



**INTERNATIONAL SCHOOL OF
TECHNOLOGY AND SCIENCES FOR WOMEN
(An Autonomous Institution)**

(Approved by AICTE New Delhi, Affiliated to JNTUK Kakinada, Accredited by NBA and NAAC with A+ Grade)

NH-16, East Gonagudem (V), Rajanagaram (M), Rajamahendravaram, East Godavari -533294

Mobile : 9505506119 / 9505506101 | Email ID : istswomens101@gmail.com | website : www.ists.ac.in



B. Tech- Data Science (R23- II Year Course Structure & Syllabus)

B.Tech.–II Year I Semester

S.No.	SUBJECT CODE	Title	L	T	P	Credits
1	23BS2101H	DiscreteMathematics& Graph Theory	3	0	0	3
2	23BS2104H	Universal humanvalues – understanding harmonyand Ethical human conduct	2	1	0	3
3	23ES2102C	Introduction DataScience	3	0	0	3
4	23PC2101C	Advanced Data Structures & Algorithms Analysis	3	0	0	3
5	23PC2102C	ObjectOriented ProgrammingThroughJava	3	0	0	3
6	23PC2105C	DataScienceLab	0	0	3	1.5
7	23PC2104C	ObjectOriented ProgrammingThroughJava Lab	0	0	3	1.5
8	23SE2101C	Pythonprogramming	0	1	2	2
9	23AC2101B	EnvironmentalScience	2	0	0	-
Total			16	2	8	20

Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation

B.Tech–II Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	23HS2201M	Optimization Techniques	2	0	0	2
2	23ES 2201C	Statistical methods for Data Science	3	0	0	3
3	23PC2201C	Data Engineering	3	0	0	3
4	23PC2202C	DBMS	3	0	0	3
5	23PC2203C	Digital Logic and Computer Organization	3	0	0	3
7	23PC2204C	Data Engineering Lab	0	0	3	1.5
8	23PC2205C	DBMS Lab	0	0	3	1.5
9	23SEC2201C	Exploratory Data Analysis With Python	0	1	2	2
10	23BS2202H	Design Thinking &Innovation	1	0	2	2
Total			15	1	10	21

MandatoryCommunityServiceProjectInternshipof08weeksdurationduringsummer Vacation



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II Year I Semester		L	T	P	C
		3	0	0	3
DISCRETE MATHEMATICS AND GRAPH THEORY					

Course Objectives:

- To introduce the students to the topics and techniques of discrete methods and combinatorial reasoning.
- To introduce a wide variety of applications. The algorithmic approach to the solution of problems is fundamental in discrete mathematics, and this approach reinforces the close ties between this discipline and the area of computer science.

Course Outcomes: At the end of the course students will be able to

1. Build skills in solving mathematical problems (L3)
2. Comprehend mathematical principles and logic (L4)
3. Demonstrate knowledge of mathematical modeling and proficiency in using mathematical software (L6)
4. Manipulate and analyze data numerically and/or graphically Using appropriate Software (L3)
5. How to communicate effectively mathematical ideas/results verbally or in writing (L1)

UNIT-I: Mathematical Logic:

Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof.

UNIT-II: Set Theory:

Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams, and Functions: Bijective, Composition, Inverse, Permutation, and Recursive Functions.

UNIT-III: Recurrence Relations:

Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations.

UNIT-IV: Graph Theory:

Basic Concepts, Graph Theory and its Applications, Sub graphs, Graph Representations: Adjacency and Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs.



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Unit-V: MultiGraphs

Multigraphs, Bipartite and Planar Graphs, Euler's Theorem, Graph Coloring and Covering, Chromatic Number, Spanning Trees, Prim's and Kruskal's Algorithms, BFS and DFS Spanning Trees.

TEXTBOOKS:

1. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay and P. Manohar, Tata McGraw Hill.
2. Elements of Discrete Mathematics - A Computer Oriented Approach, C.L. Liu and D.
3. P. Mohapatra, 3rd Edition, Tata McGraw Hill.
4. Theory and Problems of Discrete Mathematics, Schaum's Outline Series, Seymour Lipschutz and Marc Lars Lipson, 3rd Edition, McGraw Hill.

REFERENCE BOOKS:

1. Discrete Mathematics for Computer Scientists and Mathematicians, J.L. Mott, A. Kandel and T. P. Baker, 2nd Edition, Prentice Hall of India.
2. Discrete Mathematical Structures, Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, PHI.
3. Discrete Mathematics, S.K. Chakraborty and B.K. Sarkar, Oxford, 2011.
4. Discrete Mathematics and its Applications with Combinatorics and Graph Theory, K.
5. H. Rosen, 7th Edition, Tata McGraw Hill.



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II Year I Semester	L	T	P	C
	2	1	0	3
UNIVERSAL HUMAN VALUES– UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT				

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such Holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one's self, and one's surroundings (family, society, nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop socially and ecologically responsible engineers (L3, L6)

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
Lecture 4: 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



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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 PS 11 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
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

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

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

UNIT IV – Harmony in the Nature (Existence) PS10 Exploring the Four Orders of Nature PS11 Exploring Co-existence in Existence Practice Sessions for



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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 R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
- b. The Teacher's Manual R R Gaur, R Asthana, G P Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2



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II Year I Semester		L	T	P	C
		3	0	0	3
DATA SCIENCED					

Pre-requisite:

1. Knowledge in Computer Programming.
2. A course on “Mathematical Foundations of Computer Science”.
3. Background in linear algebra, data structures and algorithms, and probability.

Course Objectives:

From the course the student will learn

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

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



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UNITIII:

NoSQL movement for handling Big data: Distributing data storage and processing with Hadoop framework, case study on risk assessment for loans sanctioning,

ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling

UNITIV:

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

UNITV:

Data Visualization and Prototype Application Development: Data Visualization options, Crossfilter, 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:

3. Joel Grus, "Data Science From Scratch", O'Reilly, 2019
4. Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013



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II Year I Semester		L	T	P	C
		3	0	0	3
ADVANCED DATA STRUCTURES & ALGORITHM ANALYSIS					

Course Objectives:

The main objectives of the course is to

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

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:

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

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen’s matrix multiplication.

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.



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UNIT-IV:

Backtracking:

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

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 2nd 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
2. <http://peterindia.net/Algorithms.html>
3. Abdul Bari, 1. Introduction to Algorithms (youtube.com)



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II Year I Semester		L	T	P	C
		3	0	0	3
OBJECT-ORIENTED PROGRAMMING THROUGH JAVA					

Course Objectives:

The learning objectives of this course are to:

identify Java language components and how they work together in applications

Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.

learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications

understand how to design applications with threads in Java

understand how to use Java APIs for program development

UNIT I

Object Oriented Programming: Basic concepts, Principles, Differences between OOP & POP

Program Structure in Java: Introduction Java Buzzwords, Writing Simple Java Programs, Elements or Tokens in Java Programs, Command Line Arguments, User Input to Programs, Data Types, Variables, and Operators : Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Literal Constants, Symbolic Constants, 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, Ternary Operator? :, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement.

UNIT II

: Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, 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 Constructor Methods, Constructor access controls, 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



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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, 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. **Applet Life cycle and AWT Components.**

UNIT V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multi threaded 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.

Java Database Connectivity: Introduction, JDBC Architecture,

Text Books:

1. JAVA One Step Ahead, Anitha Seth, B.L. Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

References Books:

1. The Complete Reference Java, 11th edition, Herbert Schildt, TMH
2. Introduction to Java Programming, 7th 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_01288046454761881634_7_shared/overview



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IIYearISemester

L	T	P	C
0	0	3	1.5

DATASCIENCEANALYSISLAB

CourseObjectives:

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

ListofExperiments

1. Creating NumPy Array
 - a. Basic ndarray
 - b. Array of zeros
 - c. Array of ones
 - d. Random numbers in ndarray
 - e. An array of your choice
 - f. Matrix in NumPy
 - g. Evenly spaced ndarray

2. The Shape and Reshaping of NumPy Array
 - a. Dimensions of NumPy array
 - b. Shape of NumPy array
 - c. Size of NumPy array
 - d. Reshaping a NumPy array
 - e. Flattening a NumPy array
 - f. Transpose of a NumPy array

3. Expanding and Squeezing a NumPy Array
 - a. Expanding a NumPy array
 - b. Squeezing a NumPy array
 - c. Sorting in NumPy Arrays

4. Indexing and Slicing of NumPy Array
 - a. Slicing 1-D NumPy arrays
 - b. Slicing 2-D NumPy arrays
 - c. Slicing 3-D NumPy arrays
 - d. Negative slicing of NumPy arrays

5. Stacking and Concatenating NumPy Arrays
 - a. Stacking ndarrays
 - b. Concatenating ndarrays
 - c. Broadcasting in NumPy Arrays



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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 SciKit-Learn & NLTK

15. Python program to implement with Python NLTK/Spacy/PyNLPI.



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WebReferences:

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-datascience-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutesguide-to-key-concepts/>
3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formatspython/>
4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessingpython-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-datavisualization-exploration-python/>
6. <https://www.nltk.org/book/ch01.html>



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IIYearISemester

L	T	P	C
0	0	3	1.5

OBJECT-ORIENTEDPROGRAMMINGTHROUGHJAVALAB

CourseObjectives:

Theaimofthiscourseisto

- PracticeobjectorientedprogrammingintheJavaprogramming language
- implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrateinheritance,Exceptionhandlingmechanism,JDBCconnectivity
- ConstructThreads,EventHandling,implementpackages,JavaFXGUI

ExperimentscoveringtheTopics:

- ObjectOrientedProgrammingfundamentals-datatypes,controlstructures
- Classes,methods,objects,Inheritance,polymorphism,
- Exceptionhandling,Threads,Packages,Interfaces
- Files,I/Ostreams,JavaFXGUI

SampleExperiments:

Exercise-1:

- WriteaJAVAprogramtodisplaydefaultvalueofallprimitivedatatypeofJAVA
- 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

- WriteaJAVAprogramtosearchforanelementinagivenlistofelementsusingbinary search mechanism.
- Write aJAVAprogramtosortforanelementinagivenlistofelementsusingbubblesort
- WriteaJAVAprogramusingStringBuffertodelete,removecharacter.

Exercise-3

- Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
- WriteaJAVAprogramimplementmethodoverloading.
- WriteaJAVAprogramtoimplementconstructor.
- WriteaJAVAprogramtoimplementconstructoroverloading.

Exercise-4

- WriteaJAVAprogramtoimplementSingleInheritance
- WriteaJAVAprogramtoimplementmultilevelInheritance
- WriteaJAVAprogramforabstractclasstofindareasofdifferentshapes



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Exercise-5

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

Exercise-6

- Write a JAVA program that describes exception handling mechanism
- Write a JAVA program illustrating Multiple catch clauses
 - Write a JAVA program for creation of Java Built-in Exceptions
 - Write a JAVA program for creation of User Defined Exception

Exercise-7

- 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)
- Write a program illustrating **isAlive** and **join()**
- Write a program illustrating **Daemon Threads**.
- Write a JAVA program **Producer Consumer Problem**

Exercise-8

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

Exercise-9

- Write a java program that connect to a database using **JDBC**
- Write a java program to connect to a database using **JDBC** and insert values into it.
- Write a java program to connect to a database using **JDBC** and delete values from it



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II Year I Semester

L	T	P	C
0	1	2	2

PYTHONPROGRAMMING

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

UNIT-I: History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Part 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.

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) Bitwise 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:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.



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5. Write a program to perform the given operations on a list:
 - i. Addition
 - ii. Insertion
 - iii. Slicing
6. Write a program to perform many 5 built-in functions by taking any list.

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, Frozen set.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.
4. Write a program to add a new key-value pair to an existing dictionary.
5. 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:

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



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Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python program to demonstrate NumPy arrays creation using `array()` function.
3. Python program to demonstrate use of `ndim`, `shape`, `size`, `dtype`.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find `min`, `max`, `sum`, `cumulative sum` of array
6. 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
7. 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. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, VM 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
2	0	0	--

ENVIRONMENTAL SCIENCE

Course Objectives:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

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

Biodiversity and Its Conservation: Introduction and Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use.

UNIT-III

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

- Air Pollution.
- Water pollution
- Soil pollution
- Noise pollution



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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.

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.

Textbooks:

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses, Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson Education, 2014.
3. S. Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K. Raghavan Nambiar, "Textbook of Environmental Studies for Undergraduate Courses as per UGC model syllabus", SciTech Publications (India), Pvt. Ltd, 2010.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.
2. M. Anji Reddy, "Textbook of Environmental Sciences and Technology", BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 1/e, Prentice Hall of India Private limited, 1991.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement



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[url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science](https://www.edx.org/learn/environmental-science)

- <http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-1/Data%20Files/pdf/lec07.pdf>
- <https://www.youtube.com/watch?v=5QxxaVfgQ3k>

CourseOutcomes:

COs	Statements	Blooms Level
CO1	Grasp multidisciplinarynatureofenvironmentalstudies andvarious renewableandnon-renewableresources.	L2
CO2	Understandflowandbio-geo-chemicalcyclesandecological pyramids.	L2
CO3	Understandvariouscausesofpollutionandsolidwastemanagement andrelatedpreventivemeasures.	L2
CO4	Understandtherainwaterharvesting, watershedmanagement, ozone layerdepletionandwastelandreclamation.	L2
CO5	Illustratethecausesofpopulationexplosion, valueeducationand welfareprogrammes.	L3



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II Year II Semester

L	T	P	C
3	0	0	3

OPTIMIZATION TECHNIQUES

Pre-requisite:

Course Objectives:

1. To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
2. To state single variable and multi variable optimization problems, without and with constraints.
3. To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
4. To state transportation and assignment problem as a linear programming problem to determine Simplex method.
5. To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.

Course Outcomes: At the end of the course, student will be able to

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Apply and solve transportation and assignment problem by using Linear programming Simplex method.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions
- Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

UNIT I: Introduction and Classical Optimization Techniques:

Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.

Classical Optimization Techniques: Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multi variable Optimization with equality constraints. Solution by method of Lagrange multipliers, multi variable Optimization with inequality constraints, Kuhn – Tucker conditions

UNIT II: Linear Programming:

Standard form of a linear programming problem, geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm.



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UNITIII:TransportationProblem:

Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method, testing for optimality of balanced transportation problems, Special cases in transportation problem.

UNITIV:NonlinearProgramming:

Unconstrained cases, One – dimensional minimization methods: Classification, Fibonacci method, Univariate method, steepest descent method. Constrained cases– Characteristics of a constrained problem, Classification, Basic approach of PenaltyFunction method, Basic approaches of Interior and Exterior penalty function methods,

UNITV:DynamicProgramming:

Dynamic programmingmultistage decision processes, types, concept of sub optimizationand the principleofoptimality,computationalprocedureindynamicprogramming,examplesillustratingthe calculus method of solution, examples illustrating the tabular method of solution.

Textbooks:

1. “Engineeringoptimization:Theoryandpractice”,S.S.Rao,NewAgeInternational (P)Limited,3rdedition,1998.
2. “IntroductoryOperations Research”, H.S. Kasene& K.D. Kumar, Springer (India), Pvt.LTd.

ReferenceBooks:

1. “Optimization Methods in Operations Research and systems Analysis”,by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. OperationsResearch,Dr.S.D.Sharma,Kedarnath,Ramnath&Co



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II Year II Semester

L	T	P	C
3	0	0	3

PROBABILITY AND STATISTICS

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart probability concepts and statistical methods in various applications Engineering

Course Outcomes: Upon successful completion of this course, the students should be able to

1. Classify the concepts of data science and its importance (L2)
2. Interpret the association of characteristics and through correlation and regression tools (L4)
3. Apply discrete and continuous probability distributions (L3)
4. Design the components of a classical hypothesis test (L6)
5. Infer the statistical inferential methods based on small and large sampling tests (L4)

Unit-I: Descriptive statistics and methods for data science:

Data science – Statistics Introduction – Population vs Sample – Collection of data – primary and secondary data – Type of variable: dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency – Measures of Variability – Skewness – Kurtosis.

UNIT-II: Correlation and Regression:

Correlation – Correlation coefficient – Rank correlation.

Linear Regression: Straight line – Multiple Linear Regression - Regression coefficients and properties – Curvilinear Regression: Parabola – Exponential – Power curves.

UNIT-III: Probability and Distributions:

Probability – Conditional probability and Baye’s theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT-IV: Sampling Theory:

Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) – Point and Interval estimations – Maximum error of estimate – Central limit theorem (without proof) – Estimation using t , and F -distributions.



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UNIT–V: Tests of Hypothesis:

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors –
Level of significance – One tail and two-tail tests – Test of significance for large samples and
Small Samples: Single and difference means – Single and two proportions – Student's t-test,
F-test, χ^2 -test.

Text Books:

- **Miller and Freund's**, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
- **S. C. Gupta and V.K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

- **Shron L. Myers, Keying Ye, Ronald E Walpole**, Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
- **Jay I. Devore**, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
- **Sheldon M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011.
- **Johannes Ledolter and Robert V. Hogg**, Applied statistics for Engineers and Physical Scientists, 3rd Edition, Pearson, 2010.



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IIYearIISemester

L	T	P	C
3	0	0	3

DATA ENGINEERING

CourseObjectives:

- ExplainbasicconceptsofDataEngineering
- DiscussboutDataEngineeringLifeCycle
- HowtodesignGoodDataArchitecture

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:DataEngineeringLifeCycle: Data Life Cycle Versus DataEngineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data.

MajorundercurrentsacrosstheDataEngineeringLifeCycle: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.

UNIT-IV:Storage:RawIngredientsofDataStorage, DataStorageSystems,Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lakehouse.

Ingestion: Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch IngestionConsiderations,MessageandStreamIngestionConsiderations,WaystoIngestData

UNIT-V: Queries, Modeling and Transformation: Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modelling, Modeling 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.

TextBooks:

1. JoeReis, MattHousley, *Fundamentals of Data Engineering*, O'Reilly Media, Inc., June 2022, ISBN: 9781098108304

ReferenceBooks:

1. PaulCrickard, *Data Engineering with Python*, Packt Publishing, October 2020.
2. RalphKimball, MargyRoss, *The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling*, Wiley, 3rd Edition, 2013
3. JamesDensmore, *Data Pipelines Pocket Reference: Moving and Processing Data for Analytics*, O'Reilly Media, 1st Edition, 2021



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II Year II Semester

L	T	P	C
3	0	0	3

DATABASE MANAGEMENT SYSTEMS

Course Objectives:

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

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).

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).



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UNIT V: Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, timestamp 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, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
- 2) Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

Reference Books:

1. Introduction to Database Systems, 8th edition, C.J Date, Pearson.
2. Database Management System, 6th edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Corlos 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_0127580666728202245_6_shared/overview



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II Year II Semester

L	T	P	C
3	0	0	3

COMPUTER ORGANIZATION AND ARCHITECTURE

Course Objectives:

The purpose of the course is

- Discuss about principles of computer organization and the basic architectural concepts.
- Explain in depth understanding of basic organization, design, programming of a simple digital computer, computer arithmetic, instruction set design, microprogrammed control unit, pipelining and vector processing, memory organization and I/O systems.

UNIT I: Digital Computers and Data Representation: Introduction, Numbering Systems, Decimal to Binary Conversion, Binary Coded Decimal Numbers, Weighted Codes, Self-Complementing Codes, Cyclic Codes, Error Detecting Codes, Error Correcting Codes, Hamming Code for Error Correction, Alphanumeric Codes, ASCII Code

Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.

Boolean Algebra and Logical gates: Boolean Algebra : Theorems and properties, Boolean functions, canonical and standard forms , minimization of Boolean functions using algebraic identities; Karnaugh map representation and minimization using two and three variable Maps ; Logical gates , universal gates and Two- level realizations using gates : AND-OR, OR-AND, NAND-NAND and NOR-NOR structures

UNIT II: Digital logic circuits: Combinatorial Circuits: Introduction, Combinatorial Circuit Design Procedure, Implementation using universal gates, Multi-bit adder, Multiplexers, Demultiplexers, Decoders

Sequential Switching Circuits: Latches and Flip-Flops, Ripple counters using T flip-flops;

Synchronous counters: Shift Registers; Ring counters

UNIT III: Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Booth multiplication algorithm, **Integer Division Algorithms, Floating – point Arithmetic Operations.**

Register Transfer language and microinstructions: Bus memory transfer, arithmetic and logical micro-operations, shift and rotate micro-operations

Basic Computer Organization and Design: Stored program concept, computer Registers, common bus system, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input–Output configuration and program Interrupt.

UNIT IV: Microprogrammed Control: Control memory, Address sequencing, microprogram example, design of control unit.

CentralProcessingUnit:GeneralRegisterOrganization,InstructionFormats,Addressingmodes, Data Transfer and Manipulation

ProgramControl:conditionalFlagsandBranching

UNITV: Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

Input-OutputOrganization: Input-Output Interface, Asynchronous data transfer, Modes ofTransfer, Priority Interrupt Direct memory Access.

TextBooks:

1. DigitalLogicandComputerDesign,MorissMano,11thEdition,Pearson.
2. ComputerSystemArchitecture,3rdEdition,M.MorrisMano,PHI

ReferenceBooks:

1. DigitalLogicandComputerOrganization,Rajaraman,Radhakrishnan,PHI,2006
2. ComputerOrganization,5thEdition,Hamacher,Vranesic,Zaky,TMH,2002
3. Computer Organization & Architecture: Designing for Performance, 7th Edition, William Stallings, PHI, 2006



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II Year II Semester

L	T	P	C
0	0	3	1.5

DATAENGINEERINGLAB

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
- Build 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, pgAdmin4
- 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 Dashboard
- Perform the following operations
 - Staging and validating data
 - Building idempotent data pipelines
 - Building atomic data pipelines



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9. VersionControlwiththeNiFiRegistry
 - a. InstallingandconfiguringtheNiFiRegistry
 - b. UsingtheRegistryinNiFi
 - c. Versioningyourdatapipelines
 - d. Usinggit-persistencewiththeNiFiRegistry
10. MonitoringDataPipelines
 - a. MonitoringNiFiintheGUI
 - b. MonitoringNiFiusingprocessors
 - c. MonitoringNiFiwithPythonandtheRESTAPI
11. DeployingDataPipelines
 - a. Finalizingyourdatapipelinesforproduction
 - b. UsingtheNiFivariableregistry
 - c. Deployingyourdatapipelines
12. BuildingaProductionDataPipeline
 - a. Creatingatestandproductionenvironment
 - b. Buildingaproductiondatapipeline
 - c. Deployingadatapipelineinproduction

ReferenceBooks:

1. PaulCrickard, DataEngineeringwithPython, PacktPublishing, October2020.



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IIYearIISemester

L	T	P	C
0	0	3	1.5

DATABASEMANAGEMENTSYSTEMSLAB

CourseObjectives:

ThisCoursewillenablestudentsto

- PopulateandqueryadatabaseusingSQLDDL/DMLCommands
- Declareandenforceintegrityconstraintsonadatabase
- WritingQueriesusingadvancedconceptsofSQL
- ProgrammingPL/SQLincludingprocedures,functions,cursorsandtriggers,

Experimentscoveringthetopics:

- DDL,DML,DCLcommands
- Queries,nestedqueries,built-infunctions,
- PL/SQLprogramming-controlstructures
- Procedures,Functions,Cursors,Triggers,
- Databaseconnectivity-ODBC/JDBC

SampleExperiments:

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 sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, 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. QueriesusingConversionfunctions(to_char,to_numberandto_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 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 andSAVEPOINT in PL/SQL block.



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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.
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 FVanderLans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007



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IIYearIISemester

L	T	P	C
0	1	2	2

EXPLORATORY DATA ANALYSIS USING PYTHON (SKILL DEVELOPMENT COURSE)

CourseObjectives:

1. ThiscourseintroducesthefundamentalsofExploratoryDataAnalysis
2. Itcoversessentialexploratorytechniquesforunderstandingmultivariate databy summarizing it through statistical methods and graphical methods.

CourseOutcomes:

1. Enumerate the fundamentals of Exploratory Data Analysis.
2. Visualize the data using basic graphs and plots.
3. ApplydifferentDataTransformationTechniques.
4. Summarizethedatausingdescriptivestatistics.
5. EvaluatetheModelsandselectthebestmodel

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.

SampleExperiments:

1. a) Download Dataset from Kaggleusing the following link :
<https://www.kaggle.com/datasets/sukhmanibedi/cars4u>
- b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib,seaborn)
2. PerformNumpyArraybasicoperationsandExploreNumpyBuilt-infunctions.
3. LoadingDatasetintopandasdataframe
4. Selectingrowsandcolumnsinthedataframe

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,Datacleansing,Applyingdescriptivestatistics,Datarefactoring,Data analysis.

SampleExperiments:

1. Applydifferentvisualizationtechniquesusingsampled dataset
 - a) LineChartb)BarChartc)ScatterPlotsd)BubblePlot
2. GenerateScatterPlotusingseabornlibraryforirisdataset
3. ApplyfollowingvisualizationTechniquesforasampled dataset
 - a) AreaPlotb)StackedPlotc)Piechartd)TableChart



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4. Generate the following charts for a dataset.

a) Polar Chart b) Histogram c) Lollipop chart

5. 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:

1. Perform the following operations

- Merging Dataframes
- Reshaping with Hierarchical Indexing
- Data Deduplication
- Replacing Values

2. Apply different Missing Data handling techniques

- NaN values in mathematical operations
- Filling in missing data
- Forward and Backward filling of missing values
- Filling with index values
- Interpolation of missing values

3. Apply different data transformation techniques

- Renaming axis indexes
- Discretization and Binning
- Permutation and Random Sampling
- 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:

1. Study the following Distribution Techniques on a sampled data

- Uniform Distribution
- Normal Distribution
- Gamma Distribution
- Exponential Distribution
- Poisson Distribution
- Binomial Distribution

2. Perform Data Cleaning on a sampled dataset.

3. Compute measure of Central Tendency on a sampled dataset

- Mean b) Median c) Mode

4. Explore Measures of Dispersion on a sampled dataset



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- a) Variance b) Standard Deviation c) Skewness d) Kurtosis
5. a) Calculating percentiles on sampled dataset
b) Calculate Inter Quartile Range (IQR) and Visualize using Box Plots
6. Perform the following analysis on automobile dataset.
a) Bivariate analysis b) Multivariate analysis
7. Perform Time Series Analysis on Open Powersystems 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:

1. Perform hypothesis testing using statsmodels library
a) Z-Test b) T-Test
2. 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. Radhika Datar, Harish Garg, 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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IIYearIISemester

L	T	P	C
1	0	2	2

DESIGN THINKING & INNOVATION

Course Objectives: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

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, customer, 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, Debate on value-based innovation.

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 modeling, how to set specifications, Explaining their own product design.



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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, 1/e, HarperCollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William Lidwell, Kritina Holden, & Jill Butcher, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough, H, The era of open innovation, 2003.

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://onlinecourses.nptel.ac.in/noc22_de16/preview

Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design Thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in various sectors.	L3
CO4	Analyse to work in a multidisciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5