Program structure & Detailed Syllabus

For

Under Graduate Programme (B.Tech)

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(Applicable For Batches Admitted From 2020 − 2021)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY (AUTONOMOUS)

DUVVADA - VISAKHAPATNAM − 530 049

(An Autonomous Institute, Accredited by NAAC, Affiliated to JNTUK, Kakinada, AP)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY: VISAKHAPATNAM

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

PROGRAM STRUCTURE – VR-20

I Year **I Semester**

S. No.	Course Code	Course Title	L	T	P	C
1	**1000201106**	Calculus	3	0	0	3
2	**1000201107**	Linear Algebra and Matrix analysis	3	0	0	3
3	**1000201102**	Technical English Communication	3	0	0	2
4	**1005201100**	Problem Solving and Programming using C	1	0	4	3
5	**1003201100**	Engineering Mechanics	3	0	0	3
6	**1000201108**	Physics of Materials	0	0	3	3
7	**1000201110**	Technical English Communication Lab	0	0	3	1.5
8	**1005201110**	Problem Solving and Programming using C Lab	0	0	3	1.5
9	**1000201160**	Engineering Exploration-I	0	0	2	1
10	**1000201120**	Games, Sports and Yoga	0	0	4	0
Total Credits						**21**

Legend: L-Lecture; T-Tutorial; P -Practical; C-Credit

I Year **II Semester**

S. No.	Course Code	Course Title	L	T	P	C
1	**1000201205**	Statistics for Data Science-I	3	0	0	3
2	**1005201203**	Data Structures	3	0	0	3
3	**1005201201**	Computer Organization	3	0	0	3
4	**1005201202**	Web Design	3	0	0	3
5	**1005201212**	Data Structures Lab	3	0	0	1.5
6	**1000201213**	Physics of Materials Lab	0	0	3	1.5
7	**1005201211**	Web Design Lab	0	0	3	1.5
8	**1000201214**	R Programming for Data Science Lab	0	0	3	1.5
9	**1000201121**	Constitution of India	2	0	0	0
Total Credits						**18**

Total Credits (I Year – I & II Semesters) = 39

II Year **I Semester**

S. No.	Course Code	Course Title	L	T	P	C
1	**1000202103**	Statistics for Data Science-II	3	1	0	3
2	**1054202100**	Data Engineering	3	0	0	3
3	**1005202104**	Programming Essentials in Python	3	0	0	3
4	**1005202202**	Software Engineering	3	0	0	3
5	**1000202100**	Discrete Mathematical Structures	3	1	0	3
6	**1054202110**	Data Engineering Lab	0	0	3	1.5
7	**1005202113**	Programming Essentials in Python Lab	0	0	3	1.5
8	**1005202212**	Unified Modeling Language Lab	0	0	3	1.5
9	**1054202180**	Competitive Programming	0	0	4	2
10	**1000202120**	Life Skills	2	0	0	0
Total Credits						**21.5**

II Year **II Semester**

S. No.	Course Code	Course Title	L	T	P	C
1	**1005202101**	Operating Systems	3	0	0	3
2	**1054202200**	Artificial Intelligence	3	0	0	3
3	**1005202103**	Design and Analysis of Algorithms	3	0	0	3
4	**1005202204**	Data Warehousing and Data Mining	3	0	0	3
5	**1099202100**	Managerial Economics and Financial Analysis	3	0	0	3
6	**1005202111**	Operating Systems Lab	0	0	3	1.5
7	**1005202112**	Algorithms Lab	0	0	3	1.5
8	**1054202210**	Data Warehousing and Data Mining Lab	0	0	3	1.5
9	**1054202280**	Multivariate Data Visualization with R	1	0	2	2
10	**1054202260**	Mini Project (EPICS)	0	0	0	1
11	**1000202121**	Environmental Science	2	0	0	0
Total Credits						**22.5**
MANDATORY SUMMER INTERNSHP						
12		**Honors/Minor Courses**	**4**	0	**0**	**4**

Total Credits (II Year – I & II Semesters) = 44

Detailed Syllabus

II Year- I Semester

II Year – I Semester	STATISTICS FOR DATA SCIENCE-II	L	T	P	Credits
1000202103		3	0	0	3

Course Objectives:

- ✓ To understand basic theoretical knowledge about fundamental principles for statistical inference**.**
- ✓ To understand different statistical test applied to samples to infer conclusions**.**
- ✓ **COURSE OUTCOMES:**

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Conduct hypothetical testing for large samples and small samples	1 2 3	1 2 3
CO2	Calculate, and interpret, the correlation coefficient and regression models	1 2	2 3
CO3	Interpret production or service quality by using different quality control charts.	3 5	2 3
CO4	Analyze the time series data using different techniques	1 2 3 4 12	1 2 3 3 3

Unit-I

Test of Hypothesis-I: **[8 Hours]**

Concept and definition of statistical hypothesis, Type I and Type II errors. One tail, two-tail tests, level of significance, P –Values in Decision Making, confidence intervals.

Large sample tests: Hypothesis testing of means, proportions and difference between means and proportions.

Unit-II

Test of Hypothesis-II: **[10 Hours]**

Small Sample tests: Students' t-distribution: single mean, difference of means, paired t-test for difference of means, F-distribution and X^2 test. Test of independence of attributes - ANOVA for one-way and two-way classified data.

Unit-III

Correlation and Regression: **[10 Hours]**

The method of least squares – Inferences based on the least square's estimations, Regression: definition, linear regression, multiple regression and curve linear regression, Correlation: definition, correlation coefficient, rank correlation and correlation for bivariate distributions

Unit-IV

Statistical Quality Control methods: [9 Hours]

Introduction, types of control charts: control charts for variables and attributes, Methods for preparing control charts and distribution curve.

Unit-V

Statistical Methods in Time series Analysis data: [10 Hours]

Introduction, importance of Time series analysis, Methods in time series data analysis

Text Books:

- 1. Fundamentals of Mathematical Statistics by S.C. Gupta and V.K. Kapoor
- 2. Probability and Mathematical statistics by Prasanna Sahoo
- 3. Introduction to Time Series and Forecasting, Second Edition, by Peter J. Brockwel Richard A. Davis

Reference Books:

1) Yanchang Zhao, "R and Data Mining: Examples and Case Studies", Elsevier, 1st Edition, 2012

II Year – I Semester		L	T	P	C
1054202100	DATA ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

- To Identify the scope and essentiality of Data.
- To Analyse data, choose relevant models and algorithms for respective applications.
- To Provide students with theoretical knowledge and practical skills in the use of database and database management systems in information technology applications
- To Develop research interest towards advances in data science.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Understand Data Science fundamentals, Data Representation.	PO1, PO2, PO12	3
CO2	Create, maintain and manipulate a relational database using SQL.	PO1, PO2, PO12	3
CO3	Design and build database system for a given real world problem.	PO1, PO2, PO3, PO12	3
CO4	Identify appropriate data Processing techniques to solve real world problems.	PO1, PO2, PO3, PO12	3

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT- I

INTRODUCTION TO DATA SCIENCE

Introduction to Data Science – Evolution of Data Science – Data Engineering Ecosystem, Data Engineering Lifecycle -Data Science Roles – Data Engineering in Action-Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues-Data Sources, Data Storages- Traditional File System. **[6 HOURS]**

UNIT-II

DATA MODELS AND REPRESENTATION

Data model, structured data, unstructured data, semi-structured data and Data representation, feature representations, encoded representations, Spatial data representation, Time-series data representations. **[6 HOURS]**

UNIT-III

ACCESSING DATA- RELATIONAL DATABASE

E-R Model: Overview of Database Design, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model Introduction to the Relational Model, Relational model constraints over relations. Relational Algebra and calculus.

[8 HOURS]

UNIT-IV

ACCESSING DATA- SCHEMA REFINMENT

SQL Queries: The Form of Basic SQL Query, Union, Intersect and Except-Nested Queries-Aggregative Operators- Group by and Having Clauses-Null Values-Outer Joins.

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

[**8 HOURS]**

UNIT-V

DATA ANALYSIS TOOLS

Charts: Bar Chart/Graph. Pie Chart. Line Graph or Chart, Histogram Chart, Area Chart, Check sheet, Control chart, Gantt chart, Plots: Dot Graph or Plot, Scatter Plot, Box and whisker plot, Design of experiments (DOE). **[10 HOURS]**

Text Books:

1. The Data Engineering Cookbook by Andreas Kretz
2. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA.
3. R for data science : Import, Tidy, Transform, Visualize, And Model Data Paperback – 20 January 2017 by Hadley Wickham,Garrett Grolemund

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1. Introduction to Database Systems, 8/e C J Date, PEA
2. The Database book principles & practice using Oracle/MySql Narain Gehani, University Press.
3. Data Engineering with Python: Work with Massive Datasets to Design Data Models and Automate Data Pipelines Using Python

Introduction to Database Systems, 8/e C J Date, PEA

E-Books: https://github.com/andkret/Cookbook

NPTEL/MOOC:

1. https://www.coursera.org/learn/introduction-to-data-engineering#syllabus
2. https://www.udacity.com/course/data-engineer-nanodegree--nd027
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs09/

II Year – I Semester		L	T	P	C
1005202104	Programming Essentials in Python	3	0	0	3

COURSE OBJECTIVES:

1. To learn about Python programming language syntax, semantics, and the runtime environment.
2. To be familiarized with universal computer programming concepts like data types, containers.
3. To be familiarized with general computer programming concepts like conditional execution, loops & functions.
4. To be familiarized with general coding techniques and object-oriented programming

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Develop essential programming skills in computer programming concepts like data types, containers	PO1	3
CO2	Apply the basics of programming in the Python language	PO1 PO2	3 3
CO3	Solve coding tasks related to the fundamental notions and techniques used in object-oriented programming.	PO5	2 3
CO4	Solve coding tasks related OOPS, and Multithreading	PO12	3

UNIT- I

INTRODUCTION TO PYTHON:

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation. Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations. Control Flow-: if, if-elif-else, for, while, break, continue, pass. **[6 Hours]**

UNIT- II

STRINGS and DATA STRUCTURES:

Strings: Strings and text files, String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary,

octal, hexadecimal numbers, Data Structures: Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

[8 Hours]

UNIT- III

FUNCTIONS:

Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables. Modules: Creating modules, import statement, from, name spacing, Python packages Introduction to PIP, Installing Packages via PIP, Using Python Packages. **[8 Hours]**

UNIT- IV

INTRODUCTION TO OOPS:

Classes and Objects: Introduction, classes and objects, class method and self-argument, init() method, class and object variables, del() method, other special methods, public and private data members, private methods, calling a class method from another class method, built-in class attributes, garbage collection, class and static methods, Inheritance: Introduction, inheriting classes in python, types of inheritance, composition/containership/complex objects, abstract classes and interfaces, Meta class. **[8 Hours]**

UNIT- V

OPERATOR OVERLOADING AND EXCEPTION HANDLING

Operator Overloading: Introduction, implementing operator overloading, reverse adding, overriding__getitem__() and __setitem__() methods, overriding the in operator, overriding miscellaneous functions,overriding the _call__() method.

Error and Exception Handling: Introduction to errors and exceptions, handling exceptions, multipleexcept blocks, multiple exceptions in a single block, except block without exception, the else clause, raisingexceptions, built-in and user-defined exceptions, the finally block.

[10 Hours]

Text Books:

1. ReemaThareja,“Python ProgrammingUsing Problem Solving Approach”, Oxford University Press,2019.
2. Zed Shah, “Learn PythonThe Hard Way”, Third edition, Addison-Wesley, 2013.

Reference Books:

1. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers,2017.
2. John V. Guttag, “Introduction to Computation and Programming Using Python”, The MIT Press,
3. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.
4. Core Python Programming - Covers Fundamentals to Advanced Topics Like OOPS, Exceptions, Data Structures, Files, Threads, Networking, GUI, DB Connectivity and

Data Science Second Edition (English, Paperback, Rao R. Nageswara)

E-Books: https://www.python.org/doc/

NPTEL/MOOC:

1. https://nptel.ac.in/courses/106/106/106106182/
2. https://nptel.ac.in/courses/106/106/106106145/

II Year – I Semester		L	T	P	C
1005202202	Software Engineering	3	0	0	3

COURSE OBJECTIVES:

1. To understand the software life cycle models.
2. To understand the software requirements and SRS document.
3. To understand the importance of modeling and modeling languages.
4. To design and develop correct and robust software products.
5. To understand the quality control and how to ensure good quality software.
6. To understand the planning and estimation of software projects.
7. To understand the implementation issues, validation and verification procedures.
8. To understand the maintenance of software

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Apply the appropriate process models for the application development of SDLC	PO1 PO2 PO3 PO5 PO8	1 2 2 1 2
CO2	Understand the phases of SDLC from requirement gathering phase to design phase via Analysis Phase	PO1 PO2	2 1
CO3	Analyzing the strategies for coding and testing phase in Software product development	PO1 PO2 PO3	2 2 2
CO4	Apply the knowledge about estimation and maintenance of software systems and modeling the software project by using CASE tools	PO1 PO2 PO3 PO5	2 2 1 1

UNIT- I

Software and Software Engineering: The Nature of Software, The Unique Nature of Web Apps, Software Engineering, Software Process, Software Engineering Practice, Software Myths, Professional and ethical responsibility.

Process Models and Agile Development: Generic Process Models like Waterfall Models, Evolutionary Process Model, V-Model, Agile Model, etc. Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Terminology, Product and Process. Agile process-Extreme programming Process. **[10 Hours]**

UNIT-II

Requirements Analysis and Specification: Requirements Gathering and Analysis, Software Requirement Specification (SRS), Formal System Specification.

Software Design: Overview of the Design Process, How to Characterize of a Design? Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design. **[8 Hours]**

UNIT-III

Function-Oriented Software Design: Overview of SA/SD Methodology, Structured Analysis, Developing the DFD Model of a System, Structured Design, Detailed Design, Design Review, over view of Object Oriented design.

User Interface Design: Characteristics of Good User Interface, Basic Concepts, Types of User Interfaces, Fundamentals of Component-based GUI Development, A User Interface Design Methodology.

Coding And Testing: Coding, Code Review, Software Documentation, Testing and Test Case, Unit Testing, Black-Box Testing, White-Box Testing, Debugging, Program Analysis Tool, Integration Testing, Testing Object-Oriented Programs, System Testing, Some General Issues Associated with Testing. **[10 Hours]**

UNIT-IV

Software Reliability And Quality Management: Software Reliability, Statistical Testing, Software Quality, Software Quality Management System, ISO 9000, SEI Capability Maturity Model.

Computer Aided Software Engineering: Case and its Scope, Case Environment, Case Support in Software Life Cycle, Other Characteristics of Case Tools, Towards Second Generation CASE Tool, Architecture of a Case Environment **[9 Hours]**

UNIT-V

Software Maintenance: Software maintenance, Maintenance Process Models, Maintenance Cost, Software Configuration Management, Devops.

Software Reuse: what can be reused? Why almost No Reuse So Far? Basic Issues in Reuse Approach, Reuse at Organization Level. **[8 Hours]**

Text Books:

1. Software engineering A practitioner's Approach, Roger S. Pressman, Seventh Edition Mc Graw Hill International Edition.
2. Fundamentals of Software Engineering, Rajib Mall, Third Edition, PHI.
3. Software Engineering, Ian Sommerville, Ninth edition, Pearson education

Reference Books:

1. Software Engineering: A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
2. Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India, 2010.
3. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

II Year – I Semester		L	T	P	C
1000202100	DISCRETE MATHEMATICAL STRUCTURES (Common for CSE, IT and AI&DS)	3	1	0	3

COURSE OBJECTIVES:

- To introduce the algorithmic approach to the solution of problems, which is fundamental in discrete mathematics and this approach reinforces the close ties between this discipline and the area of computer science.
- To introduce basic logical connectives and inference theory.
- To Familiarise closed form solution of linear recurrence relations by various methods.
- To perform the operations associated with sets, functions and relations.
- To Bring awareness of basic concepts of graphs and explaining related algorithms.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	**Develop** reasoning skills using Mathematical Logic concepts.	1 2 3	2 2 3
CO2	**Evaluate** the solutions for various problems using recurrence relations	1 2	1 2
CO3	**Construct** Hasse diagrams and **Understand** the concept of Algebraic Structures	1 2 3	1 2 2
CO4	**Apply** the concepts of graph theory for a given problem.	1 2 3 12	1 2 3 3

UNIT- I

Mathematical Logic **[12 Hours]**

Propositional Logic: Connectives- negation, conjunction, disjunction, conditional and bi-conditional, well-formed formulae, tautologies, equivalence of formulae, tautological implications, Disjunctive and Conjunctive normal forms, Rules of inference and examples, Consistency of premises.

Predicative Logic.; Statement Functions, Variables and Quantifiers, Free and Bounded variables, Inference theory for predicative logic.

UNIT- II

Recurrence Relations **[8 Hours]**

Recurrence relations: Recurrence relations, solving homogeneous linear recurrence relations by characteristic roots method, solving non homogeneous linear recurrence relations.

UNIT- III

Sets, Relations and Algebraic Structures **[12 Hours]**

Sets: Sets, Operations on Sets, Principles of Inclusion–Exclusion, Pigeonhole Principle and its Application

Relations: Definition, representation, types of relations: equivalence relation, equivalence class, partial order, Hasse Diagram and total order relations.
Functions: Definition, types of functions: surjective , injective and bijective .

Algebraic Structures: Binary operations, Algebraic structures, Group, Abelian Group, Subgroups, Lagrange's theorem on finite groups.

UNIT- IV

Unit IV: Graph Theory **[10 Hours]**

Graph theory: Definitions, finite and infinite graphs, incidence and degree, isolated and pendant vertices, isomorphism, sub graphs, connected and disconnected graphs, simple graph, complete graph, bipartite graph, complete bipartite graph, planar graph, Isomorphic Graphs, Euler formula(without proof) and Graph colouring, Walk, path and circuit, Euler graph, Hamiltonian Graph.

UNIT- V

Unit V : Trees **[10 Hours]**

Trees: Some properties of trees, rooted and binary trees, spanning trees, BFS & DFS Algorithms, Minimal spanning trees, Kruskal's algorith

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Discrete Mathematics and its Applications with Combinatorics and Graph Theory, K. H. Rosen, 7th Edition, Tata McGraw Hill.
3. Joe L. Mott, Abraham Kandel and T. P. Baker, Discrete Mathematics forcomputer scientists& Mathematicians, 2/e, Prentice Hall of India Ltd, 2012.

Reference Books:

1. S. Santha and E. V. Prasad Mathematical Foundation For Computer Science , Cengage,2017.
2. Discrete Mathematical Structures, Bernand Kolman, Robert C. Busby,Sharon Cutler Ross, PHI.
3. Discrete Mathematics, S. K. Chakraborthy and B.K. Sarkar, Oxford, 2011.
4. Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rdEdition, Tata McGraw

II Year – I Semester		L	T	P	C
1054202110	**DATA ENGINEERING LAB**	0	0	3	1.5

COURSE OBJECTIVES:

- To Identify the scope and essentiality of Data.
- To Analyse data, choose relevant models and algorithms for respective applications.
- To Provide students with theoretical knowledge and practical skills in the use of database and database management systems in information technology applications
- To Develop research interest towards advances in data science.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Understand Data Science fundamentals, Data Representation.	PO1, PO2, PO12	3
CO2	Create, maintain and manipulate a relational database using SQL.	PO1, PO2, PO12	3
CO3	Design and build database system for a given real world problem.	PO1, PO2, PO3, PO12	3 3
CO4	Identify appropriate data mining algorithms to solve real world problems	PO1, PO2, PO3, PO12	3

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1.	Exercise – 1 Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.	Introduction
2.	Exercise – 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.	Queries
3.	Exercise – 3	

	Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.	
4.	Exercises –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).	Queries
5.	Exercise -5 Write an SQL query to implement JOINS.	Joins
6.	Exercise -6 Data Visualization using Boxplot Plotting Framework using R. Data Visualization using Histogram Plotting Framework using R.	Data Visualization
7.	Exercise -7 Data Visualization using Line Graph Plotting Framework using R. Data Visualization using Scatterplot Plotting Framework using R.	Data Visualization
8.	Exercise -8 Data Visualization using Pie Chart Plotting Framework using R. Data Visualization using Bar Chart Plotting Framework using R.	Data Visualization
9.	Exercise -9 Application to adjust the Number of Bins in the Histogram using R Language/ Python Programming.	Data Visualization
10.	Exercise -10 Application to analyse Stock Market Data using R Language/ Python Programming.	Data Visualization

Text Books:

1. The Data Engineering Cookbook by Andreas Kretz
2. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA.
3. R for data science : Import, Tidy, Transform, Visualize, And Model Data Paperback – 20 January 2017 by Hadley Wickham,Garrett Grolemund

Reference Books:

1. Introduction to Database Systems, 8/e C J Date, PEA
2. The Database book principles & practice using Oracle/MySqlNarainGehani, University Press.

3. Data Engineering with Python: Work with Massive Datasets to Design Data Models and Automate Data Pipelines Using Python.

Introduction to Database Systems, 8/e C J Date, PEA

E-Books: https://github.com/andkret/Cookbook

NPTEL/MOOC:

1. https://www.coursera.org/learn/introduction-to-data-engineering#syllabus
2. https://www.udacity.com/course/data-engineer-nanodegree--nd027
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs09/

II Year – I Semester		L	T	P	C
1005202113	Programming Essentials in Python Lab	0	0	3	1.5

COURSE OBJECTIVES:

1. To learn about Python programming language syntax, semantics, and the runtime environment.
2. To be familiarized with universal computer programming concepts like data types, containers.
3. To be familiarized with general computer programming concepts like conditional execution, loops & functions.
4. To be familiarized with general coding techniques and object-oriented programming.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Develop essential programming skills in computer programming concepts like data types, containers	PO1	3
CO2	Apply the basics of programming in the Python language	PO1, PO2	3
CO3	Solve coding tasks related to the fundamental notions and techniques used in object-oriented programming.	PO5	3 3
CO4	Solve coding tasks related OOPS, and Multithreading	PO12	3

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1.	**Exercise – 1** a. Practice Python Installation b. Declaration of Variables, identifiers and type conversions c. Write simple programs by defining variables and assigning values of different basic data types d. Write programs to know data type of a variable using Type statement e. Write programs to do multiple assignments at a time	Python installation

	f. Write programs for writing multiple statements in a single line g. Use Input statement, type conversion h. Use different operators in programs	
2.	**Exercise -2** Python programs on Decision Control Statements a. Write programs using selection statements b. Implement programs on and conditional branching statements	Decision Control Statements
3.	**Exercises -3** Python programs on looping control structures a. Design and develop programs using Iterative statements- while, for, nested loops b. Use Break, continue, pass statements in programs c. Understand the usage of else statement in loops with a case study	looping control structures
4.	**Exercise -4** Identify the need and importance in the creation of Python Functions and Modules a. Write programs for defining and calling functions b. Understand Scope of a variable and Use global statement c. Differentiate fruitful and void functions through a case study d. Apply recursive and Lambda functions e. Understand different kinds of arguments through a case study f. Installing and usage of standard library modules g. Use python packages	Identify the need and importance in the creation of Python Functions and Modules
5.	**Exercise -5** Solve the problems using Strings and understanding the methods and operations on Lists a. Apply string formatting operator b. Use built in string methods, functions and regular expressions	Solve the problems using Strings and understanding the methods
6.	**Exercise -6** Programs on the implementation of methods and operations of List data structure a. Define a list and write programs to access and modify elements of a list b. Practice basic list operations, methods c. Write programs to use list as a stack and queue	Programs on the implementation of methods and operations of List data structure
7.	**Exercise -7** Implement programs to solve the problems using Python other data structures: Tuples and Dictionaries	Implement programs to solve the

	a. Write programs to define a dictionary and write programs to modify values, adding new keys b. Apply looping over a dictionary c. Use built in dictionary methods, functions d. Create a tuple and assign values e. Use basic tuple operations and comparisons	problems using Python other data structures: Tuples and Dictionaries
8.	**Exercise -8** Implement the Python Classes and Objects to address the real-world scenarios a. Define classes and objects using python for the real-world scenario b. Defining constructors and using Self c. Understand public and private members d. Practice calling class methods from another class e. Write built in functions to check, get, set and delete attributes	Implement the Python Classes and Objects to address the real-world scenarios
9.	**Exercise -9** Develop the programs to implement parent-child relationship a. Demonstrate different inheritance types b. Apply polymorphism and method overriding c. Create abstract classes	Develop the programs to implement parent-child relationship
10.	**Exercise -10** Write the programs to address the exceptions via exception handling in the development of solutions and implement operator overloading a. Write a simple exception handling program with try-except b. Write a program for catching multiple exceptions c. Demonstrate raising and re raising exceptions d. Apply else and finally clauses e. Demonstrate the usage of polymorphism in overloading of operators	Write the programs to address the exceptions via exception handling in the development of solutions and implement operator overloading
11.	**Exercise -11** a. Create a series from a list, numpy array and dict b. Convert the index of a series into a column of a dataframe c. Combine many series to form a dataframe d. Assign name to the series' index e. Get the items not common to both series A and series B f. Get the minimum, 25th percentile, median, 75th, and max of a numeric series g. Get frequency counts of unique items of a series h. Bin a numeric series to 10 groups of equal size	Pandas

	i. Find the positions of numbers that are multiples of 3 from a series Get the positions of items of series A in another series B	
12.	**Exercise -12** a. create a 1D array b. Extract items that satisfy a given condition from 1D array c. Replace items that satisfy a condition without affecting the original array d. Reshape an array e. Extract all numbers between a given range from a numpy array f. Swap two columns in a 2d numpy array g. Import a dataset with numbers and texts keeping the text intact in python numpy h. Compute the mean, median, standard deviation of a numpy array i. Insert values at random positions in an array j. Find the count of unique values in a numpy array	numpy

Text Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson

Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.
2. Programming and Problem Solving with Python, Ashok NamdevKamthane, Amit Ashok Kamthane, TMH, 2019.
3. https://www.tutorialspoint.com/python3/python_tutorial.pdf

II Year – I Semester		L	T	P	C
1005202212	Unified Modeling Language Lab	0	0	3	1.5

COURSE OBJECTIVES:

1. To provide a snapshot of the instances in a system and the relationships between the instances.
2. To portray and understand functional requirements of a system

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Create UML Diagrams	PO1 PO2 PO3 PO5 PO11	1 2 3 3 3
CO2	Create State Chart Diagrams	PO2 PO3 PO5 PO11	3 2 3 3
CO3	Create Interaction Diagrams	PO2 PO3 PO5 PO11	2 2 3 3

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1.	Demonstration of Rational Rose 98, ARGO UML and IBM RSA tools.	Environment Overview
2.	Draw Class diagram and Use Case Diagram of Library Management System	Design of UML Diagrams
3.	Draw Class diagram and Use Case Diagram of Online Book Shop.	Design of UML Diagrams
4.	Draw Class diagram and Use Case Diagram of Railway Reservation System	Design of UML Diagrams
5.	Draw Class diagram and Use Case Diagram of Banking System	Design of UML Diagrams
6.	Draw Class diagram and Use Case Diagram for Hotel Management system	Design of UML Diagrams
7.	Draw State Chart Diagram for Point Sale System.	Design of UML Diagrams

8.	Draw State Chart Diagram for Library Management System.	Design of UML Diagrams
9.	Draw State Chart Diagram for Hospital Management System.	Design of UML Diagrams
10.	Draw Interaction Diagrams for Railway Reservation System.	Design of UML Diagrams

Text Books:

1. Software Engineering with UML Book by Bhuvan Unhelkar
2. Object-oriented software engineering Textbook by Bernd Bruegge

Reference Books:

1. The Unified Modeling Language User Guide by Grady Booch et All.

II Year – I Semester		L	T	P	C
1054202180	Competitive Programming	0	0	4	2

COURSE OBJECTIVES:

1. To improve logical and analytical skills
2. To improve programming patterns like recursion

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Apply bit manipulation techniques to solve problems	PO2	3
CO2	Apply the modular programming techniques to simplify the programs.	PO3	2
CO3	Able to solve problems using strings	PO3	3

S.No	Name of the experiment
1	Bit manipulations
2	Number theory: primality
3	Number theory: combinatorics
4	Recursions
5	Arrays
6	String manipulations
7	Time and space complexity optimization
8	Types of errors

Text Books:

1. Problem Solving and Program Design in C, Jeri R. Hanly, Ellot B. Koffman,7th Edition,Pearson.

2. 101 Programming puzzle problems solved: High School Junior to Seniors Join us to win Informatics Olympiad, N.B.Venkateswarlu, Feb, 2015.

Reference Books:

1. Programming in C, PradipDey, Manas Ghosh, 2nd Edition, OxfordUniversityPress.
2. How to Solve it by Computer- R.G.Dromey,PHI.

E-Books:

https://graphics.stanford.edu/~seander/bithacks.html

NPTEL/MOOC:

https://onlinecourses.nptel.ac.in/noc21_cs99/preview

II Year – I Semester		L	T	P	C
1000202120	LIFE SKILLS - AUDIT COURSE	2	0	0	0

COURSE OBJECTIVE:

The students will be able to build self-confidence, encourage critical thinking, foster independence and help people to communicate more effectively.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Build Self Confidence and Interpersonal and Intrapersonal relationships.	PO12 PO10 PO9	3 3 3
CO2	Practice Emotional Competency while communicating with others	PO12 PO10 PO9	3 3 3
CO3	Gain Intellectual Competency by practicing ethics and morals	PO12 PO10 PO8	3 3 3

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT1: LIFE SKILLS: Positive Attitude and Positive Work Ethics, Time Management, Goal Setting: Short term, Long Term. (Activity has to be conducted)

UNIT2: EMOTIONAL INTELLIGENCE: Self Awareness through Johari Window and SWOT analysis (Activity has to be conducted)

UNIT3: PROBLEM SOLVING SKILLS: Critical Thinking and Brain Storming, Creative Thinking, Conflict Management. (Activity has to be conducted)

UNIT4: PUBLIC SPEAKING: Body Language, presentation skills, impromptu presentation, interviewing others. (Activity has to be conducted**)**

UNIT 5: NPTEL Course/ Coursera /Any relevant Certificate Course has to be done

Assessment: In order to clear internal assessment, the student has to submit Project Report and give Presentation on all the activities he/she has done during the course. The student has to do a certificate course also. (Presentation, Project Report and Certificate in total will be the criteria for the assessment)

References:

- Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
- Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.
- Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books. Shalini Verma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company
- John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.

II Year- II Semester

II Year – II Semester		L	T	P	C
1005202101	Operating Systems	3	0	0	3

COURSE OBJECTIVES:

1. Study the basic concepts and functions of operating systems.
2. Understand the structure and functions of OS.
3. Learn about Processes, Threads and Scheduling algorithms.
4. Understand the principles of concurrency and Deadlocks.
5. Learn various memory management schemes.
6. Study I/O management and File systems.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Summarize various concepts of Operating Systems	PO1 PO2	1 2
CO2	Implement and Apply Process Scheduling Algorithms	PO1 PO2 PO4	1 2 2
CO3	Illustrate concepts of Paging, Segmentation and Apply Concurrency, Deadlock Mechanisms in real world	PO1 PO2 PO3	2 2 3
CO4	Analyze the concepts of file systems in operating systems	PO1 PO3 PO12	1 2 3

UNIT- I

INTRODUCTION TO OPERATING SYSTEM CONCEPT

Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types. **[8 Hours]**

UNIT-II

PROCESS MANAGEMENT

Process concept, the process, Process State Diagram, Process control block, Process Scheduling- Scheduling Queues, Schedulers, Operations on Processes, Inter process Communication, Threading Issues, Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms. **[8 Hours]**

UNIT-III

MEMORY MANAGEMENT

Swapping, Contiguous Memory Allocation, Paging, structure of the Page Table, Segmentation.

VIRTUAL MEMORY MANAGEMENT

Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing **[10 Hours]**

UNIT-IV

CONCURRENCY

Process Synchronization, The Critical- Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples.

PRINCIPLES OF DEADLOCK

System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock **[8 Hours]**

UNIT-V

FILE SYSTEM INTERFACE

The concept of a file, Access Methods, Directory structure, File system mounting, files sharing, protection. File System implementation- File system structure, allocation methods, free-space management Mass-storage structure overview of Mass-storage structure, Disk scheduling, Device drivers. Introduction to Dockers. **[10 Hours]**

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.
3. Operating Systems-S Halder, Alex A Aravind Pearson Education Second 2016.

Reference Books:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata Mc Graw Hill Education", 1996.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, TataMc Graw-Hill Education, 2007.

II Year – II Semester		L	T	P	C
1054202200	Artificial Intelligence	3	0	0	3

COURSE OBJECTIVES:

Artificial intelligence (AI) is a research field that studies how to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously. The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand what the AI is. And this course will introduce some basic search algorithms for problem solving. In this course students will learn about knowledge representation and reasoning and about the Expert Systems.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	The student should be able to identify problems that are amenable to solution by AI methods.	PO1 PO2 PO3	2 2 3
CO2	The student should be able to identify appropriate AI methods to solve a given problem.	PO1 PO2 PO3	2 2 2
CO3	Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).	PO3 PO5	3 2
CO4	The student should have knowledge in expert system	PO1 PO PO3 PO4 PO12	3 2 2 2 1

UNIT- I

INTRODUCTION TO ARTIFICIAL INTELLIGENCE: Introduction, history, intelligent systems, foundations of AI, Applications of AI, current trends in AI.

PROBLEM SOLVING: Definition, characteristics of problem, types of Problem-solving techniques, General Problem Solver (GPS), Water Jug Problem, Missionaries and Cannibals Problem. **[10 Hours]**

UNIT- II

STATE-SPACE SEARCH: Definition, Examples, Exhaustive search techniques: BFS, DFS, IDDFS, Heuristic search techniques: Uniform Cost Search, Best First Search, A* algorithm & Constraint satisfaction Problem.

GAME PLAYING: Introduction about game playing, Mini-Max Algorithm, Alpha-Beta pruning algorithm. **[14 Hours]**

UNIT- III

LOGIC CONCEPTS: Introduction, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic.

PREDICATE LOGIC: Introduction, PNX Normal form, Skolemization, Resolution in Predicate Logic. **[12 Hours]**

UNIT- IV

KNOWLEDGE REPRESENTATION: Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames.

UNCERTAINTY MEASURE: PROBABILITY THEORY: Introduction, probability theory, Bayesian belief networks, Certainty factor theory, Dempster- shafer theory. **[12 Hours]**

UNIT- V

EXPERT SYSTEM: Expert system and applications: Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, application of expert systems.

FUZZY LOGIC: Introduction, Fuzzy sets, Fuzzyset operations, Types of Menmbership functions, Multi valued logic, Linguistic variables, Hedges. **[12 Hours]**

Text Books:

1. Artificial Intelligence- Saroj Kaushik, CENGAGE Learning,
2. Artificial intelligence, A modern Approach , 2nd ed, Stuart Russel, Peter Norvig, PEA
3. Artificial Intelligence- Rich, Kevin Knight, Shiv Shankar B Nair, 3rd ed, TMH
4. Introduction to Artificial Intelligence, Patterson, PHI

Reference Books:

1. Atificial intelligence, structures and Strategies for Complex problem solving, -George F.Lugar,5thed, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
3. Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier

II Year – II Semester		L	T	P	C
1005202103	Design and Analysis of Algorithms	3	0	0	3

COURSE OBJECTIVES:

This course introduces different techniques to design algorithms using Divide and Conquer, Greedy Approach, Dynamic Programming, Randomized techniques, Multi-Threading, Backtracking and Branch and Bound. It also focuses on how to measure the time and space complexities of algorithms.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Able to analyze the performance of an algorithm in terms of time and space.	PO1 PO2 PO3	2 1 2
CO2	Give an intuition on how to find a solution to large problems by dividing them into smaller sub problems.	PO2 PO3	2 2
CO3	Identifying which designing technique can be used to solve a particular problem.	PO1 PO2 PO12	2 3 2
CO4	Able to analyse the complexities between naïve and parallel algorithms.	PO1 PO2	2 1

UNIT- I

Foundations of Algorithm: Algorithm, Algorithm Specification, Recursive Algorithm, **Analysis:** Space Complexity and Time Complexity, Asymptotic Notations, Amortized Analysis, **Sorting in linear time:** Counting sort. **[8 Hours]**

UNIT-II

Divide and Conquer: General method, Masters Theorem with proof, Applications: Binary search, Defective Chessboard, Finding the Maximum and Minimum, Quick sort, Merge sort, Matrix multiplication: Block and Strassen's matrix multiplication, Randomized Quicksort. **[10 Hours]**

UNIT-III

Greedy method: General method, Applications: Job sequencing with deadlines, knapsack problem, Single source shortest path problem, Optimal Merge Patterns.

Multithreaded Algorithms: Basics of dynamic multithreading, multithreaded matrix multiplication, multithreaded merge sort. **[8 Hours]**

UNIT-IV

Dynamic Programming: General method, Applications: Matrix chain multiplication, 0/1 knapsack problem, All pairs shortest path problem, Travelling salesperson problem, String Editing, Reliability design. **[12 Hours]**

UNIT-V

Backtracking: General method, Applications: n-queen problem, sum of subsets problem.
Branch and Bound: Control Abstraction for LC-Search, FIFO & LIFO Branch-and-Bound techniques, 15-Puzzle Problem.
Introduction to NP-Hard and NP- Completeness. **[10 Hours]**

Text Books:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, SatrajSahni and Rajasekharam, Universities Press.
2. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, PHI Pvt. Ltd.
3. The Algorithm Design Manual, 2nd edition, Steven S. Skiena, Springer.
4. Design and Analysis of Algorithms, S. Sridhar, OXFORD UNIVERSITY PRESS.
5. Introduction to the Design and Analysis of Algorithms, Anany Levi, PEA

Reference Books:

1. Design and Analysis of Computer Algorithms, First Edition, V. AHO, Pearson
2. Design and Analysis of Algorithms, ParagHimanshu Dave, HimansuBalachandra Dave, Pearson Education.
3. Introduction to Design and Analysis of Algorithms A strategic approach, R.C.T. Lee, S.S.Tseng, R.C.Chang and T.Tsai, McGrawHill.
4. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.
5. Algorithms: Fourth Edition, Robert Sedgewick, Addison-Wesley, 2008

E-Books:

1. https://kailash392.files.wordpress.com/2019/02/fundamentalsof-computer-algorithms-by-ellis-horowitz.pdf
2. https://web.ist.utl.pt/~fabio.ferreira/material/asa/clrs.pdf

NPTEL/MOOC:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://nptel.ac.in/courses/106/101/106101060/

II Year – II Semester		L	T	P	C
1005202204	Data Warehousing and Data Mining	3	0	0	3

COURSE OBJECTIVES:

This course discusses techniques for pre-processing data before mining and presents the concepts related to data warehousing, online analytical processing (OLAP), and data generalization. It presents methods for mining frequent patterns, associations, and correlations. It also presents methods for data classification and prediction, data-clustering approaches, and outlier analysis.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Understand the concepts of data warehouse and data mining	PO-1, PO-2, PO-12	3
CO2	Use data pre-processing techniques to build data warehouse	PO-1, PO-2, PO-3	3
CO3	Analyse transaction databases for association rules	PO-1, PO-2, PO-3, PO-4, PO-10	3
CO4	Understand the details of different algorithms made available by popular commercial data mining software and solve real data mining problems by using the right tools to find interesting patterns	PO-1, PO-2, PO-3, PO-5, PO-10	3

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT- I

Introduction: What Motivated Data Mining? Why Is It Important? Knowledge Discovery Process, Data Mining—On What Kind of Data, Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Classification of Data Mining Systems, Data Mining Task Primitives, Major Issues in Data Mining

Data Pre-processing: Why Pre-process the Data? Data Cleaning, Data Integration, Data Transformation, Data Reduction and Data Discretization. **[10 Hours]**

UNIT-II

Data Warehouse and OLAP Technology: An Overview: What Is a Data Warehouse? OLAP versus OLTP, A Multidimensional Data Model- Data Warehouse Schemas, Concept Hierarchies, Typical OLAP Operations, Data Warehouse Architecture, Data Warehouse Implementation. **[8 Hours]**

UNIT-III

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, Methods for expressing an attribute test conditions, Measures for selecting the best split, Algorithm for decision tree induction. Model Over fitting: Due to presence of noise, Due to lack of representation samples, Evaluating the performance of classifier: holdout method, random sub sampling, and cross-validation, bootstrap. **[10 Hours]**

UNIT-IV

Association Analysis: Basic Concepts, Frequent Itemset Mining Methods - Apriori Algorithm, Frequent-Pattern Growth Approach, Generating Association Rules from Frequent Itemsets. Mining various kinds of Association rules. **[9 Hours]**

UNIT-V

Cluster Analysis: What Is Cluster Analysis? Different Types of Clustering's, Different Types of Clusters, K-means: The Basic K-means Algorithm, K-means additional Issues, Bisecting K-means, K-means and Different Types of Clusters, Strengths and Weaknesses. Hierarchical Clustering: Agglomerative and Divisive Hierarchical Clustering algorithms, Strengths and Weaknesses of Hierarchical Clustering. DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. **[8 Hours]**

TEXT BOOKS

1. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.
2. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.

REFERENCE BOOKS

1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining : Introductory and Advanced topics : Dunham, Pearson.
3. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

E-Books:

1. https://www.academia.edu/6489220/Data_Mining_ebook
2. http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series-in-Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining.-Concepts-and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf

II Year – II Semester		L	T	P	C
1099202100	Managerial Economics And Financial Analysis	3	0	0	3

Course Overview: The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning.

Course Objectives:

1. Understand the concepts of managerial economics and the market dynamics namely Demand, Elasticity of demand and pricing in different market structures.
2. Acquire the knowledge about production theories and cost analysis besides dealing with the production and factors of production.
3. Analyze the different market structures and understand various pricing methods which are adopted in attracting the customers under different markets.
4. To provide the basic knowledge on financial accounting
5. To understanding Capital budgeting decisions.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Analyze the Demand, Price and Cost.	PO3, PO8, PO11, PO12	3
CO2	Identify the Nature of different markets	PO5, PO8, PO11, PO12	2
CO3	Understand Various Business Forms	PO5, PO8, PO11, PO12	3
CO4	Evaluate investment project proposals	PO3, PO11, PO12	3

Unit-I

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects – Concept of Demand, Types of Demand, Determinants of Demand, Demand schedule, Demand curve - Law of Demand and its Exceptions- Elasticity of Demand & Its types - Demand forecasting and Methods of forecasting.

Unit-II

Production and Cost Analysis: Concept of Production function- Cobb-Douglas Production function – Leontief production function, Production Function with One variable Input, Two Variable Inputs and Concept of Returns to scale -economies of scale,Different cost concepts – Cost –Volume-Profit (CVP) analysis (simple problems)

Unit-III

Part-I: Introduction to Market Structures and pricing methods: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly- Features – Price and Output Determination, Significance of Pricing and various methods of pricing with contemporary examples

Part-II: Introduction to Business: Features, Merits and Demerits - Sole Trader, Partnership, Joint Stock Company – Public Enterprises – Business Cycles: Meaning and Features – Phases of Business Cycle.

Unit-IV

Introduction to Financial Accounting: Systems of Book-keeping, Golden rules of Accounting, Accounting Principles, Accounting Cycle- Journal, Ledger, Trail Balance, Preparation of Trading-Account, P&L Account and Balance Sheet (Simple Problems)

Unit-V

Capital and Capital Budgeting Decisions: Introduction to Capital, Classification of Capital, Time value of money. Types of Capital Budgeting Decisions: Traditional Methods (Payback period, Accounting rate of return) and Modern methods (Net Present Value method, Internal Rate of Return Method and Profitability Index Method) (Simple Problems)

Text Books:

1. M.Kasi Reddy & Saraswathi, “Managerial Economics and Financial Analysis”, PHI Publications, New Delhi, 10th Revised Edition, 2012.
2.Varshney& Maheswari, “Managerial Economics”, Sulthan Chand Publishers, 1st Revised Edition, 2009.
3.S.N. Maheshwari & S.K.Maheshwari, “Financial Accounting”, Vikas Publication House Pvt.Ltd, 4th Edition, 2012.

Reference Books:

1. D.N. Dwivedi, “Managerial Economics”, Vikas Publication House Pvt.Ltd, 2nd Edition, 2012.
2.R.Narayana Swamy, “Financial Accounting- A managerial Perspective”, Pearson publications, 1st Indian Reprint Edition, 2012.
3.J.V.Prabhakar Rao & P.V.Rao, “Managerial Economics & Financial Analysis”, Maruthi Publishers, 1st Revised Editon, 2011

NPTEL/SWAYAMMOOCS:

1.https://onlinecourses.swayam2.ac.in/imb19_mg08/preview
2.https://www.coursera.org/learn/strategic-management

II Year – II Semester		L	T	P	C
1005202111	Operating Systems Lab	0	0	3	1.5

COURSE OBJECTIVES:

1. To provide an understanding of the design aspects of operating system.
2. To provide practical knowledge on the different concepts of operating systems.
3. To familiarize students with the Linux environment.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Stimulate CPU scheduling algorithms in operating system.	PO1 PO2 PO12	3 3 3
CO2	Evaluate memory management techniques in operating system.	PO1 PO2 PO12	3 3 3
CO3	Implement page replacement algorithms in operating system	PO1 PO2 PO3 PO12	3 3 3 3
CO4	Implement file allocation strategies used in operating system.	PO1 PO2 PO3 PO12	3 3 3 3

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1.	**Exercise -1** Study of Unix/Linux general purpose utility command list man,who,cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.	Unix/Linux Commands
2.	**Exercise – 2** Simulate the following CPU scheduling algorithms a) Round Robin b) SJF c) FCFS d) Priority	CPU Scheduling

3.	**Exercise – 3** Simulate MVT and MFT	Multi Programming
4.	**Exercise – 4** Simulate Bankers Algorithm for Dead Lock Avoidance	Dead Lock Avoidance
5.	**Exercises –5** Simulate Bankers Algorithm for Dead Lock Prevention	Dead Lock Prevention
6.	**Exercise -6** Simulate all page replacement algorithms. a) FIFO b) LRU c) LFU	Page Replacement
7.	**Exercise -7** Simulate all File allocation strategies a) Sequenced b) Indexed c) Linked	File Allocation
8.	**Exercise -8** C program to emulate the UNIX ls –l command.	ls –l command
9.	**Exercise -9** C program that illustrates how to execute two commands concurrently with a command pipe.	Command Pipe
10.	**Exercise -10** C program that illustrates two processes communicating using shared memory	Shared Memory

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.
3. Operating Systems-S Halder, Alex A Aravind Pearson Education Second 2016.

Reference Books:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata Mc Graw Hill Education", 1996.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, TataMc Graw-Hill Education, 2007.

II Year – I Semester		L	T	P	C
1005202112	Algorithms Lab	0	0	3	1.5

COURSE OBJECTIVES:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	The ability to understand, analyze and develop computer programs in the areas related to algorithms.	PO1 PO2 PO3	2 3 2
CO2	To find an algorithm to solve the problem and prove that the algorithm solves the problem correctly.	PO2 PO3	2 3
CO3	To understand the mathematical criterion for deciding whether an algorithm is efficient.	PO2 PO3	2 2

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1	**Exercise – 1** Implement recursive binary search algorithm	Divide and Conquer technique
2	**Exercise – 2** Implement recursive quick sort algorithm	Divide and Conquer technique
3	**Exercise – 3** Implement recursive merge sort algorithm	Divide and Conquer technique
4	**Exercise – 4** Implement Randomized quick sort algorithm	Divide and Conquer technique
5	**Exercise – 5** Find Optimal solution for a Knap Sack Problem	Greedy method
6	**Exercise – 6** Find the shortest path using single source shortest path algorithm	Greedy method
7	**Exercise – 7** Implement Huffman coding technique	Greedy method
8	**Exercise – 8** Implement 0/1 knapsack problem	Dynamic programming technique
9	**Exercise – 9**	Dynamic programming technique

	Find the shortest path using All pairs shortest path algorithm	
10	**Exercise – 10** Implement traveling sales person problem	Dynamic programming technique
11	**Exercise – 11** Implement sum of subsets problem	Backtracking technique
12	**Exercise – 12** Implement N-Queen's problem	Backtracking technique

Text Books:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, SatrajSahni and Rajasekharam, Universities Press.
2. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, PHI Pvt. Ltd.

Reference Books:

1. Design and Analysis of Computer Algorithms, First Edition, V. AHO, Pearson
2. Design and Analysis of Algorithms, ParagHimanshu Dave, HimansuBalachandra Dave, Pearson Education.

II Year – II Semester		L	T	P	C
1054202210	Data Warehousing and Data Mining Lab	0	0	3	1.5

COURSE OBJECTIVES:

- ✓ Introduce to methods and theory for development of data warehouses and data analysis using data mining.
- ✓ Data quality and methods and techniques for pre-processing of data.
- ✓ Modelling and design of data warehouses.
- ✓ Algorithms for classification, clustering and association rule analysis.

COURSE OUTCOMES:

	Course outcome	PO	Strength of mapping
CO1	Understand data warehouse concepts, architecture, business analysis and tools	PO1	2
CO2	Understand data pre-processing and data visualization techniques	PO1, PO2, PO3	3
CO3	Study algorithms for finding hidden and interesting patterns in data	PO1, PO2, PO4	3
CO4	Understand and apply various classification and clustering techniques using tools.	PO1, PO2, PO5	2

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1.	Implementation of OLAP operations	Understand OLAP operations
2.	Implementation of Data pre-processing techniques: 1. Splitting of the data set in Training and Validation sets. **2.** Taking care of Missing values.	Understand data pre-processing techniques
3.	Implementation of Data pre-processing techniques: 1. Taking care of Categorical Features. **2.** Normalization of data set.	Understand data pre-processing techniques
4.	Implementation of finding Association Rules for Employee data	Understand Association rules
5.	Write a program for FPGROWTH algorithm and also test it.	Apply FPGROWTH algorithm

6.	Write a program to construct an optimized DECISION TREE for a given training data and by using any attribute selection measure	Apply Decision tree algorithm
7.	Write a program for NAÏVE BAYESIAN algorithm for classifying the data.	Apply NavieBayesian algorithm
8.	Write a program to implement K-means clustering algorithm for clustering data	Apply K-,means algorithm

II Year – II Semester		L	T	P	C
1054202280	Multivariate Data Visualization with R	1	0	2	2

COURSE OBJECTIVES:

1. Conduct exploratory data analysis using visualization.
2. Craft visual presentations of data for effective communication.
3. Design and evaluate colour palettes for visualization based on principles of perception.
4. Critique existing visualizations based on data visualization theory and principles.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Graphically depict visual 2D, 3D, 4D (and so on) relationships that exist in multivariate data sets.	PO 1 PO 7 PO 12	2 3 2
CO2	Understand how to apply the techniques of conditioning and paneling to present multivariate data relationships	PO 1 PO 2 PO 7	2 3 2
CO3	Have a powerful visual toolset to visually present the results of multi-variable statistical model fitting.	PO 2 PO 3 PO 7 PO 12	2 3 2
CO4	Understand the nature of lattice panel functions and know how to create and modify them for brilliant multivariate graphics displays.	PO 2 PO 3 PO 7 PO 12	2 3 2

UNIT- I

Introduction to Lattice and to "Trellis" Graphics

Introduction to Lattice, The Trellis Object, Dimension and Physical Layout, Scales and Axes, Visualizing Univariate Distributions, Two Sample QQ Plots, Strip Plots. **[9 Hours]**

UNIT-II

Multiway Tables and Scatter Plots

Multiway Tables, Multipanel Dot Plots, Scatter Plots and Extensions, Shingles and Advanced Indexing, More Scatter Plots, Parallel Co-ordinates Plot. **[10 Hours]**

UNIT-III

Trivariate, 3D, and Other Complex Displays

Trivariate Displays, 3D Scatter Plots, 3D Panel Functions, Visualizing Theoretical 3D Surfaces. **[10 Hours]**

UNIT-IV

Finer Control Graphical Parameters and Other Settings

Graphical Parameters and Other Settings, Plot Coordinates and Axis Annotation, Labels and Legends, Data Manipulation, Shingles and Related Utilities, Ordering Categorical Variables. **[9 Hours]**

UNIT-V

The Shapes of Data, Marks and Channels

Introduction to Viz Hub, making a Face with D3.js, Input for Visualization: Data and Tasks, Loading and Parsing Data with D3.js, Encoding Data with Marks and Channels Rendering Marks and Channels with D3.js and SVG, Introduction to D3 Scales, Creating a Scatter Plot with D3.js **[10 Hours]**

Text Books:

1. Lattice: Multivariate Data Visualization with R (Use R!) Paperback – Illustrated, 27 November 2008
2. Visualization Analysis and Design (AK Peters Visualization Series) 1st Edition
3. Data Visualization with R,Rob Kabacoff,2020-12-01

Reference Books:

1. Interactive Data Visualization for the Web: An Introduction to Designing with D3 2nd Edition
2. Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks
3. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures 1st Edition

E-Books:

https://visualr.io/library/e-books/

NPTEL/MOOC:

1. https://www.udemy.com/course/multivariate-data-visualization-with-r/

II Year – II Semester		L	T	P	C
1000202121	Environmental Science	2	0	0	0

COURSE OBJECTIVES:

1. Classify, describe and explain the concepts of Ecosystems and environmental Studies.
2. Overall understanding of different types of natural resources and its conservation.
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
4. An understanding of the environmental impacts of developmental activities and the importance of environmental management.
5. Awareness on the social issues, environmental legislations and global treats.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Gain a higher level of personal involvement and interest in understanding and solving environmental problems.	1,6,7	2
CO2	Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities.	1,6,7	2
CO3	Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices.	1,6,7	2

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT I **(8 hrs)**

Multidisciplinary nature of Environmental Studies:
Definition Scope and its importance, Multidisciplinary nature of Environmental science.

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Energy flow in the ecosystem – Ecological pyramids - Ecological succession.

Social Issues and the Environment: Impacts of microbial toxins on human health. Urban problems related to energy- Water conservation, rain water harvesting and 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.

UNIT II - (3 hrs)

BIODIVERSITY AND ITS CONSERVATION: Definition: genetic, species and ecosystem diversity –Value of biodiversity, Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India – Conservation of biodiversity.

UNIT III: (8 hrs)

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, 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 IV – (9 hrs)

ENVIRONMENTAL POLLUTION: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Noise pollution
e. Nuclear hazards

Role of an individual in prevention of pollution – Pollution case studies

Environmental Laws: Wildlife Protection Act 1972 –Water pollution prevention and control Act 1974 - Forest Conservation Act 1980n –Air pollution prevention and control Act 1981. Environmental Protection Act 1986 and 2006 - – Public awareness

SOLID WASTE MANAGEMENT: Causes**,** effects and control measures of urban and industrial wastes.

Sustainable Development: Goals of Sustainability, Conferences, Carbon credits and carbon footprints.

UNIT V – (4 hrs)

Environmental Management:

EIA and EA: Introduction, definition, scope, objectives and methodology.
Disaster management: Definition, floods, earthquake, cyclone and landslides.
Ecotourism: Definition, principles, advantages and disadvantages
Environmental Diary

Field Trip

Field work/Environmental Visit: Visit to a local area to document environmental assets – reserve forest/ eco-tourist spot : Visit to a local polluted site - Study of local environment - common plants, insects, birds - Study of simple ecosystems –pond, river, hill slopes etc - Visit to industries/water treatment plants/effluent treatment plants.

Text Books:

1. Text book of Environmental Studies for Undergraduate courses by ErachBharuncha for University Grants Commission, Universities Press.
2. Environmental Studies by Palaniswamy – Pearson Education.
3. Environmental Studies by Dr. S. Azeem Unnisa, Academic Publishing Company

Reference Books:

1. Textbook of Environmental Science by Deeksha Dave and E. Sai Baba Reddy, Cengage Publications.
2. Text of Environmental Sciences and Technology by M. Anji Reddy, BS Publications.
3. Comprehensive Environmental studies by J.P Sharma, Laxmi Publications.
4. Environmental sciences and Engineering – J Glynn Henry and Gary W Heinke – Prentice hall of India Private Limited.
5. A textbook of Environmental Studies by G.R Chatwal, Himalaya Publishing house.
6. Introduction to Environmental engineering and science by Gilbert M Masters and Wendell P Ela – Prentice hall of India private limited.

E-Books: (Specify links)

NPTEL/MOOC: (Specify Links)