UNIVERSITY OF MADRAS

Dwaraka Doss Goverdhan Doss Vaishnav College [Autonomous]
Shift – II

FACULTY OF DATA SCIENCE
BACHELOR OF SCIENCE DEGREE COURSE IN
DATA SCIENCE

CHOICE BASED CREDIT SYSTEM (CBCS) WITH GRADING
SEMESTER SYSTEM WITH CREDITS

B.Sc. (Data Science)
(Effective from the Academic year 2022-23)

REGULATIONS

1. **ELIGIBILITY FOR ADMISSION**

Candidates for admission to the first year of the B.Sc. (Data Science) programme shall be required to have passed the higher secondary examinations under Science stream with Physics, Chemistry, Mathematics and Computer Science (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University.

COURSE OF STUDY

B.Sc. (Data Science)

FIRST SEMESTER

Sl.No	Course Component	Name of the Course	Instructional Hours	Credits	Examination Hours	Max. Marks	
						CIA	ESE
1	**Part – I**	**Language Courses**	**4 + 2***	**3**	**3**	**25**	**75**
2	**Part – II**	**English**	**4**	**3**	**3**	**25**	**75**
3	**Part – III**	Core I **- Basics of Data Science**	**5**	**4**	**3**	**25**	**75**
4	Part – III	Core Practical I **Python**	**5**	**4**	**3**	**40**	**60**
5	**Part – III**	Allied I **Statistical Methods and its Applications**	**6**	**5**	**3**	**25**	**75**
6	**Part – IV**	**Non Major Elective /**	**2**	**2**	**3**	**25**	**75**

		***Basic Tamil / Advanced Tamil**					
7	**Part – IV**	**Skill Based Subject Soft Skills – I**	**2**	**3**	**3**	**50**	**50**
	Total		**30**	**24**			

SECOND SEMESTER

Sl.No	Course Component	Name of the Course	Instructional Hours	Credits	Examination Hours	Max. Marks	
						CIA	ESE
1	**Part – I**	**Language Courses**	**4 + 2***	**3**	**3**	**25**	**75**
2	**Part – II**	**English**	**4**	**3**	**3**	**25**	**75**
3	**Part – III**	Core II **Object Oriented Programming with Java**	**5**	**4**	**3**	**25**	**75**
4	**Part – III**	Core Practical II **Object Oriented Programming with Java**	5	**4**	**3**	**40**	**60**
5	**Part – III**	Allied II **Probability and Statistics**	6	**5**	**3**	**25**	**75**
6	**Part – IV**	**Non Major Elective / *Basic Tamil / Advanced Tamil**	**2**	**2**	**3**	**25**	**75**
7	**Part – IV**	**Skill Based Subject** Soft Skills – II	**2**	**3**	**3**	**50**	**50**
	Total		**30**	**24**			

Non Major Electives (Semester I) – Any one	Non Major Electives (Semester II) – Any one
1. Fundamentals of Computers 2. Introduction to HTML & Web Designing 3. Principles of Computer Organization 4. Introduction to Programming Concepts	1. Fundamentals of Free Open Source Software 2. Principles of System Analysis and Design 3. Introduction to System Programming 4. Fundamentals of Software Engineering

THIRD SEMESTER

Sl.No	Course Component	Name of the Course	Instructional Hours	Credits	Examination Hours	Max. Marks	
						CIA	ESE
1	**Part – I**	**Language Courses**	**4 + 2***	**3**	**3**	**25**	**75**
2	**Part – II**	**English**	**4**	**3**	**3**	**25**	**75**
3	**Part – III**	**Core III** Data Structures and Analysis of **Algorithms**	**6**	**4**	**3**	**25**	**75**
4	**Part – III**	**Core Practical III** Data Structures and **Analysis of Algorithms**	**5**	**4**	**3**	**40**	**60**
5	**Part – III**	Allied III 1. **Optimization Techniques** 2. **Data Base Management Systems**	6	**5**	**3**	**25**	**75**
6	**Part – IV**	**Skill Based Subject Soft Skills – III**	**2**	**3**	**3**	**50**	**50**
7	**Part – IV**	**Environmental Studies**	**1**		**Examination will held in Semester IV**		
	Total		**30**	**22**			

FOURTH SEMESTER

Sl.No	Course Component	Name of the Course	Instructional Hours	Credits	Examination Hours	Max. Marks	
						CIA	ESE
1	**Part – I**	**Language Courses**	**4 + 2***	**3**	**3**	**25**	**75**
2	**Part – II**	**English**	**4**	**3**	**3**	**25**	**75**
3	**Part – III**	Core IV **Artificial Intelligence**	**6**	**4**	**3**	**25**	**75**
4	**Part – III**	Core Practical IV **MATLAB**	**5**	**4**	**3**	**40**	**60**
5	**Part – III**	Allied IV 1. **Operating systems with Unix** 2. **Time series Analysis and Forecasting**	**6**	**5**	**3**	**25**	**75**
6	**Part – IV**	**Skill Based Subject**	**2**	**3**	**3**	**50**	**50**

		Soft Skills – IV					
7	**Part – IV**	**Environmental Studies**	**1**	**2**	**3**	**25**	**75**
	Total		**30**	**24**			

FIFTH SEMESTER

Sl.No	Course Component	Name of the Course	Instructional Hours	Credits	Examination Hours	Max. Marks	
						CIA	ESE
1	**Part – III**	Core V **Machine Learning**	**5**	**4**	**3**	**25**	**75**
2	**Part – III**	Core Practical V **Machine Learning**	**5**	**4**	**3**	**40**	**60**
3	**Part – III**	Core VI **Big data Analytics**	**6**	**4**	**3**	**25**	**75**
4	**Part – III**	Core Practical VI **Data Analytics using Rapid Miner**	**6**	**4**	**3**	**40**	**60**
5	**Part – III**	Elective I 1. **Marketing Analytics** 2. **Data Communication and Computer Networks**	**6**	**5**	**3**	**25**	**75**
6	**Part – IV**	**Value Education**	**2**	**2**	**3**	**25**	**75**
	Total		**30**	**23**			

SIXTH SEMESTER

Sl.No	Course Component	Name of the Course	Instructional Hours	Credits	Examination Hours	Max. Marks	
						CIA	ESE
1	**Part – III**	Core VII **IoT and Cloud Technologies**	**6**	**4**	**3**	**25**	**75**
2	**Part – III**	Core Practical VII **IoT and Cloud Technologies**	**6**	**4**	**3**	**40**	**60**
3	**Part – III**	Core VIII **Deep Learning**	**6**	**4**	**3**	**25**	**75**
4	**Part – III**	Elective II 1. **Analytics for Service Industry**	**6**	**5**	**4**	**25**	**75**

		2. **Data Mining and Multidimensional Modeling**					
5	**Part – III**	Elective III 1. **Natural Language processing** 2. **Financial Analytics**	**6**	**5**	**3**	**25**	**75**
6	**Part – V**	**Extension Activity**		**1**			
	Total		**30**	**23**			

PROGRAMME EDUCATION OBJECTIVES [PEO'S]:

The programme specific outcomes of B.Sc.[Data Science] are to

PEO1	To progress their career productively in software industry, academia, research, entrepreneurial pursuit, government, consulting firms and other 1 Information Technology enabled services.
PEO2	To achieve peer-recognition; as an individual or in a team; by adopting ethics and professionalism and communicate effectively to excel well in cross culture and inter- disciplinary teams.
PEO3	To continue a lifelong professional development in computing that contributes in self and societal growth.
PEO4	To execute statistical analyses with professional statistical software.
PEO5	To demonstrate skill in **data management**.
PEO6	To **solve** problems in real-world contexts and will **communicate** these solutions effectively

PROGRAM OUTCOMES (PO)

At the end of the programme the student will be able:

PO 1	To undertake/ engage in employment oriented activities, development activities and allied activities particularly in response to the needs of the society.
PO 2	To understand the needs and to acquire the required competencies to support local, regional and national development.
PO 3	To develop conceptual understanding of the subject, problem solving and application of skills in practical orientation of the subjects.
PO 4	To develop critical and analytical thinking.
PO 5	To instill entrepreneurial spirits among the students along with ethics and business

	orientation.
PO 6	To kindle curiosity to review upon the diverse environments for enhanced and innovative and best practices.
PO7	To engage in lifelong learning and continuing learning and enduring proficient progress

Mapping of POs TO PEOs

PEO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
PEO 1	3	3	3	3	3	3	2
PEO 2	3	3	2	3	3	2	2
PEO 3	3	3	2	3	3	3	3
PEO 4	3	3	3	3	2	2	3
PEO 5	3	3	3	3	3	3	1
PEO 6	3	3	2	3	3	3	3

CRITERIA FOR MAPPING
3- STRONG 2- MEDIUM 1- LOW

PROGRAMME SPECIFIC OUTCOMES [PSO's]

PSO1	Learning the applications of various software elements which help to identify various analysis and design methodologies
PSO2	Demonstrate by developing computer programs in the area related to algorithm, web designing, facilitating efficient design for complex problems.
PSO3	Enables the students to be familiar with the modern- day issues, latest trends in computing and technology and create ideas and solutions to existing problems
PSO4	Building code in Various Programming Languages and applications
PSO5	Detailed Glimpse of Orientation and Interconnection.
PSO6	Gains Knowledge in the various aspects of new Trends and Technologies.

Semester	**I**
Subject	**CORE I – BASICS OF DATA SCIENCE**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. To understand the basic concepts of Data Science
2. To understand the principles of algorithms, flowchart and source code
3. To acquire a solid foundation in Python.

To visualize data using plots in python

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

CO 1	• To explain the basic concepts of data science and its applications	K1,K2,K 3,K4,K5
CO 2	• To explain the Features of Python • To demonstrate Control Statements and Looping Statements	K1,K2,K 3,K4,K5
CO 3	• To understand Python Functions • To create and illustrate Numpy Libraries • To perform Data Manipulation using Pandas.	K1,K2,K 3&K4,
CO 4	• To understand the File Concepts • Apply Exception Handling Techniques	K1,K2,K 3,K4,K5
CO 5	• To Create and manipulate Database • To create Data Visualization using Matplotlib	K1,K2,K 3,K4,K5

Mapping of Course Outcomes to Program Outcome:

PO/ PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	2	2	2	2	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Average	**2.8**	**3.00**	**3.00**	**3.00**	**2.4**	**2.8**	**2.8**	**2.8**	**3.00**	**3.00**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT-1

Introduction to Data Science

Introduction: Data Science - Big Data and Data Science hype – getting past the hype - Datafication - Current landscape of perspectives - Skill sets needed - Statistical Inference - Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA – Applications of Data Science - Data Science in Business - Business Intelligence vs Data Science – Data Analytics Life Cycle - Machine Learning

UNIT II

Introduction to Python

Features of Python - How to Run Python – Identifiers- Reserved Keywords- Variables - Comments in Python - Indentation in Python - Multi-Line Statements- Input, Output and Import Functions- Operators. Data Types and Operations: Numbers -Strings -List -Tuple - Set -Dictionary - Mutable and Immutable Objects - Data Type Conversion. Flow Control: Decision Making-Loops-Nested Loops-Control Statements- Types of Loops-List Comprehensions-Set Comprehensions-Dictionary Comprehensions-Nested Dictionaries.

UNIT III

Functions

Function Definition - Function Calling - Function Arguments - Anonymous Functions (Lambda Functions) - Recursive Functions - Modules and Packages: Built-in Modules - Creating Modules - import Statement- Namespaces and Scope - The dir() function - The reload() function -Packages in Python - Date and Time Modules – Numpy Libraries and Data Manipulation Using Pandas.

UNIT IV

File Handling and Object Oriented Programming

Opening a File-Closing a File - Writing to a File - Reading from a File - File Methods - Renaming a File - Deleting a File - Directories in Python. Regular Expressions. Class Definition - Creating Objects - Built-in Attribute Methods - Built-in Class Attributes - Destructors in Python - Encapsulation - Data Hiding – Inheritance-Method Overriding – Polymorphism - Exception Handling.

UNIT V

Database Programming and Visualizations

Connecting to a Database - Creating Tables - INSERT Operation - UPDATE Operation - DELETE Operation - READ Operation - Transaction Control -Disconnecting from a Database - Exception Handling in Databases - GUI Programming - CGI Programming- Data Visualizations using Matplotlib – histograms, bar charts, pie charts.

TEXT BOOKS

1. Doing Data Science, Straight Talk From The Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly (2014).
2. Big Data Analytics, paperback 2nd ed., Seema Acharya, SubhasiniChellappan, Wiley (2019).
3. Dr. Jeeva Jose (2018) ,Taming Python By Programming, Khanna Publishers

4. Jake Vanderplas. Python Data Science Handbook: Essential Tools for Working with Data 1st Edition.

REFERENCES

1. LjubomirPerkovic(2012),Introduction to Computing Using Python: An Application DevelopmentFocus, John Wiley & Sons
2. John V Guttag(2013), Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press.
3. Kenneth A. Lambert(2012), Fundamentals of Python: First Programs, Cengage Learning.

Semester	**I**
Subject	**CORE PRACTICAL I – PYTHON**
Maximum Marks	CIA- 40 Marks ESE-60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

OBJECTIVES:

- To build websites and software, automate tasks, and conduct data analysis.
- Open Source and Community Development.

LIST OF PROGRAMS

1. Demonstrate the working of "id" and "type" functions.
2. Find all prime numbers within a given range.
3. Print n terms of Fibonacci series using iteration.
4. Demonstrate use of slicing in string.
5. Compute the frequency of the words from the input. The output should output after sorting the key alphanumerically.
6. Write a program that accepts a comma separated sequence of words as input and prints the words in a comma-separated sequence after sorting them alphabetically.
7. Demonstrate use of list & related functions.
8. Demonstrate use of Dictionary & related functions.
9. Demonstrate use of tuple & related functions.
10. Implement stack using list.
11. Implement queue using list.
12. Read and write from a file.
13. Copy a file.
14. Demonstrate working of classes and objects.
15. Demonstrate class method & static method.
16. Demonstrate constructors.
17. Demonstrate inheritance.
18. Demonstrate aggregation/composition.
19. Create a small GUI application for insert, update and delete in a table.
20. Bar charts, histograms and pie charts.

Semester	**II**
Subject	**CORE II - OBJECT ORIENTED PROGRAMMING WITH JAVA**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. Understand the concepts of Object Oriented Programming
2. Become proficient programmers through the java programming language
3. Give insight into real world applications.

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

CO1	● Use the syntax and semantics of java programming language and basic concepts of OOP.	K1,K2,K3,K4, K5
CO2	● Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages	K1,K2,K3,K4, K5
CO3	● Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.	K1,K2,K3&K4
CO4	● Design event driven GUI and web related applications which mimic the real word scenarios	K1,K2,K3&K4
CO5	● Build the internet-based dynamic applications using the concept of applets	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	**P O**	**P O**	**P O**	**PO4**	**PO5**	**P O6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**

	1	2	3								
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Introduction

Introduction to Java-Features of Java-Object Oriented Concepts-Software Evolution - Software Development, SDLC Models – SDLC steps – Software Testing – Software Quality - Lexical Issues-Data Types – Variables – Arrays – Operators - Control Statements – Classes – Objects –Constructors - Overloading method - Access control - static and fixed methods - Inner classes -Inheritance-Overriding Methods-Using super-Abstract class.

UNIT II

Packages & Threads

Packages-Access Protection-Importing Packages-Interfaces-Exception Handling-Throw and Throws- Thread-Synchronization-Messaging- Runnable Interface-Inter thread communication -Deadlock-suspending, resuming and stopping threads-Multithreading.

UNIT III

Input/Output & Collection API

I/O Streams-File Streams-String Objects-String Buffer-Char Array - Java Utilities-Collections interface - Collection classes-Enumeration – Vector -Stack –Hash tables - String class.

UNIIT IV

Networking

Networking –Networking basics – java and the Net – InetAddress- TCP/IP Client Sockets –URL- URLConnection – TCP/IP Server Sockets – Datagrams.

UNIT V

Graphical User Interface in Java

Working with windows using AWT Classes - Class Hierarchy of Window and Panel -AWT controls - Layout Managers – Menus- Menu bars - Dialog Boxes- File Dialog- Applets-Life cycle of Applet-Types of Applets-Event handling-Applet tags - JDBC and connecting to Databases – CRUD operations.

TEXT BOOKS

1. P.Naughton and H.Schildt(1999), Java 2 (The Complete Reference), Third Edition, Tata MCGraw Hill Edition

2. K.K. Aggarwal &Yogesh Sing (2008), Software Engineering, Revised Third Edition, New Age International Publishers

REFERENCE BOOKS

1. Cay S. Horstmann, Gary Cornell(2012), Core Java 2 Volume I, Fundamentals- Ninth Edition Addision Wesley

2. K.Arnold and J.Gosling, The Java Programming Language- Second Edition, ACM Press/Addison- Wesley Publishing Co. New York

Semester	**II**
Subject	**CORE PRACTICAL II OBJECT ORIENTED PROGRAMMING WITH JAVA**
Maximum Marks	CIA- 40 Marks ESE-60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

OBJECTIVES:

- Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
- Read and make elementary modifications to Java programs that solve real-world problems.

LIST OF PROGRAMS

Application

1. Program to illustrate i) constructors ii) inheritance iii) overloading and overriding
2. Implementation of Packages, interfaces, Exception handling
3. Implementation of concurrent and synchronized threads.
4. Implementation of string and string buffer classes and methods.
5. Implementation of stack and vector.
6. Implementation of file read and writes operation.

Applet programs

1. Working with Frames and various controls
2. Working with Dialogs and Menus
3. Working Panel and Layout
4. Incorporating Graphics
5. Working with applets
6. Working with Images
7. Network Programming

Semester	III
Subject	**CORE III - DATA STRUCTURES AND ANALYSIS OF ALGORITHMS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. Understand the meaning asymptotic time complexity analysis and various data structures
2. To enhancing the problem solving skills and thinking skills
3. To write efficient algorithms and Programs

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

CO1	● To understand the asymptotic notations and analysis of time and space complexity ● To understand the concepts of Linked List, Stack and Queue.	K1,K2,K3,K4, K5
CO2	● To understand the Concepts of Trees and Graphs ● Perform traversal operations on Trees and Graphs. ● To enable the applications of Trees and Graphs.	K1,K2,K3,K4, K5
CO3	● To apply searching and sorting techniques.	K1,K2,K3&K4
CO4	● To understand the concepts of Greedy Method ● To apply searching techniques.	K1,K2,K3&K4
CO5	● To understand the concepts of Backtracking Method ● To enable the applications.	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4

CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Arrays and ordered Lists

Abstract data types – asymptotic notations – complexity analysis- Linked lists: Singly linked list – doubly linked lists - Circular linked list, General lists- stacks – Queues – Circular Queues – Evaluation of expressions

UNIT – II

Trees and Graphs

Trees – Binary Trees – Binary Tree Traversal – Binary Tree Representations – Binary Search Trees - threaded Binary Trees - Application of trees (Sets). Representation of Graphs – Graph implementation – graph Traversals - Minimum Cost Spanning Trees – Shortest Path Problems-Application of graphs

UNIT-III

Searching and Sorting

Sorting – Bubble Sort, Insertion Sort, Quick Sort , Merge Sort, Selection Sort. Searching – Linear search, Binary search

UNIT IV

Greedy Method and Dynamic programming

Greedy Method : Knapsack problem– Job Sequencing with deadlines – Optimal storage on tapes.General method – Multistage Graph Forward Method– All pairs shortest path – Single source shortest path – Search Techniques for Graphs – DFS – Connected Components – Bi-Connected Components

UNIT V

Backtracking

General Method – 8-Queen‟s – Sum Of Subsets – Graph Colouring – Hamiltonian Cycles – Branch And Bound: General Method – Travelling Sales Person Problem

TEXT BOOK

1. Seymour Lipshutz(2011), Schaum‟s Outlines - Data Structures with C, Tata McGraw Hill publications
2. Ellis Horowitz and SartajSahni (2010), Fundamentals of Computer Algorithms, Galgotia Publications Pvt., Ltd.
3. Dr. K. Nagesware Rao, Dr. Shaik Akbar, ImmadiMurali Krishna, Problem Solving and Python Programming(2018)

REFERENCE BOOKS

1. Gregory L.Heileman(1996), Data Structures, Algorithms and Object-Oriented Programming, McGraw Hill International Edition, Singapore.
2. A.V.Aho, J.D. Ullman, J.E.Hopcraft(2000). Data Structures and Algorithms, Addison Wesley Publication.
3. Ellis Horowitz and SartajSahni, Sanguthevar Raja sekaran (2010) ,Fundamentals of Computer Algorithms, Galgotia Publications Pvt.Ltd.

Semester	**III**
Subject	**CORE PRACTICAL III - DATA STRUCTURES AND ANALYSIS OF ALGORITHMS**
Maximum Marks	CIA- 40 Marks ESE-60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

- To predict the performance of different algorithms in order to guide design decisions.
- To provide theoretical estimation for the required resources of an algorithm to solve a specific computational problem

LIST OF PROGRAMS

1. Perform stack operations
2. Perform queue operations
3. Perform tree traversal operations
4. Search an element in an array using linear search.
5. Search an element in an array using binary search
6. Sort the given set of elements using Merge Sort.
7. Sort the given set of elements using Quick sort.
8. Search the Kth smallest element using Selection Sort
9. Find the Optimal solution for the given Knapsack Problem using Greedy Method.
10. Find All pairs shortest path for the given Graph using Dynamic Programming method
11. Find the Single source shortest path for the given Travelling Salesman problem using

Dynamic Programming method

12. Find all possible solution for an N Queen problem using backtracking method
13. Find all possible Hamiltonian Cycle for the given graph using backtracking method

Semester	**IV**
Subject	**CORE IV ARTIFICIAL INTELLIGENCE**
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. Describe the concepts of Artificial Intelligence
2. Understand the method of solving problems using Artificial Intelligence
3. Understand natural language processing
4. Introduce the concept of Expert system, Fuzzy logic

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

CO 1	• Design user interfaces to improve human–AI interaction and real-time decision-making. • Evaluate the advantages, disadvantages, challenges, and ramifications of human–AI augmentation.	K1,K2,K 3,K4,K5
CO 2	• Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	K1,K2,K 3,K4,K5
CO 3	• Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	K1,K2,K 3&K4,

CO 4	• Extract information from text automatically using concepts and methods from natural language processing (NLP), including stemming, n-grams, POS tagging, and parsing	K1,K2,K 3,K4,K5
CO 5	• Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness. • Determine the framework in which artificial intelligence and the Internet of things may function, including interactions with people, enterprise functions, and environments.	K1,K2,K 3,K4,K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Introduction to Artificial Intelligence

What is Artificial Intelligence? AI Technique, Representation of a problem as State space search, production systems, Problem characteristics, Production System characteristics – Issues in the design of search programs, Heuristic Search Techniques - Generate & Test Hill Climbing, Best First search, Problem reduction, Constraint satisfaction, Means-End Analysis

UNIT II

Knowledge Representation

Approaches and issues in knowledge representation –Using Predicate Logic – Representing simple facts in logic – Representing Instance and ISA relationship – Computable functions and predicates – resolution – Natural deduction - Representing knowledge using rules –Procedural versus declarative knowledge – Logic programming - Forward versus backward reasoning – Matching – Control Knowledge - Symbolic reasoning under uncertainty - Logics for Non-monotonic reasoning – Implementation Issues – Augmenting a problem solver – Implementation: Depth first search, Breadth first search

UNIT III

Statistical Reasoning

Probability and Bayes‟ Theorem - Certainty factors and rule-based systems- Bayesian networks – Dempster - Shafer Theory - Weak slot-filler structure - Semantic nets – frames. Strong slot-filler structure- Conceptual dependency – Scripts – CYC – Syntatic – Semantic spectrum of Representation – Logic and slot-and-filler structure – Other representational Techniques

UNIT IV

Game Playing, Planning & NLP

Minimax search procedure-Adding alpha-beta cutoffs- Additional Refinements – Iterative Deepening – Reference on specific games Planning - Components of a Planning system – Goal stack planning – Nonlinear planning using constraint posting- Hierarchical planning – Reactive systems.Natural Language Processing - Syntactic Analysis, Semantic Analysis, Discuses and Pragmatic Processing – Statistical Natural Language processing.

UNIT V

Learning & Advanced Topics in AI

What is learning? – Rote learning – Learning by taking advice – Learning in problem solving – Learning from examples: Induction – Explanation based learning – Discovery – Analogy – Formal learning theory - Neural Net learning and Genetic learning - Expert System: Representation-Expert System shells-Knowledge Acquisition. Fuzzy logic system – Crisp sets – Fuzzy sets – Fuzzy terminology – Fuzzy logic control – Sugeno style of Fuzzy inference processing – Fuzzy Hedges – Neuro Fuzzy systems.

TEXT BOOKS

1. Elaine Rich, Kevin Knight (2008), Shivsankar B Nair, Artificial Intelligence, Third Edition, Tata McGraw Hill Publication,

REFERENCE BOOKS

1.Russel S, Norvig P (2010), Artificial Intelligence : A Modern approach,Third Edition, Pearson Education

2. Dan W Patterson (2007), Introduction to Artificial Intelligence and Expert System, Second Edition, Pearson Education Inc.

3. Jones M(2006), Artificial Intelligence application Programming, Second Edition, Dreamtech Press

4. Nilsson (2000), Artificial Intelligence : A new synthesis, Nils J Harcourt Asia PTE Ltd.

Semester	**IV**
Subject	**CORE PRACTICAL IV MATLAB**
Maximum Marks	CIA- 40 Marks ESE- 60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

- Use of MATLAB and MathWorks Statistics and Machine Learning Toolbox.
- Create and troubleshoot basic m scripts.
- Import datasets for analysis.
- Plot datasets.
- Create publishable, reproducible analysis reports.

LIST OF PROGRAMS

1. Introduction to MATLAB, MATLAB Elements & Simple Programs and debugging concepts.
2. Write a MATLAB Program for functions.
3. Write a MATLAB Programs by using IF Then Else, Case, Statement, for Loop, While loop.
4. Write a MATLAB Program for 2-D graph.
5. Write a MATLAB Program for 3-D graph.
6. Write a MATLAB Program for various Image operations.
7. Write a MATLAB Program for Animations.

8. Study of MATLAB debugging commands.
9. Write a MATLAB Program to create GUI.
10. Write a MATLAB Program to simulate a simple circuit.
11. Write a MATLAB Program to create Movie.
12. Write MATLAB Program to read sound file and adjust its parameters.
13. Write MATLAB Program to read .avi file.
14. Implement Non-AI and AI Techniques
15. Implement any two Player game

Semester	**V**
Subject	**CORE V – MACHINE LEARNING**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. To Learn about Machine Intelligence and Machine Learning applications
2. To implement and apply machine learning algorithms to real-world applications.
3. To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.

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

CO 1	• Appreciate the importance of visualization in the data analytics solution	K1,K2,K3,K4,K5
CO 2	• Apply structured thinking to unstructured problems	K1,K2,K3,K4,K5
CO 3	• Understand a very broad collection of machine learning algorithms and problems	K1,K2,K3&K4,
CO 4	• Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory	K1,K2,K3,K4,K5

CO 5	• Develop an appreciation for what is involved in learning from data.	K1,K2,K3,K4,K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Introduction

Machine Learning - Difference between AI, Machine Learning and Big data. Supervised and unsupervised learning, parametric vs non-parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier-K-nearest neighbour, support vector machines.

UNIT II

Neural networks and genetic algorithms

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III

Bayesian and computational learning

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV

Instant based learning

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT V

Advanced learning

Recommendation systems – opinion mining, sentiment analysis. Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order

Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.

TEXT BOOKS

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning" 2015, MIT Press.

REFERENCE BOOK

1. EthemAlpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
2. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Semester	**V**
Subject	**CORE PRACTICAL V- MACHINE LEARNING**
Maximum Marks	CIA- 40 Marks ESE-60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

- To discover patterns in the user data and then make predictions based on these and intricate patterns for answering business questions and solving business problems.

LIST OF PROGRAMS

Write a Python Implementation:

1. Reading and writing into.csv files
2. Implement the Find –S algorithm.
3. Implement the Candidate-Elimination algorithm.
4. Classify a sample using ID3 algorithm.
5. Build an artificial neural network by implementing back propagation algorithm.
6. Construct the naïve Bayesian classifier for classification.
7. Construct a naive Bayesian classifier and evaluate the classifier with accuracy, precision, and recall metrics

8. Applying EM algorithm for clustering using K-means algorithm.
9. Implement the k-Nearest Neighbour algorithm to classify the data set.
10. Implement the non-parametric Locally Weighted Regression algorithm.

Semester	**V**
Subject	**CORE VI - BIG DATA ANALYTICS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Working with Tableau

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

CO 1	• Understand Big Data and its analytics in the real world	K1,K2,K 3,K4,K5
CO 2	• Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm	K1,K2,K 3,K4,K5

CO 3	• Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics	K1,K2,K 3&K4,
CO 4	• Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics	K1,K2,K 3,K4,K5
CO 5	• Implement Big Data Activities using Hive	K1,K2,K 3,K4,K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Big data Introduction

Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.

UNIT II

Map reduce

Introduction to Map Reduce frame work - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.

UNIT III

Pig and Hive

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper.

UNIT IV

Mongo DB

No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export.

UNIT V

Cassandra

Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

TEXT BOOKS

1. JSeema Acharya, SubhashiniChellappan, "Big Data and Analytics", Wiley Publication, 2015.
2. Ramesh Sharda, DursunDelen, Efraim Turban (2018), Business Intelligence, Pearson Education Services Pvt Ltd.

REFERENCE BOOK

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.
2. Tom White, "Hadoop: The Definitive Guide", O"Reilly Publications, 2011.
3. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.
4. Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2014.

Semester	**V**
Subject	**CORE PRACTICAL VI - DATA ANALYTICS USING RAPID MINER**
Maximum Marks	CIA- 40 Marks ESE- 60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

- To enable everything from data mining to model deployment, and model operations.
- To offer all of the data preparation and machine learning capabilities needed to drive an organization.

LIST OF PROGRAMS

1. Data cleaning and pre-processing
2. Hadoop Programming: Word Count MapReduce Program Using Eclipse
3. Implementing Matrix Multiplication Using One Map-Reduce Step.

4. Implementing Relational Algorithm on Pig.
5. Implementing database operations on Hive.
6. Implementing Bloom Filter using Map-Reduce
7. Implementing Frequent Item set algorithm using Map-Reduce.
8. Implementing Clustering algorithm using Map-Reduce
9. Implementing Page Rank algorithm using Map-Reduce
10. Sentiment Analysis
11. Opinion mining
12. Predictive modeling

Semester	**VI**
Subject	**CORE VII IOT AND CLOUD TECHNOLOGIES**
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. Learn basic concepts of Cloud Computing.
2. To get an overview of MapReduce Concepts.
3. To learn about infrastructure security, Data Security and Privacy.

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

CO 1	• Design an IoT system with cloud infrastructure.	K1,K2, K3,K4, K5

CO 2	• . Implement the M2M Communication protocols in a prototype	K1,K2, K3,K4, K5
CO 3	• Understand the basic concepts of the main sensors used in electromechanical systems	K1,K2, K3&K 4,
CO 4	• Understand/implement computer models of common engineering information types.	K1,K2, K3,K4, K5
CO 5	• Understand storage mechanisms / analysis algorithms for data management in distributed & data intensive applications	K1,K2, K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

IoT Introduction

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU - Protocols for IoT.

UNIT II

Introduction to Cloud Computing

Cloud Computing – Definition – SPI Framework – Software Model – Cloud Services Delivery Model – Deployment Models – Key drivers – Impact on Users – Governance in the cloud – Barriers to Cloud Computing Adoption in the enterprise. Examples of Cloud Service Providers: Amazon Web services – Google – Microsoft Azure Services Platform – Sun Open Cloud Platform.

UNIT III

Virtual Machines Provisioning and Migration Services

Introduction and Inspiration -Background and Related Work- Virtual Machines Provisioning and Manageability-Virtual Machine Migration Services- VM Provisioning and Migration in

Action -Provisioning in the Cloud Context - Future Research Directions- The Anatomy of Cloud Infrastructures -Distributed Management of Virtual Infrastructures- Scheduling Techniques for Advance Reservation of Capacity- Capacity Management to meet SLA Commitments.

UNIT IV

Data Security, Identity and Access Management

Data security and storage: Aspects of Data Security -Data Security Mitigation -Provider Data and Its Security. Identity and Access Management: Trust Boundaries and IAM -Why IAM? - IAM Challenges- IAM Definitions- IAM Architecture and Practice-Getting Ready for the Cloud - Relevant IAM Standards and Protocols for Cloud Services - IAM Practices in the Cloud-Cloud Authorization Management- Cloud Service Provider IAM Practice.

UNIT V

Security and Privacy

Security Management: Standards – Security Management in the Cloud – Availability Management – Access Control. Privacy: What is Privacy – Data Life Cycle – Key Privacy Concerns – Who is responsible for protecting Privacy – Privacy Risk Management – Legal and Regulatory Implications. IoT and Cloud Integration: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment.

TEXT BOOKS

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press.
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. Tim Mather, Subra Kumaraswamy, ShahedLatif (2010), Cloud Security and Privacy, OREILLY Media.
4. RajkumarBuyya, James Broberg, AndrzejGoscinski(2011),CLOUD COMPUTING Principles and Paradigms, John Wiley & Sons, Inc., Hoboken, New Jersey.

REFERENCE BOOK

1. Ronald L. Krutz and Russell Dean Vines(2010), Cloud Security, Wiley – India.

Semester	**VI**
Subject	**CORE PRACTICAL VII - IOT AND CLOUD TECHNOLOGIES**
Maximum Marks	CIA- 40 Marks ESE- 60 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

- To improve efficiency and bringing important information to the surface more

quickly than a system depending on human intervention.

- To provide easy, scalable access to computing resources and IT services.

LIST OF PROGRAMS

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when "1"/"0" is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

Semester	**VI**
Subject	**CORE VIII DEEP LEARNING**
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	4 Credits / 75 Hours
Exam Duration	3 Hours

Objectives

1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2. To understand the theory behind deep learning methods such as Convolutional Neural Networks, Auto encoders and Boltzmann Machines

3. To have a grasp of the open issues and trends in deep learning research.

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

CO1	• Design user interfaces to improve human–AI interaction and real-time decision-making. • Evaluate the advantages, disadvantages, challenges, and ramifications of human–AI augmentation.	K1,K2,K3,K4, K5
CO2	• Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	K1,K2,K3,K4, K5
CO3	• Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	K1,K2,K3&K4 ,
CO4	• Extract information from text automatically using concepts and methods from natural language processing (NLP), including stemming, n-grams, POS tagging, and parsing	K1,K2,K3,K4, K5
CO5	• Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness. • Determine the framework in which artificial intelligence and the Internet of things may function, including interactions with people, enterprise functions, and environments.	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Introduction

Overview of machine learning, linear classifiers, loss functions What Are Neural Networks: History, Artificial and biological neural networks, Artificial intelligence and neural networks Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates.

UNIT II

Multilayer perceptron

The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples- Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies- Kohonen Self-Organizing Maps: Self-organizing map, The SOM algorithm, Learning vector quantization

UNIT III

Introduction to TensorFlow

Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras- Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, problem and solution of under fitting and overfitting

UNIT IV

Recurrent Neural Networks

Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, GRU, Encoder Decoder architectures.

UNIT V

Deep Learning applications

Image segmentation, Object detection, Attention model for computer vision tasks, Natural Language Processing, Speech Recognition, Video Analytics. Tools :TensorFlow, Keras, PyTorch, Caffe, Theano, MXNet. Applications: Object detection with RCNN - YOLO, SSD. Speech recognition with RNN.

TEXT BOOKS

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, OReilly, 2017.

REFERENCE BOOK

1. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G., H., and Van Loan, C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Semester	**I**
Subject	**ALLIED I – STATISTICAL METHODS AND ITS APPLICATIONS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

- **To Define the type and quantity of data need to be collected.**
- **To Organize and summarize the data.**
- **To Analyze the data and drawing conclusions from it.**

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

CO1	• Describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis. Solve a range of problems using the techniques covered.	K1,K2,K3,K4, K5
CO2	• Critically evaluate the underlying assumptions of analysis tools	K1,K2,K3,K4, K5
CO3	• Understand and critically discuss the issues surrounding sampling and significance	K1,K2,K3&K4
CO4	• Discuss critically the uses and limitations of statistical analysis and Probability.	K1,K2,K3&K4
CO5	• Conduct basic statistical analysis of data.	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	3.00	3.00	3.00	3.00	3.00	2.8	2.60	3.00	2.40	2.80	3.00
Criteria for Mapping	3= Strong 2= Medium 1= Low										

UNIT - I

Nature and Scope of Statistical Methods and Their Limitations — Classifications,Tabulation and Diagrammatic Representation of various types of statistical data —Frequency Curves and Ogives — Graphical determination of percentiles quartiles and theirproperties — Merits and Demerits.

UNIT - II

Measures of Location — Arithmetic Mean, Median, Mode, Geometric Mean, HarmonicMean and their properties — Merits and Demerits.

UNIT - III

Measures of Dispersion — Range, Mean Deviation, Quartile Deviation, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis and their properties.

UNIT - IV

Probability of an event — Finitely additive probability sopace addition and multiplicationtheorems — Independence of events — Conditional Probability — Bayes Theorem.

UNIT - V

Concepts of Random Variable — Mathematical expectation — Moments of random variable (raw and central moments) — Moment generating function — Chebychev'sinequality — Simple Problems.

REFERENCES

1. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
2. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics, Vol.I, WorldPress, Calcutta.
3. Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics,Holden Day.
4. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics,McGraw Hill.

ADDITIONAL REFERENCES

1. Bhat B.R. Srivenkatramana T and Rao Madhava K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Rohatgi V.K (1967): An Introduction to Probability Theory and Mathematical Statistics,John Wiley & Sons.
3. Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State UniversityPress

Semester	**II**
Subject	**ALLIED II – PROBABILITY AND STATISTICS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours

Exam Duration	3 Hours

Objectives

- This course aims at providing the required skill to apply the statistical tools in engineeringproblems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To familiarize the knowledge of testing of hypothesis for small and large samples whichplays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays
- very important roles in the field of agriculture and statistical quality control.

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

CO1	● Analyze statistical data graphically using frequency distributions and cummulative frequency distributions.	K1,K2,K3,K4, K5
CO2	● Analyze statistical data using measures of central tendency, dispersion and location. ● Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.	K1,K2,K3,K4, K5
CO3	● Translate real-world problems into probability models.	K1,K2,K3&K4
CO4	● Derive the probability density function of transformation of random variables	K1,K2,K3&K4
CO5	● Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables..	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Probability And Random Variables

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete andcontinuous random variables – Moments – Moment generating functions –

Binomial, Poisson,Geometric, Uniform, Exponential and Normal distributions.

UNIT II

Two - Dimensional Random Variables

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linearregression – Transformation of random variables – Central limit theorem (for independent andidentically distributed random variables).

UNIT III

Testing Of Hypothesis

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chisquare and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV

Design Of Experiments

One way and Two way classifications - Completely randomized design – Randomized block design– Latin square design - 2^2factorial design.

UNIT V

Statistical Quality Control

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and npcharts) – Tolerance limits - Acceptance sampling.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4thEdition, 2007.

REFERENCES:

1. Probability and Statistics for Engineering and the Sciences, 9E by Jay L. Devore, 2020.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning,New Delhi, 8th Edition, 2014.
3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and StochasticProcesses", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition,Elsevier, 2004.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems ofProbability and Statistics", Tata McGraw Hill Edition, 2004.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineersand Scientists", Pearson Education, Asia, 8th Edition, 2007.

Semester	III
Subject	ALLIED III – 1. OPTIMIZATION TECHNIQUES

Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

The objective of this course is to enable the student to

1. Formulate and solve linear programming problems (LPP)
2. Evaluate Integer Programming Problems, Transportation and Assignment Problems.
3. Obtain solution to network problems using CPM and PERT techniques.
4. Able to optimize the function subject to the constraints.
5. Identify and solve problems under Markovian queuing models.

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

CO1	● Recall the theoretical foundations of various issues related to linear programming modeling to formulate real-world problems as a L P model	K1,K2,K3,K4, K5
CO2	● Explain the theoretical workings of the graphical, simplex and analytical methods for making effective decision on variables so as to optimize the objective function	K1,K2,K3,K4, K5
CO3	● Identify appropriate optimization method to solve complex problems involved in various industries CO	K1,K2,K3&K4
CO4	● Demonstrate the optimized material distribution schedule using transportation model to minimize total distribution cost.	K1,K2,K3&K4
CO5	● Find the appropriate algorithm for allocation of resources to optimize the process of assignment.	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Linear Models

Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods

tosolve LPP- Simplex Method- Big M method, Two-Phase method

UNIT II

Integer Programming And Transportation Problems

Integer programming: Branch and bound method- Transportation and Assignment problems - Travelling salesman problem.

UNIT III

Project Scheduling

Project network -Diagram representation – Floats - Critical path method (CPM) – PERT-Costconsiderations in PERT and CPM.

UNIT IV

Classical Optimisation Theory

Unconstrained problems – necessary and sufficient conditions - Newton-Raphson method, constrained problems – equality constraints – inequality constraints - Kuhn-Tuckerconditions.

UNIT V

Queuing Models

Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of aQueuing system, Service facility, Queue discipline, Single channel models, multiple service channels.

TEXT BOOK:

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.

REFERENCES:

1. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.
2. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
3. Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill,2017.
4. Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming,Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
5. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.

Semester	**III**
Subject	**ALLIED III – 2. DATABASE MANAGEMENT SYSTEMS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks

Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

1. To Teach the basic database concepts, applications, data models, schemas andinstances.
2. To familiarize Entity Relationship model for a database.
3. To Demonstrate the use of constraints and relational algebra operations.
4. To Describe the basics of SQL and construct queries using SQL.

CO 1	• Identify the basic concepts and various data model used in database design ER modelling concepts and architecture use and *design* queries using SQL • Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.	K1,K2,K3,K4, K5
CO 2	• Design ER-models to represent simple database application scenarios • Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data. • Implement the concept of Relational Algebra And Calculus	K1,K2,K3,K4, K5
CO 3	• Formulate query, using SQL, solutions to a broad range of query and data update problems.	K1,K2,K3&K4 ,
CO 4	• Recognize and identify the use of normalization and functional dependency, indexing and hashing technique used in database design..	K1,K2,K3,K4, K5
CO 5	• Apply and relate the concept of transaction, concurrency control and recovery in database.	K1,K2,K3,K4, K5

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

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT - I

Introduction: Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- Levels, Mappings, Database, users and DBA
Database Design: Database Design Process, ER Diagrams - Entities, Attributes, Relationships, Constraints, keys, extended ER features, Generalization, Specialization, Aggregation, Conceptual design with the E-Rmodel.

UNIT - II
The Relational Model: Introduction to the relational model, Integrity constraints over relations, Enforcing integrity constraints, Querying relational data, Logical database design: E-R to relational, Introduction to views, Destroying/altering tables and views.
Relational Algebra And Calculus: Preliminaries, relational algebra operators, relational calculus - Tuple and domain relational calculus, expressive power of algebra and calculus.

UNIT - III
SQL: Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. transactioncontrol commands – Commit, Rollback, Save point, cursors, stored procedures,Triggers

UNIT - IV
Schema Refinement And Normal Forms: Introduction to schema refinement, functional dependencies, reasoning about FDs. Normal forms: 1NF, 2NF, 3NF, BCNF, properties of decompositions, normalization, schema refinement in database design, case studies.

UNIT – V
Transactions Management: Transaction concept, transaction state, implementation of atomicity and durability, concurrent executions, Serializability, recoverability, implementation of isolation, transaction definition in SQL, testing for Serializability.
Concurrency Control And Recovery System: Concurrency control, lock based protocols, time-stamp based protocols, validation based protocols, multiple granularity. Recovery system - failure classification, storage structure, recovery and atomicity, log- based recovery, shadow paging, buffer management, failure with loss of non-volatile storage, advanced recovery techniques, remote backup systems.
Overview Of Storage And Indexing: Tree structured indexing - intuition for tree indexes, indexed sequential access method (ISAM), B+ Trees - a dynamic tree structure.

TEXT BOOKS:
1. Raghurama Krishnan, Johannes Gehrke , Database Management Systems, 3rd edition, Tata McGraw Hill, New Delhi,India.
2. Elmasri Navate, Fundamentals of Database Systems, Pearson Education,India.
REFERENCE BOOKS:
1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan (2005), Database System Concepts, 5th
edition, McGraw-Hill, New Delhi,India.
2. Peter Rob, Carlos Coronel (2009), Database Systems Design, Implementation and Management, 7thedition.

Semester	IV
Subject	ALLIED IV–1. OPERATING SYSTEMS WITH UNIX
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

OBJECTIVES

1. To have an overview of different types of operating systems.
2. To know the components of an operating system.
3. To have a thorough knowledge of process and storage management.
4. To know the concepts of I/O and file systems.

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

CO1	• Describe the general architecture of computers	K1,K2,K3,K4, K5
CO2	• Describe, contrast and compare differing structures for operating systems	K1,K2,K3,K4, K5
CO3	• Understand and analyse theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files	K1,K2,K3&K4
CO4	• Understand the high-level structure of the Linux kernel both in concept and source code I	K1,K2,K3&K4
CO5	• Acquire a detailed understanding of one aspect (the scheduler) of the Linux kernel	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	3.00	3.00	3.00	3.00	3.00	2.8	2.60	3.00	2.40	2.80	3.00
Criteria for Mapping	3= Strong 2= Medium 1= Low										

UNIT I

Introduction

Types of System- OS Structure - Components - Services - System Structure - Layered Approach - Virtual Machines - System Design and Implementation. Process Management: Process - Process Scheduling - Cooperating Process - Threads - Inter-process Communication. CPU Scheduling: CPU Schedulers - Scheduling Criteria - Scheduling Algorithms– Views – Goals.

UNIT II

Process Synchronization

Critical-Section Problem - Synchronization Hardware - Semaphores Classical Problems of Synchronization- Critical Region - Monitors. Deadlocks: Characterization- Methods for Handling Deadlocks - Deadlock Prevention - Avoidance - Detection - Recovery.

UNIT III

Memory Management

Address Binding - Dynamic Loading and Linking - Overlays - Logical and Physical Address Space - Contiguous Allocation - Internal & External Fragmentation. Non-Contiguous Allocation: Paging and Segmentation Schemes - Implementation - Hardware-Protection - Sharing - Fragmentation.

UNIT IV

Virtual Memory

Demand Paging - Page Replacement - Page Replacement Algorithms - Thrashing. File System: File Concepts - Access Methods - Directory Structures - Protection Consistency Semantics - File System Structures - Allocation Methods - Free Space Management.

UNIT V

I/O System

Overview - I/O Hardware - Application I/O Interface - Kernel I/O Subsystem - Transforming I/O Requests to Hardware Operations - Performance. Secondary Storage Structures: Protection - Goals - Domain - Access matrix - The Security Problem - Authentication - Threats - Threat Monitoring - Encryption. Unix- introduction-different types of files-General purpose utilities-file systems-ordinary files-shell- Vi editor-File attributes– Implementation of UNIX commands.

TEXT BOOKS

1. SilberschatzP.B.Galvin, Gange(2011), Operating System Concepts, Sixth edition, Addison-Wesley Publishing Co.
2. Sumitabha Das (2008), Unix Concepts and Applications, Fourth reprint, TATAMCGRAW HILL publishing Company Limited.

REFERENCE BOOKS

1. H.M.Deitel(2007),An Introduction to Operating Systems, Second Edition, Addison Wesley.
2. A.S.Godbole(2011),Operating systems, Third Edition, Tata McgrawHilL publishingCompany Limited.

Semester	IV
Subject	ALLIED IV–2. TIME SERIES ANALYSIS AND FORECASTING
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

OBJECTIVES

1. To understand the basic concepts of time series.
2. To perform various analysis of time series data.
3. Forecast with ARMA model.

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

CO1	● Understand the fundamental advantage and necessity of forecasting in various situations.	K1,K2,K3,K4, K5
CO2	● Know how to choose an appropriate forecasting method in a particular environment	K1,K2,K3,K4, K5
CO3	● Know how to apply various forecasting methods, which includes obtaining the relevant data← and carrying out the necessary computation (running suitable statistical software, if necessary).	K1,K2,K3&K4
CO4	● Improve forecast with better statistical models based on statistical analysis	K1,K2,K3&K4
CO5	● To equip students with various forecasting techniques and knowledge on modern statistical methods for analyzing time series data	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT – I

Time Series and its Components

Introduction, Utility of time series analysis, Components of time series-Additive and multiplicative models for analysis of time series, Measurement of trend- Graphic method, Semi-average method, Moving average method, Method of curve fitting by principle of least squares.

UNIT-II

Time series and its Components (contd.)

Measurement of Seasonal variation-Method of simple averages, Ratio to trend method, Ratio to moving average method, Link Relative method, Measurement of Cyclicalvariations-Residual method.

UNIT –III

Time series models

Introduction, Examples of time series, Objectives of time series analysis, Some simple time series models- Definition, Models with trend and seasonality- Population of U.S.A, Level of lake Huron, A General approach to time series modeling.

UNIT –IV

Stationary models and Autocorrelation function

Definitions-Covariance function, Stationary, Autocorrelation function, Examples-White noise, First order moving average or MA(1) process, First order Autoregression or AR(1) process, The sample Auto correlation function-Definition, A model for lake Huron data, Estimation and Elimination of trend andseasonal components-Estimation and Elimination of trend in the absence of seasonality-Trend estimation by exponential smoothing, Trend elimination by differencing.

UNIT – V

ARMA Model

Definitions-Linear process, Moving average, ARMA(1,1) process, invertible ARMA(1,1) process, noninvertible ARMA(1,1) process, ACVF, ACF and PACF of the ARMA(1,1) process, Forecasting ARMA processes-Prediction of an ARMA(1,1) process.

TEXT BOOKS

1. S.P. Gupta (2008) Statistical methods, Sultan Chand & Sons.
2. J. Brockwell & Richard. A. Davis, Introduction to Time Series and Forecasting,Second Edition, Springer.

Semester	**V**
Subject	ELECTIVE I – 1. MARKETING ANALYTICS
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

1. Recognize challenges in dealing with data sets in marketing.
2. Identify and apply appropriate algorithms for analyzing the social media and web data
3. Make choices for a model for new machine learning tasks.

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

CO 1	● Critically evaluate the key analytical frameworks and tools used in marketing ● Apply key marketing theories, frameworks and tools to solve Marketing problems	K1,K2,K3,K4, K5
CO 2	● Utilise information of a firm's external and internal marketing environment to identify and prioritise appropriate marketing strategies	K1,K2,K3,K4, K5
CO 3	● Exercise critical judgement through engagement and reflection with existing marketing literature and new developments in the marketing environment	K1,K2,K3&K4
CO 4	● Critically evaluate the marketing function and the role it plays in achieving organisational success both in commercial and non-commercial settings	K1,K2,K3&K4
CO5	● Evaluate and act upon the ethical and environmental concerns linked to marketing activities	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**

CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Marketing Analytics

Introduction to marketing research, Research design setup, qualitative research, quantitate research, Concept development, scale development, Exploring Data, Descriptive Statistics. Product analytics- features, attributes, benefits, Price analytics, Promotion analytics, Channel analytics, Multiple Discriminate analysis.

UNIT II

Customer Analytics

Customer Analytics, Analyzing customer satisfaction, Prospecting and Targeting the Right Customers, Covariance and Correlation analysis, Developing Customers, Retaining Customers, Customer lifetime value case, Factor analysis. Market Segmentation & Cluster Analysis, Scatterplots & Correlation Analysis, Linear Regression, Model Validation & Assessment, Positioning analytics, Cross tabulation.

UNIT III

Social Media Analytics (SMA)

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.

UNIT IV

Facebook Analytics

Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. 9 (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction. (Websites)

UNIT V

Web Analytics and making connections

Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing.

TEXT BOOKS

1. Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, ChuckHemann& Ken Burbary, Pearson, ISBN 9780789750303
2. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Eric Siegel, Pearson,
3. Marketing Analytics: Optimize Your Business with Data Science in R, Python, and SQL, Dave Jacobs
4. Matthew Ganis, AvinashKohirkar. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media. Pearson 2016.

5. Jim Sterne. Social Media Metrics: How to Measure and Optimize Your Marketing Investment. Wiley, 2020.
6. Marshall Sponder. Social Media Analytics. McGraw Hill Latest edition.

REFERENCE BOOKS

1.Marketing Analytics: A practical guide to real marketing science, Mike Grigsby, Kogen Page, ISBN 9780749474171
2. Marketing Metrices3e, Bendle, Farris, Pferfery, Reibstein,
3.Cutting Edge Marketing Analytics: Real World Cases and Data Sets for Hands on Learning, Raj Kumar Venkatesan, Paul Farris, Ronald T. Wilcox.

Semester	**V**
Subject	ELECTIVE I – 2. DATA COMMUNICATION AND COMPUTER NETWORKS
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

- To introduce the fundamental network architecture concepts and their core principle issues in the emerging communication / data networks.
- To have a complete picture of the data and computer networks systematically
- To provide a strong foundation in networking concepts and technology

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

CO1	• Understand the basics of data communication, networking, internet and their importance.	K1,K2,K3,K4, K5
CO2	• Analyze the services and features of various protocol layers in data networks.	K1,K2,K3,K4, K5
CO3	• Differentiate wired and wireless computer networks	K1,K2,K3&K4
CO4	• Analyse TCP/IP and their protocols.	K1,K2,K3&K4
CO5	• Recognize the different internet devices and their functions.	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3

CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Data Communications

Introduction– Networks – The Internet – Protocols and Standards- Network Models: OSI model – TCP/IP protocol suite – Transmission Media: Guided media – Unguided Media.

UNIT II

Data Link Layer

Error Detection and Correction: Introduction- Block coding – Linear block codes – Cyclic Codes – Checksum. Framing – Flow and Error Control: Protocols –Noiseless Channels: Stop-and –Wait – Noisy Channel: Stop-and Wait Automatic Repeat Request-Go-Back –N.

UNIT III

Medium Access and Network Layer

Multiple Access: Random Access – Controlled access- Channelization. Network LayerLogical addressing: IPv4 addresses – IPv6 addresses. Transport Layer: Process – to Process delivery: UDP – TCP. Congestion Control – Quality of Service

UNIT IV

Application Layer

Domain Naming System: Name Space - Domain Name Space - Distribution of Name Space - DNS in the INTERNET - Resolution–Remote logging –e-mail – FTP.

UNIT V

Wireless Networks

Wireless Communications – Principles and Fundamentals. WLANs – WPAN- Satellite Networks - Ad-hoc Networks.

TEXT BOOKS

1. Forouzan, A. Behrouz. (2006), Data Communications & Networking, Fourth Edition, Tata McGraw Hill Education.
2. Nicopolitidis, Petros, Mohammad SalamehObaidat, G. L. Papadimitriou(2018), Wireless Networks, John Wiley & Sons.

REFERENCE BOOKS

1.Fred Halsall(1996), Data Communications Computer Networks and Open Systems, Fourth Edition, Addison Wesley.

Semester	**VI**
Subject	ELECTIVE II – 1. ANALYTICS FOR SERVICE INDUSTRY
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

1. Recognize challenges in dealing with data sets in service industry.
2. Identify and apply appropriate algorithms for analyzing the healthcare, Human resource, hospitality and tourism data.
3. Make choices for a model for new machine learning tasks.

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

CO1	● Understand and critically apply the concepts and methods of business analytics	K1,K2,K3,K4, K5
CO2	● Identify, model and solve decision problems in different settings	K1,K2,K3,K4, K5
CO3	● Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity	K1,K2,K3&K4
CO4	● Create viable solutions to decision making problems	K1,K2,K3&K4
CO5	● Instil a sense of ethical decision-making and a commitment to the long-run welfare of both organisations and the communities they serve	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3

CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Healthcare Analytics

Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges-Phenotyping Algorithms. Biomedical Image Analysis and Signal Analysis- Genomic Data Analysis for Personalized Medicine. Review of Clinical Prediction Models

UNIT II

Healthcare Analytics Applications

Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer- Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

UNITIII

HR Analytics

Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus analytical thinking; HRMS/HRIS and data sources; Analytics frameworks like LAMP, HCM:21(r) Model.

UNIT IV

Performance Analysis

Predicting employee performance,Training requirements, evaluating training and development, Optimizing selection and promotion decisions.

UNIT V

Tourism and Hospitality Analytics

Guest Analytics – Loyalty Analytics – Customer Satisfaction – Dynamic Pricing – optimized disruption management – Fraud detection in payments.

TEXT BOOKS

1. Chandan K. Reddy and Charu C Aggarwal, “Healthcare data analytics”, Taylor & Francis, 2015.
2. Edwards Martin R, Edwards Kirsten (2016),“Predictive HR Analytics: Mastering the HR Metric”, Kogan Page Publishers, ISBN-0749473924
3. Fitz-enzJac (2010), “The new HR analytics: predicting the economic value of your company‟s human capital investments”, AMACOM, ISBN-13: 978-0-8144-1643-3
4. RajendraSahu, Manoj Dash and Anil Kumar. Applying Predictive Analytics Within the Service Sector.

REFERENCE BOOKS

1. Hui Yang and Eva K. Lee, “Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.
2. Fitz-enzJac, Mattox II John (2014), “Predictive Analytics for Human Resources”, Wiley, ISBN- 1118940709.

Semester	**VI**
Subject	ELECTIVE II – 2. DATA MINING AND MULTIDIMENSIONAL MODELING
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

1. To understand the concept of Data Mining and Data Warehousing
2. To understand various Data mining tasks & techniques
3. To discuss the applications of Data mining in various fields

To implement the concepts of Mining with an Open Source Tool.

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

CO 1	• To understand various tools of Data Mining and their techniques to solve the real time problems.	K1,K2,K 3,K4,K5
CO 2	• Remove redundancy and incomplete data from the dataset using data preprocessing methods • Characterize the kinds of patterns that can be discovered by association rule mining	K1,K2,K 3,K4,K5
CO 3	• Be familiar with the process of data analysis, identifying the problems, and choosing the relevant models and algorithms to apply.	K1,K2,K 3&K4,
CO 4	• Be familiar with mathematical foundations of data mining tools..	K1,K2,K 3,K4,K5
CO 5	• Design Multidimensional data model for dataware house and analyze the market needs by applying suitable OLAP operations • Explain the concept of Data mining system and apply the various preprocessing techniques on large dataset	K1,K2,K 3,K4,K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	3.00	3.00	3.00	3.00	3.00	2.8	2.60	3.00	2.40	2.80	3.00
Criteria for Mapping	3= Strong 2= Medium 1= Low										

UNIT – I

Data Mining

Introduction–Motivating Challenges, Origins of Data Mining, Data Mining tasks. Data: Types of Data, Data Quality, Data Preprocessing.

UNIT – II

Classification

Introduction, Decision Tree construction algorithms, ID3, CART, Pruning, Bayesian classification, Rule based classification, K-Nearest Neighbor classification.

UNIT – III

Association Rule Mining

Introduction, Automatic discovery of Association Rules in Transaction databases, Apriori algorithm, Shortcomings, FP Growth algorithm

UNIT – IV

Cluster Analysis

Introduction, PartitionalClusterings,K-Means, k-Medoids,Modern Clustering Methods, BIRCH,DBSCAN,CHAMELEON.

UNIT – V

Data Warehousing and Multidimensional Modeling

Introduction, A Multidimensional Data Model, A Three Tier data Warehouse Architecture, Types of OLAP Service, From Data Warehousing to Data Mining. ER Modeling vsmulti-dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, introduction to business metrics and KPIs, creating cubes using SSAS.

TEXT BOOKS

1.Jiawei Han, Micheline Kamber (2011), Data Mining, Concepts and Techniques, Morgan Kauffman Publishers.

2. Pang Ning Tan, Michael Steinbach, Vipin Kumar (2005), Introduction to Data Mining, Addison Wesley.

3. K. P. Soman, ShyamDiwakar, V. Ajay (2006), Insight into Data Mining: Theory & Practice, Prentice Hall of India.

4. Immon.W.H., Building the Data Warehouse, Wiley Dream Tech, 3rd Edition, 2003

REFERENCE BOOK

1. Ian H. Witten &Eibe Frank (2011), Data Mining, Practical Machine Learning Tools and Techniques, Morgan Kaufmann series.
2. Sam Aanhory& Dennis Murray, Data Warehousing in the Real World –Pearson Edn Asia

Semester	**VI**
Subject	ELECTIVE III – 1. NATURAL LANGUAGE PROCESSING
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

1. Understand approaches to syntax and semantics in NLP.
2. Understand approaches to discourse, generation, dialogue and summarization within NLP.
3. Understand current methods for statistical approaches to machine translation.

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

CO 1	● Describe the fundamental concepts and techniques of natural language processing. ● Explain the advantages and disadvantages of different NLP technologies and their applicability in different business situations.	K1, K2, K3, K4, K5
CO 2	● Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each ● Use NLP technologies to explore and gain a broad understanding of tex	K1, K2, K3, K4, K5
CO 3	● Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions. ● Use NLP methods to analyse sentiment of a text document.	K1, K2, K3&

		K4,
CO 4	• Analyze large volume text data generated from a range of real-world applications. • Use NLP methods to perform topic modelling.	K1, K2, K3, K4, K5
CO 5	• Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness. • Determine the framework in which artificial intelligence and the Internet of things may function, including interactions with people, enterprise functions, and environments.	K1, K2, K3, K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Introduction

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issue-Applications – The role of machine learning – Probability Basics –Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.

UNIT II

Word level and syntactic analysis

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

UNIT III

Semantic analysis and discourse processing

Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

UNIT IV

Natural Language Generation

Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation. Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

UNIT V

Information retrieval and lexical resources

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame NetStemmers- POS Tagger- Research Corpora.

TEXT BOOKS

1. Daniel Jurafsky, James H. Martin, "Speech & language processing", Pearson publications.
2. Allen, James. Natural language understanding. Pearson, 1995.

REFERENCE BOOK

1. Pierre M. Nugues, "An Introduction to Language Processing with Perl and Prolog",Springer

Semester	**VI**
Subject	ELECTIVE III – 2. FINANCIAL ANALYTICS
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	5 Credits / 90 Hours
Exam Duration	3 Hours

Objectives

1. To provide a solid foundation in business.
2. To acquire logical & analytical skills in financial analytics

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

CO1	● Interpret and discuss the outputs of given financial models and create their own models.	K1,K2,K3,K4, K5
CO2	● Design and create visualisations that clearly communicate financial data insights.	K1,K2,K3,K4, K5

CO3	• Gain essential knowledge and hands-on experience in the data analysis process, including data scraping, manipulation, exploratory data analysis..	K1,K2,K3&K4
CO4	• Be prepared for more advanced applied financial modelling courses	K1,K2,K3&K4
CO5	• Improve leadership, teamwork and critical thinking skills for financial decision making.	K1,K2,K3,K4, K5

Mapping of Course Outcomes to Program Outcomes:

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3
Average	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**2.8**	**2.60**	**3.00**	**2.40**	**2.80**	**3.00**
Criteria for Mapping	**3= Strong 2= Medium 1= Low**										

UNIT I

Financial Analytics

Introduction: Meaning-Importance of Financial Analytics uses-Features-Documents used in Financial Analytics: Balance Sheet, Income Statement, Cash flow statement-Elements of Financial Health: Liquidity, Leverage, Profitability. Financial Securities: Bond and Stock investments - Housing and Euro crisis - Securities Datasets and Visualization - Plotting multiple series.

UNIT II

Descriptive Analytics

Data Exploration, Dimension Reduction and Data Clustering Geographical Mapping, Market Basket Analysis. Predictive Analytics, Fraud Detection, Churn Analysis, Crime Mapping, Content Analytics, Sentiment Analysis. Analyzing financial data and implement financial models. Process of Data analytics: obtaining publicly available data, refining such data, implement the models and generate typical output, Prices and individual security returns, Portfolio returns, Risks, Factor Models.

UNITIII

Forecasting Analytics

Estimating Demand Curves and Optimize Price, Price Bundling, Non Linear Pricing and Price Skimming, Forecasting, Simple Regression and Correlation Multiple Regression to forecast sales. Modelling Trend and Seasonality Ratio to Moving Average Method, Winter‟s Method

UNIT IV

Business Intelligence & Tableau

Definition of BI – A Brief History of BI – The Architecture of BI. The origin and Drivers of BI. Successful BI Implementation – Analytics Overview – Descriptive, Predictive and Perspective Analytics. Business reporting and Visualization – components - A brief history of data visualization – Different types of charts and graphs – The emergence of data visualization and visual analytics – Performance dashboards – Dashboard design – Best practices in dashboard design – Business performance management – Balanced Scorecards – Six sigma as a performance measurement system.

Unit V

Visualizations

Using Tableau to Summarize Data, Slicing and Dicing Financial Data, Charts to Summarize Marketing Data. Functions to Summarize Data, Pricing Analytics, Risk based pricing, Fraud Detection and Prediction, Recovery Management, Loss Risk Forecasting, Risk Profiling, Portfolio Stress Testing.

TEXTBOOKS

1. Analysis of Economic Data, Gary Koop, (4th Edition), Wiley.
2. Statistics and Data Analysis for Financial Engineering: with R examples; David Ruppert, David S. Matteson, Springers.

REFERENCE BOOKS

1. Analyzing Financial Data and Implementing Financial Models Using „R", Ang Clifford, Springers.
2. Microsoft Excel 2013: Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Publishing

Semester	**I**
Subject	**NON MAJOR ELECTIVE I – 1. FUNDAMENTALS OF COMPUTERS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

UNIT-1

Introduction to Computers:

Definition of Computers, History and Generations of Computers, Characteristics of computer, Classification of Computers. Fundamental Block diagram of Computer: CPU, Input & Output Unit. Input devices, Output devices, Types of printer's, Memory, CD-ROM, Hard disk, Floppy disk.

UNIT-2

Software

Definition of Software, Types of Software-System software, Application software and Utility software. Computer Languages: Definition, types of Programming languages, Language Processors :Assemblers, Interpreters, Compiler and Editors. Introduction to Operating Systems: Types of Operating System, Functions of Operating System examples. MS-DOS Internal and External Commands.

UNIT-3

Windows

Introduction to Windows, Starting Windows, Desk Top, Task Bar, Start Up Menu Working with programs and icons-Adding, removing, starting and quitting programs and icon. Working with files and folders-creating, deleting, opening, finding, copying, moving and renaming files and folders. Control Panel, setting, My Computer, Recycle bin, My documents, drives. Windows notepad, Accessories and windows Explorer.

UNIT-4

MS-Word

Overview of Word Processing, Parts of word window, Types of Menus. Opening, creating saving, cut, copy and paste. print and print preview. Find and Replace, Header& Footer, save & save as, Borders and shading, Bullets & Numbering, spelling and Grammar, Word count, Mail Merge, Table handling and important shortcut keys, Macros.

UNIT-5

MS-PowerPoint

Overview of MS-PowerPoint, Slides, PowerPoint views, Auto content wizard, Custom Animation, Transition and build effects, Printing slides and important shortcut keys.

REFERENCES:

1. Microsoft Office 2007 Training Guide, BPB Publications-2010
2. Fundamentals of Computers,V Rajaraman 6th edition PHI Learning Private Limited 2014
3. Sanjay Saxena: A First Course in Computers. Vikas Publishing House.
4. Peter Norton: Computing Fundamentals. 6th Edition, McGraw Hill-Osborne,2007
5. Alexis Leon and Marthews Leon: Introduction to Computers, Leon Vikas,1999.

Semester	**I**
Subject	**NON MAJOR ELECTIVE I – 2. INTRODUCTION TO HTML & WEB DESIGNING**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

Objectives

1. Demonstrate knowledge of Web programming terminology and how applied using Web Browsers (e.g., Web writing styles, election statements, design and management, etc.)
2. Develop a Graphical User Interface (GUI) based on problem description

3. Develop an Event Planning Chart based on problem description so as to define the processing that is to occur based on specific events
4. Develop an Algorithm to verify Image size and padding

UNIT – I

World Wide Web: Introduction the web defined – web browser details – web writing styles – web presentation outline, design, and management – registering web pages. Searching the World Wide Web: introduction – directories, search engines and meta search engines – search fundamentals – search strategies – how does a search engine works. Telnet and FTP: introduction – telnet and remote login – File transfer – Computer Viruses

UNIT – II

HTML Basics: Understanding HTML – Setting Up the Document Structure – Formatting Text by Using Tags – Using Lists and Backgrounds – Creating Hyperlinks and Anchors Style Sheets and Graphics: Introduction to Style sheets

UNIT – III

Graphics: Selecting a Graphics Format – Preparing Graphics for Web Use – Inserting Graphics – Arranging Elements on the Page – Controlling Image Size and Padding

UNIT – IV

Hyper linking from Graphics – Utilizing Thumbnail Graphics – Including Alternate Text for Graphics- Navigation: Creating Navigational Aids – Creating Tables – Formatting Tables

UNIT - V

Layouts: Creating Division-Based Layouts – Creating User Forms – Using Frames for Layout – Incorporating Audio and Video

TEXT BOOK

1. Microsoft Step by Step – HTML and XH, Faithe Wempen, Prentice Hall of India Private Limited, New Delhi.

REFERENCE BOOK

1. Ivan Bayross, “Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP”, Fourth Edition, 2010, BPB Publications.

E-REFERENCES

1.http://www.tutorialspoint.com/html_webdesign/index.html

Semester	**I**
Subject	**NON MAJOR ELECTIVE I – 3. PRINCIPLES OF COMPUTER ORGANIZATION**
Maximum Marks	CIA- 25 Marks ESE-75 Marks
Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

Objectives

1. To impart basic concepts of computer architecture and organization,
2. To explain key skills of constructing cost-effective computer systems.
3. To familiarize the basic CPU organization.

4. To help students in understanding various memory devices.
5. To facilitate students in learning IO communication

UNIT - I
STRUCTURE OF COMPUTERS
Computer types, Functional units, Basic operational concepts, VonNeumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes.COMPUTER ARITHMETIC: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations.

UNIT - II
BASIC COMPUTER ORGANIZATION AND DESIGN
Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats,
Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC

UNIT - III
REGISTER TRANSFER AND MICRO-OPERATIONS
Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit.MICRO-PROGRAMMED CONTROL: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.

UNIT - IV
MEMORY SYSTEM
Memory Hierarchy, Semiconductor Memories, RAM(Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID.

UNIT – V
INPUT OUTPUT
I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA.MULTIPROCESSORS: Characteristics of multiprocessors, Interconnection structures, InterProcessor Arbitration, Inter processor Communication and Synchronization, Cache Coherence.

TEXT BOOKS:
1. M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India.

REFERENCE BOOKS:
1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
3. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,
4. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHil

Semester	**I**
Subject	**NON MAJOR ELECTIVE I – 4.** **INTRODUCTION TO PROGRAMMING CONCEPTS**
Maximum Marks	CIA- 25 Marks ESE-75 Marks

Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

Objectives

1. To express algorithms and draw flowcharts in a language independent manner.
2. To teach how to write modular, efficient and readable C programs.
3. To impart knowledge in creating and using Arrays of the C data types.
4. To describe the techniques for creating program modules in C using functions and recursive functions.

UNIT- I

Introduction to the C Language – Algorithm, Pseudo code, Flow chart, Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output, Operators(Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associatively, Expression Evaluation, Type conversions.

UNIT- II

Statements- Selection Statements(making decisions) – if and switch statements, Repetition statements (loops)-while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Simple C Program examples.

UNIT- III

Functions- Introduction to Structured Programming, Functions- basics, user defined functions, inter function communication(call by value, call by reference), Standard functions. Storage classes-auto, register, static, extern, scope rules, arrays to functions, recursive functions, example C programs.

UNIT – IV

Arrays– Basic concepts, one-dimensional arrays, two – dimensional arrays, multidimensional arrays, C programming examples Pointers – Introduction (Basic Concepts), pointers to pointers, compatibility, Pointer Applications, Arrays and Pointers, Pointer Arithmetic, memory allocation functions, array of pointers, pointers to void, pointers to functions, command –line arguments, Introduction to structures and unions.

UNIT-V

Strings – Concepts, C Strings, String Input / Output functions, string manipulation functions, string /data conversion. Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling),Positioning functions.

TEXT BOOKS

1. Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.

2. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd edition

REFERENCE BOOKS

1. Let Us C Yashavant kanetkar BPB.
2. Absolute beginner's guide to C, Greg M. Perry, Edition 2, Publisher: Sams Pub., 1994.
3. Computer Programming and Data Structures by E Balagurusamy, Tata McGraw Hill

Semester	**II**
Subject	NON MAJOR ELECTIVES - II 1. FUNDAMENTALS OF FREE OPEN SOURCE SOFTWARE
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

Objectives

1. To expose students to free opensource software environment and introduce them to use opensource packages.
2. Demonstrate different opensource technology like Linux, PHP & MySQL with different packages.
3. To understand opensource software practices and tools.

4. To use the opensource software in operating systems, Programming and web framework in approaching real time applications.

UNIT I

IntroductionToOpen Source

Introduction to open sources – Need of open sources – advantages of open sources –application ofopen sources. Opensource operating systems: LINUX: Introduction – general overview –Kernelmodeandusermode–process–advancedconcepts–scheduling–personalities–cloning–signals–developmentwithLinux.

UNIT II
MYSQL
MySQL: Introduction – setting up account – starting, terminating and writing your own SQLprograms-record selection Technology – working with strings – Date and Time – sorting Queryresults –generating summary –working withmetadata–using sequences–MySQLandWeb.

UNITIII
Php
PHP:Introduction–programminginwebenvironment–variables-constants–datatypes–operators – statements – functions – arrays – OOP – string manipulations and regular expression –file handling and data storage – PHP and SQL database – PHP and LDAP – PHP connectivity –sendingand receiving E-mails–debugging and errorhandling–security –templates.

UNIT IV
Python
Syntaxandstyle–Pythonobjects–numbers–sequences–strings–listsandtuples–dictionaries–conditionalloops–files–inputandoutput–errorsandexceptions–functions–modules–classesand OOP– execution environment.

UNIT V
Perl

Pertbackgrounder–pertoverview–pearlparsingrules–variablesanddata–statementsandcontrol structures –subroutines -packages andmodules–workingwith files–datamanipulation.

UNIT VI
ContemporaryIssues
Expertlectures,onlineseminars –webinars

TEXTBOOKS

1. TheLinuxKernel Book,RemyCard, EricandFrankMevel,Wiley Publications2003.
2. MySQLBible,SteveSuchring,John Wiley2002.

REFERENCEBOOKS

1. ProgrammingPHP,RasmusLerdorfandLevinTatroe,O_Reilly,2002

2. CorePythonProgramming,WesleyJ. Chun,PrenticeHall,200
3. Perl:TheCompleteReference,2ndEdn, MartinC.Brown,TMH,2009
4. MySQL: The Complete Reference, 2nd Edn, Vikram Vaswani, TMH, 2009
5. PHP:TheCompleteReference,2ndEdn,SteveHolzner,TMH2009.

Semester	**II**
Subject	NON MAJOR ELECTIVES - II 2. PRINCIPLES OF SYSTEM ANALYSIS AND DESIGN
Maximum Marks	CIA- 25 Marks ESE- 75 Marks

Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

UNIT I

Basic Concept of Systems

The System: Definition and Concepts; Elements of a System: Input, Output Processor, Control, Feedback, Environment, Boundaries and Interface; Characteristics of a System; Types of systems -Physical and Abstract System, Open and Closed Systems, Man-made Systems; Information and its categories

Information System and System Analyst

Information systems: TPS, OAS, MIS, DSS, ESS; System Analyst: Role and need of system analyst, System Analyst as an agent of change.

UNIT II

System Development Life Cycle

Introduction to SDLC, Various phases: study, analysis, design, development, testing, implementation, maintenance; System documentation: Types of documentation and their importance.

System Planning and Information Gathering

Initial Investigations, Identification of user needs, Project Identification and Selection; Needs of Information Gathering, Determination of requirements, Information gathering tools: interviews, group communication, questionnaires, presentations and site visits.

UNIT III

Feasibility Study

Definition, Importance of feasibility study, Types of feasibility study, System selection plan and proposal, Prototyping, Cost-Benefit Analysis: Tools and Techniques.

Tools for System Analysis

Data Flow Diagram (DFD), Logical and Physical DFDs, Developing DFD; System Flowcharts and Structured charts, Structured English, Decision trees and Decision tables.

UNIT IV

System Design

Module specifications, Module Coupling and cohesion, Top-down and bottom-up design; Logical and Physical design, Structured design.

Input and Output

Input design: Input data, Input media and devices; Output design; Form Design: Classification of forms, Requirements of Form design.

UNIT V

System Implementation and Maintenance

Need of System Testing, Types of System Testing, Quality Assurance; System Conversion, Conversion methods, procedures and controls, System evaluation and performance, Maintenance activities and issues.

System Security and Audit

System Security, Security Threats, Risk Analysis, Control measures, System Audit, Disaster Recovery Planning

TEXT BOOKS

1. Elias m. Awad: System Analysis and Design
2. Perry Edwards: System Analysis & design Mc Graw Hill

Semester	**II**
Subject	NON MAJOR ELECTIVES - II 3. INTRODUCTION TO SYSTEM PROGRAMMING
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

Objective

1. To understand the steps involved in the Analysis and Design of a System

UNIT I

Overview

Introduction - The System Development Life Cycle (SDLC) - System Development - Methodologies - Project Team Roles and Skills - Planning Phase: Identifying business value - Feasibility Analysis - Creating the work plan, staffing the project, Controlling and directing the project.

UNIT II

Analysis Phase

System Analysis - analysis process, business process automation, business process improvement, business process reengineering, developing the analysis plan. Gathering Information – interviews, joint application design, questionnaires, document analysis, observation, selecting the appropriate technique. Process Modelling – data flow diagrams, use cases. Data Modelling – ER diagram.

UNIT III

Design Phase

System Design – design strategies, developing the design plan, moving from logical to physical model. Architecture Design – computing architectures, infrastructure design, global issues, security, User Interface (UI) – principles of UI design, UI design process, navigation design, input design,output design. Data Storage Design – data storage formats, optimizing data storage. Program Design – structure chart, program specification.

UNIT IV

Implementation Phase

Construction - managing programming, system testing, developing documentation. Installation – conversion, change management, post implementation activities & maintenance, concept of PERT and GANTT Charts.

UNIT V

Management Information System

Concept of Management, organization & System approach to management, MIS Planning, Designing and implementation, Role of DSS, Decision making & MIS, DSS and Knowledge

Management System.

TEXT BOOKS

1. System Analysis and Design, Kenneth E Kendall Julie, PHI, 2012

REFERENCEBOOKS

1. Modern Systems Analysis and Design, Jeffrey A. Hoffer, Pearson India, 2011

Semester	**II**
Subject	NON MAJOR ELECTIVES - II 4. FUNDAMENTALSOF SOFTWARE ENGINEERING
Maximum Marks	CIA- 25 Marks ESE- 75 Marks
Credits/ Instruction Hours	2 Credits / 30 Hours
Exam Duration	3 Hours

UNIT I

Software Life Cycle Models Software Process Introduction – S/W Engineering Paradigm – life cycle models: waterfall, incremental, spiral, win-win spiral, Agile, evolutionary, prototyping – Object-Oriented life cycle models-system engineering – computer-based system – life cycle process – development process.

UNIT II

Requirements Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modelling – Case Tools.

UNIT III

Design Design Concepts and Principles Modular design – design heuristic – Software architecture – data design – architectural design – transform & transaction mapping –Introduction to SCM process – Software Configuration Items.

UNIT IV

Testing Software Testing Taxonomy of Software testing – levels – black box testing – testing boundary conditions – structural testing — regression testing– Software testing strategies – unit testing – integration testing – validation testing – system testing and debugging – Traceability matrix.

UNIT V

Software Project Management Software cost estimation – Function point models – COCOMO model –Project Scheduling-Delphi method – Software challenges – Software Maintenance-Reliability – Reliability and availability models.