

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning

**Handling large data:** problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

### UNIT III:

**NoSQL movement for handling Bigdata:** Distributing data storage and processing with





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Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling

**UNIT IV:**

**Tools and Applications of Data Science:** Introducing **Neo4j** for dealing with graph databases, graph query language **Cypher**, Applications graph databases, Python libraries like **nlTK** and **SQLite** for handling Text mining and analytics, case study on classifying Reddit posts

**UNIT V:**

**Data Visualization and Prototype Application Development:** Data Visualization options, Cross filter, the JavaScript MapReduce library, Creating an interactive dashboard with **dc.js**, Dashboard development tools.

Applying the Data Science process for real-world problem-solving scenarios as a detailed case study.

**Textbook:**

- 1) Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, “Introducing to Data Science using Python tools”, Manning Publications Co, Dreamtech press, 2016
- 2) Prateek Gupta, “Data Science with Jupyter” BPB publishers, 2019 for basics

**Reference Books:**

- 1) Joel Grus, “Data Science from Scratch”, OReilly, 2019
- 2) Doing Data Science: Straight Talk from The Frontline, 1 st Edition, Cathy O’Neil and Rachel Schutt, O’Reilly, 2013.

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II Year I Semester		3	0	0	3
<b>Course Code:</b> 1005232103	Advanced Data Structures & Algorithms Analysis	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## ADVANCED DATA STRUCTURES & ALGORITHM ANALYSIS

### Course Objectives:

The main objectives of the course is to

- To provide knowledge on advance data structures frequently used in Computer Science domain
- To Develop skills in algorithm design techniques popularly used
- To Understand the use of various data structures in the algorithm design

### Course Outcomes:

After completion of the course the student will be able to –

- Illustrate the working of the advanced tree data structures and their applications (K3)
- Understand the Graph data structure, traversals and apply them in various contexts. (K3)
- Apply various data structures in the design of algorithms (K3)
- Apply Branch and Bound to solve problems such as knapsack and travelling salesman. (K3)
- Analyze algorithms with respect to space and time complexities (K4)

### UNIT – I:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.

AVL Trees – Creation, Insertion, Deletion operations and Applications

B-Trees – Creation, Insertion, Deletion operations and Applications

### UNIT – II:

Heap Trees (Priority Queues) – Min and Max Heaps, Operations and Applications

Graphs – Terminology, Representations, Basic Search and Traversals, Connected

Components and Biconnected Components, applications

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

### UNIT – III:

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths

Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths – General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem

### UNIT – IV:

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph



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Coloring, 0/1 Knapsack Problem

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem

**UNIT – V:**

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem

NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP)

NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling



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**Textbooks:**

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press
2. Computer Algorithms/C++ Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran 2<sup>nd</sup> Edition University Press

**Reference Books:**

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. Data Structures using C & C++: Langsam, Augenstein&Tanenbaum, Pearson, 1995
5. Algorithms + Data Structures & Programs: N.Wirth, PHI
6. Fundamentals of Data Structures in C++: Horowitz Sahni& Mehta, Galgottia Pub.
7. Data structures in Java: Thomas Standish, Pearson Education Asia

**Online Learning Resources:**

1. [https://www.tutorialspoint.com/advanced\\_data\\_structures/index.asp](https://www.tutorialspoint.com/advanced_data_structures/index.asp)
2. <http://peterindia.net/Algorithms.html>
3. Abdul Bari, [1. Introduction to Algorithms \(youtube.com\)](#)

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<b>II Year I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Course Code:</b> 1005232102	Object Oriented Programming through Java	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## OBJECT-ORIENTED PROGRAMMING THROUGH JAVA

### Course Objectives:

The learning objectives of this course are to:

- To identify Java language components and how they work together in applications
- To learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- To learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- To understand how to design applications with threads in Java
- To understand how to use Java APIs for program development

### Course Outcomes:

After completion of the course, students will be able to

- Interpret the concepts of Object Oriented Programming and the Java Programming Constructs (K2)
- Demonstrate the concepts of Object Orientation like Objects, Classes, Methods, Constructors alongside the usage of various keywords(K2)
- Apply the concepts of Array operations, Inheritance and Interfaces to solve the real-world problems(K3)
- Examine the usage of Packages and Exception handling to build the Java Applications(K3)
- Analyze the methods of String handling, Survey the techniques of Multithreading and Connect the front-end with the back-end through Java Database Connectivity.(K4)

### UNIT I:

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if-else Expressions, TernaryOperator?., Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement.



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### **UNIT II:**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

### **UNIT III:**

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class- Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

### **UNIT IV:**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java. Lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto- boxing and Auto- unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java. time. Instant), Formatting for Date/Time in Java, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

### **UNIT V:**

String Handling in Java: Introduction, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer. Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.



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Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface

Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

**Text Books:**

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object-oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4<sup>th</sup> Edition, Pearson.

**References Books:**

1. The complete Reference Java, 11<sup>th</sup> edition, Herbert Schildt, TMH
2. Introduction to Java programming, 7<sup>th</sup> Edition, Y Daniel Liang, Pearson

**Online Resources:**

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012880464547618816347\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview)

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<b>II Year I Semester</b>	<b>Data Science Lab</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Course Code: 1044232110</b>		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

## DATA SCIENCE LAB

### Course Objectives:

- The main objective of the course is to inculcate the basic understanding of Data Science and its practical implementation using Python.

### Course Outcomes:

- Make use of NUMPY library to perform various operations on arrays. **(K3)**
- Utilize pandas to import data from different file formats. **(K3)**
- Model different types of charts using matplotlib. **(K3)**
- Apply preprocessing techniques like scaling, standardization, encoding on the given dataset. **(K3)**

### List of Experiments

- Creating a NumPy Array
  - Basic ndarray
  - Array of zeros
  - Array of ones
  - Random numbers in ndarray
  - An array of your choice
  - Imatrix in NumPy
  - Evenly spaced ndarray
- The Shape and Reshaping of NumPy Array
  - Dimensions of NumPy array
  - Shape of NumPy array
  - Size of NumPy array
  - Reshaping a NumPy array
  - Flattening a NumPy array
  - Transpose of a NumPy array
- Expanding and Squeezing a NumPy Array
  - Expanding a NumPy array
  - Squeezing a NumPy array
  - Sorting in NumPy Arrays
- Indexing and Slicing of NumPy Array
  - Slicing 1-D NumPy arrays
  - Slicing 2-D NumPy arrays
  - Slicing 3-D NumPy arrays
  - Negative slicing of NumPy arrays
- Stacking and Concatenating Numpy Arrays
  - Stacking ndarrays
  - Concatenating ndarrays



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- c. Broadcasting in Numpy Arrays
6. Perform following operations using pandas
  - a. Creating dataframe
  - b. concat()
  - c. Setting conditions
  - d. Adding a new column
7. Perform following operations using pandas
  - a. Filling NaN with string
  - b. Sorting based on column values
  - c. groupby
8. Read the following file formats using pandas
  - a. Text files
  - b. CSV files
  - c. Excel files
  - d. JSON files
9. Read the following file formats
  - a. Pickle files
  - b. Image files using PIL
  - c. Multiple files using Glob
  - d. Importing data from database
10. Demonstrate web scraping using python
11. Perform following preprocessing techniques on loan prediction dataset
  - a. Feature Scaling
  - b. Feature Standardization
  - c. Label Encoding
  - d. One Hot Encoding
12. Perform following visualizations using matplotlib
  - a. Bar Graph
  - b. Pie Chart
  - c. Box Plot
  - d. Histogram
  - e. Line Chart and Subplots
  - f. Scatter Plot
13. Getting started with NLTK, install NLTK using PIP
14. Python program to implement with Python Sci Kit-Learn & NLTK
15. Python program to implement with Python NLTK/Spicy/Py NLPI.

**Web References:**

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes->



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- [guide-to-key-concepts/](#)  
3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/>



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4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-exploration-python/6>.
6. <https://www.nltk.org/book/ch01.html>

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II Year I Semester	Object Oriented Programming through Java Lab	L	T	P	C
Course Code: 1005232111		0	0	3	1.5

## OBJECT-ORIENTED PROGRAMMING THROUGH JAVA LAB

### Course Objectives:

The aim of this course is to

- Practice object-oriented programming in the Java programming language
- Implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrate inheritance, Exception handling mechanism, JDBC connectivity
- Construct Threads, Event Handling, implement packages, Java FX GUI

### Course Outcomes:

- After completion of the course, students will be able to
- Make use of Primitive Data Types, Expressions, Classes and Methods to conduct investigations of various problems (K3).
- Simulate Inheritance, Exception Handling Mechanism and Runtime Polymorphism to design solutions for complex problems (K3).
- Discriminate Standalone Applications with the Graphical User Interface Environment to understand the procedure of Event Handling (K4).

### Experiments covering the Topics:

- Object Oriented Programming fundamentals- data types, control structures
- Classes, methods, objects, Inheritance, polymorphism,
- Exception handling, Threads, Packages, Interfaces
- Files, I/O streams, JavaFX GUI

### Sample Experiments:

#### Exercise – 1:

1. Write a JAVA program to display default value of all primitive data type of JAVA
2. Write a java program that display the roots of a quadratic equation  $ax^2+bx=0$ . Calculate the discriminate D and basing on value of D, describe the nature of root.

#### Exercise - 2

1. Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
2. Write a JAVA program to sort for an element in a given list of elements using bubble sort
3. Write a JAVA program using StringBuffer to delete, remove character.

#### Exercise - 3

1. Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
2. Write a JAVA program implements method overloading.



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3. Write a JAVA program to implement constructor.
4. Write a JAVA program to implement constructor overloading.

**Exercise - 4**

1. Write a JAVA program to implement Single Inheritance
2. Write a JAVA program to implement multi level Inheritance
3. Write a JAVA program for abstract class to find areas of different shapes

**Exercise - 5**

1. Write a JAVA program give example for “super” keyword.
2. Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?
3. Write a JAVA program that implements Runtime polymorphism

**Exercise - 6**

1. Write a JAVA program that describes exception handling mechanism
2. Write a JAVA program Illustrating Multiple catch clauses
3. Write a JAVA program for creation of Java Built-in Exceptions
4. Write a JAVA program for creation of User Defined Exception

**Exercise - 7**

1. Write a JAVA program that creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds, (Repeat the same by implementing Runnable)
2. Write a program illustrating **is Alive** and **join ()**
3. Write a Program illustrating Daemon Threads.
4. Write a JAVA program Producer Consumer Problem

**Exercise – 8**

1. Write a JAVA program that import and use the user defined packages
2. Without writing any code, build a GUI that display text in label and image in an ImageView (use JavaFX)
3. Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI

**Exercise – 9**

1. Write a java program that connects to a database using JDBC
2. Write a java program to connect to a database using JDBC and insert values into it.
3. Write a java program to connect to a database using JDBC and delete values from it

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II Year I Semester	Python Programming	L	T	P	C
Course Code: 1005232180		0	1	2	2

## PYTHON PROGRAMMING

### (Skill Enhancement Course)

#### Course Objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these
- Implement Dictionary keys in python convert this dictionary as a pandas data frame

#### Course Outcomes:

After completion of the course, students will be able to

- Write a program to define a function using default arguments
- Write a program to sum all the items in a given dictionary
- Write a program to define a function with multiple return values.
- Python program to check whether a JSON string contains complex object or not

#### UNIT-I:

**History of Python Programming Language, Thrust Areas of Python, Installing Anaconda**

Python Distribution, Installing and Using Jupyter Notebook.

**Parts of Python Programming Language:** Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.





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**Control Flow Statements:** if statement, if-else statement, if...elif...else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

**Sample Experiments:**

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
  - i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

**UNIT-II:**

**Functions:** Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, \*args and \*\*kwargs, Command Line Arguments.

**Strings:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

**Lists:** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

**Sample Experiments:**

7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.
9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.
11. Write a program to perform the given operations on a list:
  - i. Addition ii. Insertion iii. slicing
12. Write a program to perform any 5 built-in functions by taking any list.



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### **UNIT-III:**

**Dictionaries:** Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries,

Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement. Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

#### **Sample Experiments:**

13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
14. Write a program to count the number of vowels in a string (No control flow allowed).
15. Write a program to check if a given key exists in a dictionary or not.
16. Write a program to add a new key-value pair to an existing dictionary.
17. Write a program to sum all the items in a given dictionary.

### **UNIT-IV:**

**Files:** Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data,

Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

**Object-Oriented Programming:** Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

#### **Sample Experiments:**

18. Write a program to sort words in a file and put them in another file. The output files should have only lower-case words, so any upper-case words from source must be lowered.
19. Python program to print each line of a file in reverse order.
20. Python program to compute the number of characters, words and lines in a file.
21. Write a program to create, display, append, insert and reverse the order of the items in the array.
22. Write a program to add, transpose and multiply two matrices.
23. Write a Python program to create a class that represents a shape. Include methods to



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calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

### **UNIT-V:**

**Introduction to Data Science:** Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

### **Sample Experiments:**

24. Python program to check whether a JSON string contains complex object or not.
25. Python Program to demonstrate NumPy arrays creation using array () function.
26. Python program to demonstrate use of ndim, shape, size, dtype.
27. Python program to demonstrate basic slicing, integer and Boolean indexing.
28. Python program to find min, max, sum, cumulative sum of array
29. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
  - a) Apply head () function to the pandas data frame
  - b) Perform various data selection operations on Data Frame
- 30.** Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

### **Reference Books:**

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

### **Online Learning Resources/Virtual Labs:**

1. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
2. <https://www.coursera.org/learn/python?specialization=python#syllabus>



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II Year I Semester		L	T	P	C
Course Code: 1000232125	<b>Environmental Science</b>	2	0	0	0

### ENVIRONMENTAL SCIENCE

#### Course Objectives:

- Basic understanding of the ecosystem and its diversity.
- Overall understanding of the natural resources.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- Awareness on the social issues, environmental legislation and global treaties.
- An understanding of the environmental impact of developmental activities.

#### Course Outcomes:

At the end of course student will be able to:

- Describe the Natural resources and their importance for the sustenance of the life and learn to conserve the natural resources.(K2)
- Interpret the concepts of Eco-system and its function in the environment.(K3)
- Predict the control or reduce pollution with waste management practices.(K3)
- Illustrate Environmental legislations of India and the first global initiatives towards sustainable development with Case Studies.(K3)
- Relate human Population size to natural resources and resource Consumption.(K3)

#### UNIT I

**Multidisciplinary Nature of Environmental Studies:** – Definition, Scope and Importance – Need for Public Awareness.

**Natural Resources :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

#### UNIT II

**Ecosystems:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- Forest ecosystem.



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- b. Grassland ecosystem
- c. Desert ecosystem.
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Biodiversity and its Conservation :** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### UNIT III

**Environmental Pollution:** Definition, Cause, effects and control measures of:

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

**Solid Waste Management:** Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

### UNIT IV

**Social Issues and the Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

### UNIT V

**Human Population and the Environment:** Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**Field Work:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..



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**Textbooks:**

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

**References:**

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M.Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private limited
5. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

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<b>II Year II Semester</b>	<b>Managerial Economics and Financial Analysis</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Course Code:</b> 1099232201		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

## MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

### Course Objectives:

- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods strategy
- To give an overview on investment appraisal methods to promote and the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

### Course Outcomes:

- Demonstrate managerial economics & elasticity of demand (K2)
- Generalize production function and cost concepts (K2)
- Explain market structures and industrial organizations (K2)
- Determine financial performance of a company (K3)
- Apply capital budgeting techniques in Investment proposals (K3)

### UNIT - I

#### Managerial Economics

Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting-Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

### UNIT - II

#### Production And Cost Analysis

Introduction – Nature, meaning, significance, functions and advantages. Production Function–Least- cost combination– Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA)  
- Determination of Break-Even Point (Simple Problems).

### UNIT - III

#### Business Organizations and Markets

Introduction – Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies



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- Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition
- Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price- Output Determination - Pricing Methods and Strategies

### UNIT - IV

#### Capital Budgeting

Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

### UNIT - V

#### Financial Accounting and Analysis

Introduction – Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance-Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

#### Textbooks:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

#### Reference Books:

1. Ahuja Hl Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, NewAge International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

#### Online Learning Resources:

<https://www.slideshare.net/123ps/managerial-economics-ppt>  
<https://www.slideshare.net/rossanz/production-and-cost-45827016>  
<https://www.slideshare.net/darkyla/business-organizations-19917607>  
<https://www.slideshare.net/balarajbl/market-and-classification-of-market>  
<https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396>  
<https://www.slideshare.net/ashu1983/financial-accounting>

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II Year II Semester	Statistical Methods For Data Science	L	T	P	C
Course Code: 1000232204		3	0	0	3

**STATISTICAL METHODS FOR DATA SCIENCE  
(COMMON TO CSE (DATA SCIENCE), AI & DS, CSE (AIDS))**

**Course Objectives:**

- Understand the types of problems that the statistical method attempts to answer in order to facilitate decision-making.
- Apply statistical methods to hypotheses testing and inference problems.
- Utilize data to create technically sound conclusions based on evidence.
- Explain the theory behind the analyses, the conclusions drawn from them, and the consequences that follow.

**Course Outcomes:**

- Demonstrate knowledge of the basic principles that underlie sample selection, experimental design, statistical theories. (K2)
- Using point estimation, examine the data and make conclusions regarding the collection of data for the study. (K3)
- Interpret data and use confidence intervals and interval estimation to derive conclusions about the data collected for the study. (K3)
- Analyze to test several theoretical hypotheses and error types for large samples and its applications. (K4)
- Apply the distinct small sample tests such as t-test, F-test, chi-square test to examine the significant real-world problems. (K3)

**UNIT I:**

**Basic Concepts**

Random variables (discrete and continuous), probability density functions, properties, mathematical expectation. Probability distributions: Binomial, Poisson and Normal-their properties. Population, sample, parameter and statistic; characteristics of a good estimator; Consistency – Invariance property of Consistent estimator, Sufficient condition for consistency; Unbiasedness; Sufficiency.

**UNIT II:**

**Point Estimation**

Point Estimation- Estimator, Estimate, Methods of point estimation – Maximum likelihood method (the asymptotic properties of ML estimators are not included), Large sample properties of ML estimator (without proof)- applications, Method of moments, method of least squares, method of minimum chi-square and modified minimum chi-square-Asymptotic Maximum Likelihood Estimation and applications.



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**UNIT III:**

**Interval Estimation**

Confidence limits and confidence coefficient; Duality between acceptance region of a test and a confidence interval; Construction of confidence intervals for population proportion (small and large samples) and between two population proportions (large samples); Confidence intervals for mean and variance of a normal population; Difference between the mean and ratio of two normal populations.

**UNIT IV:**

**Testing of hypotheses**

Types of errors, power of a test, most powerful tests; Neyman-Pearson Fundamental Lemma and its applications; Notion of Uniformly most powerful tests; Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions.

**UNIT V :**

**Small sample tests**

Student's t-test, test for a population mean, equality of two population means, paired t-test, F-test for Equality of two population variances, Chi-square test for goodness of fit and test for independence of attributes,  $\chi^2$  test for testing variance of a normal distribution.

**Textbooks:**

1. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference – Testing of Hypotheses, Prentice Hall of India, 2014

**Reference Books:**

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. S. Ross, a First Course in Probability, Pearson Education India, 2002.
3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
4. Robert V Hogg, Elliot A Tannis and Dale L. Zimmerman, Probability and Statistical Inference, 9th edition, Pearson publishers, 2013.

**Online Learning Resources:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_ma74/preview](https://onlinecourses.nptel.ac.in/noc21_ma74/preview)  
[https://onlinecourses.nptel.ac.in/noc22\\_mg31/preview](https://onlinecourses.nptel.ac.in/noc22_mg31/preview)



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II Year II Semester		L	T	P	C
Course Code: 1044232201	DATA ENGINEERING	3	0	0	3

### DATA ENGINEERING

#### Course Objectives:

The objectives of Data Engineering are

- To learn about basic concepts of Data Engineering
- To gain knowledge of the Data Engineering Life Cycle
- To learn How to design Good Data Architecture
- To assimilate about Data Storage Systems and Data warehouse in Data Engineering
- To internalize about Queries, Modeling and Transformation.

**Course Outcomes:** After completion of the course the student will be able to –

- Describe basic concepts of Data Engineering and Business, Technical Responsibilities
- Illustrate significant shifts occur throughout the Data Engineering Life Cycle
- Apply the structures and design Good Data Architecture.
- Illustrate about Data Storage Systems and Data warehouse in Data Engineering with
- Ingest Data.
- Make use of Queries, Modeling and Transformation in Business Analytics through ML ETL.

#### UNIT-I:

**Introduction to Data Engineering:** Definition, Data Engineering Life Cycle, Evolution of Data Engineer, Data Engineering Versus Data Science, Data Engineering Skills and Activities,

Data Maturity, Data Maturity Model, Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, Data Engineers and Other Technical Roles.

#### UNIT-II:

**Data Engineering Life Cycle:** Data Life Cycle Versus Data Engineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data.

**Major undercurrents across the Data Engineering Life Cycle:** Security, Data Management, DataOps, Data Architecture, Orchestration, Software Engineering.

#### UNIT-III:

**Designing Good Data Architecture:** Enterprise Architecture, Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts.

**Data Generation in Source Systems:** Sources of Data, Files and Unstructured Data, APIs, Application Databases (OLTP), OLAP, Change Data Capture, Logs, Database Logs, CRUD, Source System Practical Details.



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**UNIT-IV:**

**Storage:** Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lakehouse.

**Ingestion:** Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data

**UNIT-V:**

**Queries, Modelling and Transformation:** Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modelling, Modelling Streaming Data, Transformations, Streaming Transformations and Processing.

**Serving Data for Analytics, Machine Learning and Reverse ETL:** General Considerations for serving Data, Business Analytics, Operational Analytics, Embedded Analytics, Ways to serve data for analytics and ML, Reverse ETL.

**Text Books:**

1. Joe Reis, Matt Housley, Fundamentals of Data Engineering, O'Reilly Media, Inc., June 2022, ISBN: 9781098108304

**Reference Books:**

1. Paul Crickard, Data Engineering with Python, Packt Publishing, October 2020.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley, 3rd Edition, 2013
3. James Densmore, Data Pipelines Pocket Reference: Moving and Processing Data for Analytics, O'Reilly Media, 1st Edition, 2021

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<b>II Year II Semester</b>	<b>Database Management Systems</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Course Code: 1005232202</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## DATABASE MANAGEMENT SYSTEMS

### Course Objectives:

The main objectives of the course is to

- To study about the theoretical knowledge and practical skills in the use of databases and database management systems in information technology applications.
- To understand about the logical design, physical design and implementation of relational databases are covered.
- To understand and construct ER Model on various applications.

### Course Outcomes:

After completion of the course, students will be able to

- Discuss elements of Database System and its Architecture for defining the schema.
- Make Use of relational model concepts and create queries using Basic SQL.
- Develop ER Model and perform various query operations on SQL.
- Construct the relations using different normal forms without redundant information.
- Illustrate state of the transaction using ACID properties and Organize database storage structures and access techniques using file organization, indexing methods include B+ Tree, Hashing.

### UNIT I:

**Introduction:** Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**Entity Relationship Model:** Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

### Unit II:

**Relational Model:** Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).





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**UNIT III:**

**SQL:** Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion). Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non-updatable), relational set operations.

**UNIT IV:**

**Schema Refinement (Normalization):** Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), MVD, Fourth normal form (4NF), Fifth Normal Form (5NF).

**UNIT V:**

**Transaction Concept:** Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

**Introduction to Indexing Techniques:** B+ Trees, operations on B+Trees, Hash Based Indexing:

**Text Books:**

- 1) Database Management Systems, 3<sup>rd</sup> edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
- 2) Database System Concepts, 5<sup>th</sup> edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

**Reference Books:**

1. Introduction to Database Systems, 8<sup>th</sup> edition, C J Date, Pearson.
2. Database Management System, 6<sup>th</sup> edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

**Web-Resources:**

1. <https://nptel.ac.in/courses/106/105/106105175/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01275806667282022456\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview)

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II Year II Semester	Digital Logic & Computer Organization	L	T	P	C
Course Code: 1004232104		3	0	0	3

## DIGITAL LOGIC & COMPUTER ORGANIZATION

### Course Objectives:

The main objectives of the course is to

- To learn fundamental concepts of Number representation and Conversion and Boolean Algebra.
- Designing of different types of Sequential logic circuits.
- Discuss about the Components in computer.
- To Analyze Arithmetic operation of computers and processor organization.
- Study the Different units in computer organization.

### Course Outcomes:

After completion of the course, students will be able to

- Analyze the Digital Circuit using basic Boolean algebra.
- Designing of Registers and counters using flipflops and Describe the concepts of computers and processors.
- Design different Digital circuits using arithmetic operations in computers.
- Explain the organization of Memory by using Register concepts.
- Explain about the Input and output access in Computer Organization.

### UNIT – I:

**Data Representation:** Binary Numbers, Fixed Point Representation. Floating Point Representation. Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Binary codes

**Digital Logic Circuits-I:** Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic expressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers

### UNIT – II:

**Digital Logic Circuits-II:** Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters

**Basic Structure of Computers:** Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, Von- Neumann Architecture

### UNIT – III:

**Computer Arithmetic:** Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations

**Processor Organization:** Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control



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**UNIT – IV:**

**The Memory Organization:** Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage

**UNIT – V:**

**Input/Output Organization:** Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces

**Textbooks:**

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 6<sup>th</sup> edition, McGraw Hill, 2023.
2. Digital Design, 6<sup>th</sup> Edition, M. Morris Mano, Pearson Education, 2018.
3. Computer Organization and Architecture, William Stallings, 11<sup>th</sup> Edition, Pearson, 2022.

**Reference Books:**

1. Computer Systems Architecture, M. Moris Mano, 3<sup>rd</sup> Edition, Pearson, 2017.
2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier, 2004.
3. Fundamentals of Logic Design, Roth, 5<sup>th</sup> Edition, Thomson, 2003.

**Online Learning Resources:**

<https://nptel.ac.in/courses/106/103/106103068/>

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II Year II Semester	Data Engineering Lab	L	T	P	C
Course Code: 1044232210					

## DATA ENGINEERING LAB

### Course Objective:

- The main objective of this course is to teach how build data engineering infrastructure and data pipelines.

### Course Outcomes:

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

- Build our Data Engineering Infrastructure
- Demonstrate Reading and Writing files
- Develop Data Pipelines and integrate with Dashboard
- Deploy the Data Pipeline in production

### Experiments:

- Installing and configuring Apache NiFi, Apache Airflow
- Installing and configuring Elasticsearch, Kibana, PostgreSQL, pgAdmin 4
- Reading and Writing files
  - Reading and writing files in Python
  - Processing files in Airflow
  - NiFi processors for handling files
  - Reading and writing data to databases in Python
  - Databases in Airflow
  - Database processors in NiFi
- Working with Databases
  - Inserting and extracting relational data in Python
  - Inserting and extracting NoSQL database data in Python
  - Building database pipelines in Airflow
  - Building database pipelines in NiFi
- Cleaning, Transforming and Enriching Data
  - Performing exploratory data analysis in Python
  - Handling common data issues using pandas
  - Cleaning data using Airflow
- Building the Data Pipeline
- Building a Kibana Dash Board
- Perform the following operations
  - Staging and validating data
  - Building idempotent data pipelines
  - Building atomic data pipelines
- Version Control with the NiFi Registry



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- a. Installing and configuring the NiFi Registry
- b. Using the Registry in NiFi
- c. Versioning your data pipelines
- d. Using git-persistence with the NiFi Registry
- 10. Monitoring Data Pipelines
  - a. Monitoring NiFi in the GUI
  - b. Monitoring NiFi using processors
  - c. Monitoring NiFi with Python and the REST API
- 11. Deploying Data Pipelines
  - a. Finalizing your data pipelines for production
  - b. Using the NiFi variable registry
  - c. Deploying your data pipelines
- 12. Building a Production Data Pipeline
  - a. Creating a test and production environment
  - b. Building a production data pipeline
  - c. Deploying a data pipeline in production

**Reference Books:**

1. Paul Crickard , Data Engineering with Python, Packt Publishing, October 2020.



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II Year II Semester	Database Management Systems Lab	L	T	P	C
Course Code: <b>1005232211</b>		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

## DATABASE MANAGEMENT SYSTEMS LAB

### Course Objectives:

This Course will enable students to

- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers

### Course Outcomes:

After completion of the course, students will be able to

- Write a PL/SQL program to check whether the given number is ARMSTRONG or not.
- Write a PL/SQL Code Creation of forms for any Information System such as Student Information System, Employee Information System etc.

### Experiments covering the topics:

- DDL, DML, DCL commands
- Queries, nested queries, built-in functions,
- PL/SQL programming- control structures
- Procedures, Functions, Cursors, Triggers,
- Database connectivity- ODBC/JDBC

### Sample Experiments:

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with subQueries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, Constraints. Example: - Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to\_char, to number and to date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next day, add months, last day, months between, least, greatest, trunc, round, to char, to date)
5.
  - i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be



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selected from the table and printed for those who secured first class and an exception can be raised if no records were found)

- ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.



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7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Create a table and perform the search operation on table using indexing and non-indexing techniques.
13. Write a Java program that connects to a database using JDBC
14. Write a Java program to connect to a database using JDBC and insert values into it
15. Write a Java program to connect to a database using JDBC and delete values from it

**Text Books/Suggested Reading:**

1. Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007



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II Year II Semester	Exploratory Data Analysis using Python	L	T	P	C
Course Code: 1044232280		0	1	2	2

**EXPLORATORY DATA ANALYSIS USING PYTHON**  
(Skill Development Course)

**Course Objectives:**

- This course introduces the fundamentals of Exploratory Data Analysis
- It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.

**Course Outcomes:**

After completion of the course the student will be able to –

- Demonstrate the fundamentals of Exploratory Data Analysis. (K2)
- Illustrate the data using basic graphs and plots. (K3)
- Apply different Data Transformation Techniques. (K3)
- Summarize the data using descriptive statistics. (K2)
- Evaluate the Models and select the best model. (K5)

**UNIT-I**

**Exploratory Data Analysis Fundamentals:** Understanding data science, the significance of EDA, Steps in EDA, making sense of data, Numerical data, Categorical data, Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA, Getting started with EDA.

**Sample Experiments:**

1. a) Download Dataset from Kaggle using the following link:  
<https://www.kaggle.com/datasets/sukhmanibedi/cars4u>  
b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib, seaborn)
2. Perform Numpy Array basic operations and Explore Numpy Built-in functions.
3. Loading Dataset into pandas dataframe
4. Selecting rows and columns in the dataframe

**UNIT-II**

**Visual Aids for EDA:** Technical requirements, Line chart, Bar charts, Scatter plot using seaborn, Polar chart, Histogram, Choosing the best chart

**Case Study:** EDA with Personal Email, Technical requirements, Loading the dataset, Data transformation, Data cleansing, Applying descriptive statistics, Data refactoring, Data analysis.

**Sample Experiments:**

5. Apply different visualization techniques using sample dataset





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- a) Line Chart b) Bar Chart c) Scatter Plots d) Bubble Plot
- 6. Generate Scatter Plot using seaborn library for iris dataset
- 7. Apply following visualization Techniques for a sample dataset
  - a) Area Plot b) Stacked Plot c) Pie chart d) Table Chart
- 8. Generate the following charts for a dataset.
  - a) Polar Chart b) Histogram c) Lollipop chart
- 9. Case Study: Perform Exploratory Data Analysis with Personal Email Data

### UNIT-III

**Data Transformation:** Merging database-style dataframes, Concatenating along with an axis, Merging on index, Reshaping and pivoting, Transformation techniques, Handling missing data, Mathematical operations with NaN, Filling missing values, Discretization and binning, Outlier detection and filtering, Permutation and random sampling, Benefits of data transformation, Challenges.

#### Sample Experiments:

- 10. Perform the following operations
  - A. Merging Dataframes
  - B. Reshaping with Hierarchical Indexing
  - C. Data Deduplication
  - D. Replacing Values
- 11. Apply different Missing Data handling techniques
  - A. NaN values in mathematical Operations
  - B. Filling in missing data
  - C. Forward and Backward filling of missing values
  - D. Filling with index values
  - E. Interpolation of missing values
- 12. Apply different data transformation techniques
  - A. Renaming axis indexes
  - B. Discretization and Binning
  - C. Permutation and Random Sampling
  - D. Dummy variables

### UNIT-IV

**Descriptive Statistics:** Distribution function, Measures of central tendency, Measures of dispersion, Types of kurtosis, Calculating percentiles, Quartiles, Grouping Datasets, Correlation, Understanding univariate, bivariate, multivariate analysis, Time Series Analysis

#### Sample Experiments:

- 13. Study the following Distribution Techniques on a sample data
  - A. Uniform Distribution
  - B. Normal Distribution
  - C. Gamma Distribution
  - D. Exponential Distribution
  - E. Poisson Distribution
  - F. Binomial Distribution
- 13. Perform Data Cleaning on a sample dataset.



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15. Compute measure of Central Tendency on a sample dataset
  - A. Mean
  - B. Median
  - C. Mode
16. Explore Measures of Dispersion on a sample dataset
  - a) Variance b) Standard Deviation c) Skewness d) Kurtosis
- 17.A. Calculating percentiles on sample dataset
  - B. Calculate Inter Quartile Range(IQR) and Visualize using Box Plots
18. Perform the following analysis on automobile dataset.
  - a) Bivariate analysis b) Multivariate analysis
19. Perform Time Series Analysis on Open Power systems dataset

#### **UNIT-V**

**Model Development and Evaluation:** Unified machine learning workflow, Data preprocessing, Data preparation, Training sets and corpus creation, Model creation and training, Model evaluation, Best model selection and evaluation, Model deployment

**Case Study:** EDA on Wine Quality Data Analysis

#### **Sample Experiments:**

20. Perform hypothesis testing using statsmodels library
  - a) Z-Test b) T-Test
21. Develop model and Perform Model Evaluation using different metrics such as prediction score, R2 Score, MAE Score, MSE Score.
22. Case Study: Perform Exploratory Data Analysis with Wine Quality Dataset

#### **Text Book:**

1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 2020.

#### **References:**

1. Ronald K. Pearson, Exploratory Data Analysis Using R, CRC Press, 2020
2. RadhikaDatar, HarishGarg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, 1st Edition, Packt Publishing, 2019

#### **Web References:**

1. <https://github.com/PacktPublishing/Hands-on-Exploratory-Data-Analysis-with-Python>
2. <https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-data-analysis-eda-using-python/#h-conclusion>
3. <https://github.com/PacktPublishing/Exploratory-Data-Analysis-with-Python-Cookbook>

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II Year II Semester	Design Thinking & Innovation	L	T	P	C
Course Code: 1002232220		1	0	2	2

## DESIGN THINKING & INNOVATION

### Course Objectives:

The objective of this course is to

- Familiarize students with design thinking process as a tool for breakthrough innovation.
- Equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

### Course Outcomes:

- Define the concepts related to design thinking. (K2)
- Explain the fundamentals of Design Thinking and innovation (K2)
- Apply the design thinking techniques for solving problems in various sectors. (K3)
- Analyze to work in a multidisciplinary environment (K4)
- Evaluate the value of creativity (K5)
- Formulate specific problem statements of real time issues (K3)

### UNIT I

#### Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

### UNIT II

#### Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

**Activity:** Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

### UNIT III

#### Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

**Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation,



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Debate on value-based innovation.



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#### **UNIT IV**

##### **Product Design**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

**Activity:** Importance of modelling, how to set specifications, Explaining their own product design.

#### **UNIT V**

##### **Design Thinking in Business Processes**

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

**Activity:** How to market our own product, About maintenance, Reliability and plan for startup.

##### **Textbooks:**

1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

##### **Reference Books:**

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

##### **Online Learning Resources:**

- <https://nptel.ac.in/courses/110/106/110106124/>
- <https://nptel.ac.in/courses/109/104/109104109/>
- [https://swayam.gov.in/nd1\\_noc19\\_mg60/preview](https://swayam.gov.in/nd1_noc19_mg60/preview)

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