BHARATHIDASANUNIVERSITY, TIRUCHIRAPPALLI-620024
B.Sc. DATA SCIENCE

CHOICEBASEDCREDITSYSTEM– LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2026–2027 onwards)

Sem	Part	Courses	Title	Ins. Hrs.	Credits	Exam. Hours	Maximum Marks		
							Int.	Ext.	Total
I	I	Ability Enhancement Course – I (AEC - I)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course –II (AEC - II)	English Course – I	6	3	3	30	70	100
	III	Core Course -1 (CC - 1)	Programming in C and Data Structures	4	4	3	30	70	100
		Core Practical - 1 (CP - 1)	Programming in C and Data Structures Lab	4	4	3	40	60	100
		Allied Course – 1 (AC - 1)	Any one from the list	4	4	3	30	70	100
		Allied Course Practical -1 (ACP - 1)	Any one from the list	2	**	**	**	**	**
	IV	Value Education		2	2	3	30	70	100
		Interdisciplinary Course – 1 (IDC - 1) #	One Course from Outside Department	2	2	3	30	70	100
	Total			**30**	**22**	–	--	--	**700**
II	I	Ability Enhancement Course – III (AEC - III)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course – IV (AEC - IV)	English Course – II	6	3	3	30	70	100
	III	Core Course- 2(CC - 2)	Programming in Python	4	4	3	30	70	100
		Core Practical - 2(CP - 2)	Programming in Python Lab	4	4	3	40	60	100
		Allied Course - 2 (AC - 2)	Any one from the list	4	4	3	30	70	100
		Allied Course Practical -1 (ACP - 1)	Any one from the list	2	4	3	40	60	100
	IV	Skill Enhancement Course - 1(SEC - 1) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Interdisciplinary Course - 2 (IDC - 2) #	One Course from Outside Department	2	2	3	30	70	100
	Total			**30**	**26**	--	--	--	**800**

III	I	Ability Enhancement Course –V(AEC - V)	(Tamil$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course –VI (AEC - VI)	English Course – III	6	3	3	30	70	100
	III	Core Course- 3(CC - 3)	Relational Database Systems	4	4	3	30	70	100
		Core Practical - 3 (CP - 3)	Relational Database Systems Lab	4	4	3	40	60	100
		Allied Course - 3 (AC - 4)	Any one from the list	4	4	3	30	70	100
		Allied Course Practical - 2 (ACP-2)	Any one from the list	2	**	**	**	**	**
	IV	Skill Enhancement Course - 2 (SEC - 2) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Interdisciplinary Course – 3 (IDC - 3) $$	One Course from Outside Department	2	2	3	30	70	100
		Health & Wellness @		–	1	–			100
	Total			**30**	**23**	**–**	--	--	**800**
	I	Ability Enhancement Course –VII (AEC - VII)	(Tamil$ / Other Languages+,#)	6	3	3	30	70	100
IV	II	Ability Enhancement Course –VIII (AEC - VIII)	English Course – IV	6	3	3	30	70	100
	III	Core Course - 4(CC - 4)	Data Warehousing and Data Mining	4	4	3	30	70	100
		Core Practical - 4(CP - 4)	Data Warehousing and Data Mining Lab	4	4	3	40	60	100
		Allied Course - 4 (AC - 4)	Any one from the list	4	4	3	30	70	100
		Allied Course Practical - 2 (ACP-2)	Any one from the list	2	4	3	40	60	100
	IV	Skill Enhancement Course - 3 (SEC - 3) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Interdisciplinary Course – 4 (IDC - 4) $$	One Course from Outside Department	2	2	3	30	70	100
	Total			**30**	**26**	**–**	--	--	**800**
	Summer Internship / Industrial Activity during the Summer Vacation after II Year								

V	III	Core Course - 5 (CC - 5)	Big Data Analytics	4	4	3	30	70	100
		Core Course - 6 (CC - 6)	Fundamentals of Algorithms	5	4	3	30	70	100
		Core Course - 7 (CC - 7)	Cloud Computing	5	4	3	30	70	100
		Core Course - 8 (CC - 8)	Block Chain Technology	5	4	3	30	70	100
		Core Practical - 5(CP - 5)	Big Data Analytics Lab	5	4	3	40	60	100
	IV	Skill Enhancement Course - 4 (SEC - 4)	Any one from the list	2	2	3	30	70	100
		Skill Enhancement Course - 5 (SEC - 5) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Introduction to Disaster Management		2	2	3	30	70	100
		Summer Internship / Industrial Activity @@	(with Viva-Voce)	–	2	--	20	80	100
	Total			**30**	**28**	--	--	--	**900**
VI	III	Core Course - 9(CC - 9)	Natural Language Processing	4	4	3	30	70	100
		Core Course- 10(CC - 10)	Machine Learning	5	4	3	30	70	100
		Core Course- 11(CC - 11)	Network Security	5	4	3	30	70	100
		Core Project Work(CPW) @@	Project Work (with Viva-Voce)	6	4	3	20	80	100
	IV	Value Added Course	General Studies for Competitive Examinations	2	1	--	30	70	100
		Skill Enhancement Course - 6 (SEC - 6)	Any one from the list	2	2	3	30	70	100
		Skill Enhancement Course - 7 (SEC - 7) ##	Naan Mudhalvan Course	2	2	3	30	70	100
		Environmental Studies		2	2	3	30	70	100
		Gender Studies		2	1	3	30	70	100
		Extension Activities *		--	1	--	--	--	--
	Total			**30**	**25**	**--**	**--**	**--**	**900**
	Grand Total			**180**	**150**	--	**--**	**--**	**4900**

ALLIED COURSE

First Year	Second Year
Mathematics	Statistics

SKILL ENHANCEMENT COURSE (SEC)			
Sl. No.	**Title of paper**	**Sl. No.**	**MANDATORY Naan Mudhalvan Scheme ##**
1.	Mobile Application Development	1.	**2nd Semester:**
2.	Internet of Things		
3.	Cyber Security	2.	**3rd Semester:**
4.	Virtual Reality and Augmented Reality		
5.	Web Technology	3.	**4th Semester:**
6.	R Programming		
7.	Shell Programming	4.	**5th Semester:**
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INTERDISCIPLINARY COURSE (IDC) FOR WHO HAVE OPT TAMIL AS PART – I (for other Department Students only)	
1st Semester	Fundamentals of Information Technology
2nd Semester	Working Principles of Internet
3rd Semester	Digital Marketing
4th Semester	Introduction to Data Science

INTERDISCIPLINARY COURSE (IDC) # FOR WHO HAVE NOT OPT TAMIL AS PART – I		
Those who have studied Tamil upto 10th+2 but opt for other languages in degree	1st Semester	Special Tamil - I
	2nd Semester	Special Tamil - II
Those who have not studied Tamil in school level	1st Semester	Basic Tamil - I
	2nd Semester	Basic Tamil – II
Those students who opt for either special Tamil (or) Basic Tamil as IDCs, have to choose 2 more IDCs courses in their 3rd and 4th Semester from Outside his/her department.		

INTERDISCIPLINARY COURSE (IDC) $$ FOR NCC CADETS ONLY	
NCC Course is a Compulsory Course for the NCC Cadets in the 3rd Semester:	**NCC Course is a Compulsory Course for the NCC Cadets in the 4th Semester:**
Introduction to NCC	1. Special Subject Army **(or)** 2. Special Subject Navy **(or)** 3. Special Subject Air force
Those students who opt for NCC Courses as IDCs, have to choose 2 more IDCs courses in their 1st and 2nd Semester from Outside his/her department.	

SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

Sl. No.	Part	Types of the Courses	No. of Courses	Credits for each Course	Total Credits	Marks
1.	I	Ability Enhancement Course	4	3	12	400
2.	II	Ability Enhancement Course	4	3	12	400
3.	III	Core Course	11	4	44	1100
4.		Core Practical	5	4	20	500
5.		Allied Course (AC)	4	4	16	400
6.		Allied Course Practical (ACP)	2	4	8	200
7.		Core Project Work (CPW)	1	4	4	100
8.	IV	Skill Enhancement Course (SEC)	7	2	14	700
9.		Interdisciplinary Course (IDC)	4	2	8	400
10.		Value Education	1	2	2	100
11.		Health and Wellness	1	1	1	100
12.		Introduction to Disaster Management	1	2	2	100
13.		Summer Internship / Industrial Activity	1	2	2	100
14.		Value Added Course	1	1	1	100
15.		Environmental Studies	1	2	2	100
16.		Gender Studies	1	1	1	100
17.		**EXTENSION ACTIVITIES** (NCC / NSS / SPORTS / ANTI DRUG CELL / YRC & Any Other Activities	--	1	1	--
Total			**49**	**-**	**150**	**4900**

$ For those who have studied Tamil upto10th+2 (Regular Stream)

+ Syllabus for other Languages should be on parwith Tamil at degree level

Those who have studied Tamil upto10th+2 but opt for other languages in degree level under Part –I should study special Tamil and those who have not studied Tamil in the school level should study Basic Tamil in Part– IV under the Interdisciplinary Course.

** Examination at the end of the next semester

Naan Mudhalvan Scheme: As per the Naan Mudhalvan Scheme

instructions, 5 courses from 2nd to 6th semester should be studied under Skill Enhancement Course.

$ NCC Course is one of the Choices in the Interdisciplinary Course.

$ Only the NCC Cadets are eligible to choose this course. However, NCC Course is a Compulsory Course for the NCC Cadets.

@ **Health and Wellness: Assessments:**

- Use self-reflective worksheets to assess their understanding
- submit the worksheets to internal audit / external audit
- Every student's activity report should be documented and the same have to be assessed by the Physical Director with Mentor. The evaluation should be for 100 marks. No examination is required.

Scheme of Evaluation:

Part	Description	Marks
A	Report	40
B	Attendance	20
C	Activities (Observation During Practice)	40
Total		**100**

@ **Summer Internship / Industrial Activity**

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Internship will be carried our during the summer vacation after the second year. Viva-Voce will be conducted by the college and Marks shall be send to the University and the same will be included in the 5th semester Mark Statement.

Summer Internship / Industrial Activity& Project Work

Scheme of Evaluation:

Description	**Marks**
Report	80
Viva-Voce	20
Total	**100**

* Extension Activities shall be outside instruction hours.

PROGRAMME OUTCOMES (POs):

PO1	**Communication Skill:** Mandatory language courses facilitate to become proficient in communication, culturally aware, and more employable in both Indian and global contexts. Improve presentations skill, debates, and professional communication.
PO 2	**Disciplinary Knowledge:** Learn in-depth complex scientific concepts, demonstrate their ability to explain and apply their knowledge. Consistent in learning by earning extra credits in specialized courses within the science domain and enhance disciplinary knowledge.
PO 3	**Critical thinking:** Field and academic visits will help students to develop observation skills, grasping ability, collect and interpret data and propose models that will help them to understand hypotheses and conclusions.
PO 4	**Analytical Reasoning:** Through the interactions, students will develop skills of critical reading of texts, identifying gaps in knowledge, formulating scientific questions, and on will recognizing the synthesis of new ideas.
PO 5	**Scientific Reasoning:** Skill oriented courses will provide details on principles, conduct of proper calibration and use of scientific instrumentation and appropriate use of scientific techniques in experimental design
PO 6	**Self-directed Learning:** Preparation of field reports helps them to present their results and discussion in a written format that is typically required for their future professions.
PO 7	**Reflective Thinking:** All core courses with laboratory components will provide exposure to a wide range of research techniques, therein enhancing their understanding of the application of techniques in their domain.
PO 8	**Problem Solving:** Students will develop the ability to reason, apply numerical concepts, and equations in their fields of study for interpreting scientific data and drawing relevant scientific conclusions.
PO 9	**Research-related Skills:** Students undertaking a internship will have the opportunity to design, develop and execute their own research ideas in their experiments, thus expanding their knowledge of research methods and laboratory skills.
PO 10	**Lifelong Learning:** Ability to understand the gaps in knowledge and skill, adapt to technological change, engage in self-directed learning.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

After successful completion of B.Sc. Data Science programme the students will be able to

- Apply the computing knowledge to analyse real world applications.

- Solve the complex problems in the field of data science with an understanding of different types and formats of data
- Understand the concepts and ability to apply appropriate models.
- Develop programs and models for the various domain specific problems.
- The ability to exposure, identify and analyse big data, adjust and adapt with the dynamic technical environment for the growth of IT industry

Year: First **CORE COURSE 1** **Semester: I**

Code : **Credits: 4**

PROGRAMMING IN C AND DATA STRUCTURES
(Theory)

COURSE OBJECTIVES

This course aims to:

- identify and recall the fundamental syntax of C programming while defining the basic concepts of linear and non-linear data structures.
- explain and interpret the logical flow and the operational mechanics of various linear and non-linear data structures.
- Apply C programming syntax and memory management techniques to implementation of linear and non-linear data structures.
- analyse and differentiate complex programming constructs and data structures to optimize memory and data management.
- evaluate and justify the selection of programming constructs, memory management techniques, and data structures.

UNIT – I: INTRODUCTION

Basic of C: History of C and its importance – Structure of a C program – Data Types – Constants and Variables – Operators and Expressions – Order of Precedence, Evaluating of Arithmetic Expressions – Type Conversion- Decision Statements: if, if-else, and nested if statements.

UNIT – II: LOOPING AND FUNCTIONS

Loops Structures: For Loop, While, Do-while loop – Arrays: - One Dimensional Array, Two-dimensional Arrays, Character Arrays and Strings – Functions: Function with arrays - Function with decision and looping statements - Recursion.

UNIT – III: POINTERS AND STRUCTURES

Pointers: Introduction – Pointer Expressions – Chain of Pointers – Pointers and Arrays – Array of Pointers – Pointers as function arguments – Functions returning Pointers – Pointers to Functions – Function pointer – Structures - declaration, initialization, Array of Structures – Pointer to structures, Structures and functions – Typed of Enumerated data types, Unions.

UNIT – IV: STRING AND FILES

Strings Processing, Standard string library functions – Files: introduction and files functions – Writing and reading in Text mode – Simple application: Display the contents of a file. Write data to a file. Append data to an existing file – File IO– Reading and writing structures.

UNIT – V: DATA STRUCTURES

Stack: LIFO concept, Stack operations, Array implementation of stack – Queue: FIFO concept, Queue operations, Array implementation of queue – Singly Linked

List: concepts, operations – Doubly Linked List: concepts, operations – Trees: General trees, Binary trees.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. E. Balagurusamy, "Programming in ANSI C", Tata McGraw Hill, New Delhi, Nineth Edition, 2024.
2. Reema Thareja, "Data Structure using C, "Oxford University Press", New Delhi, Third Edition, 2023

REFERENCES:

1. Byron S. Gottfried, "Programming with C", Schaum's Outline Series, Tata-McGraw Hill Edition, New Delhi, 1991.
2. E.Horowitz, S.Sahni and Susan Anderson Freed, "Fundamental Data Structures in C", 2ed, Orient BlackSwan Publisher, 2009
3. E.Karthikeyan, "A Textbook on C Fundamentals, Data Structures and Problem Solving", Prentice-Hall of India Private Limited, New Delhi, 2008.
4. YashavantKanetkar, "Let us C", BPB Publications, Tenth Edition, New Delhi, 2010.
5. Szuhay, Jeff, and Szuhay, Jeff, "Learn C Programming: A Beginner's Guide to Learning C Programming the Easy and Disciplined Way", Packt Publishing, 2020.
6. Jena, Sisir Kumar, and Jena, Sisir Kumar, "C Programming: Learn to Code", CRC Press, 2021.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1 demonstrate the ability to construct C programs by correctly utilizing basic building blocks

CO2 design and implement modular software solutions using functions and recursion ad arrays

CO3 apply pointer arithmetic to manage memory addresses and organize complex information using user-defined data types

CO4 design and implement modular software solutions using functions and recursion

CO5 analyse and implement core data structure concepts, including the LIFO/FIFO operations of stacks and queues

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	2	3	1	1	2	1	0	2	0	2	3	1	1	2	1	1.47
CO2	2	3	2	2	2	1	1	3	1	2	3	2	2	3	1	2.00
CO3	1	3	2	3	3	1	1	3	2	2	3	3	2	3	2	2.27
CO4	2	3	2	2	2	1	1	3	1	2	3	2	2	3	1	2.00
CO5	1	3	3	3	2	1	1	3	2	2	3	3	3	3	2	2.33
Average	1.6	3.0	2.0	2.2	2.2	1.0	0.8	2.8	1.2	2.0	3.0	2.2	2.0	2.8	1.4	**2.01**

3 - Strong, 2 - Medium, 1- Low

Year: First **CORE PRACTICAL 1** **Semester: I**

Code: **PROGRAMMING IN C AND DATA STRUCTURES LAB (Practical)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- identify and define core C programming elements and the structural properties of linear data structures like Arrays and Stacks.
- demonstrate how to use conditional logic and control structures to solve mathematical logic problems
- implement fundamental algorithms for data retrieval and organization, specifically performing Linear Search and Bubble Sort
- analyse and compare the operational mechanisms of various data structures
- Design and construct modular programs that utilize dynamic memory and pointers to perform complex operations

LIST OF EXERCISES

1. **Input/Output, Arithmetic, and Conditional Logic:**
   Concepts: Basic I/O (printf, scanf), operators, expressions, decision-making (if, switch)
   Write a C Program to compute grade based on marks

2. **Loops and Pattern Printing:**
   Concepts: for, while, do-while loops, nested loops
   Write a C Program to Generate Multiplication Table

3. **Arrays and Strings:**
   Concepts: 1D & 2D arrays, string handling functions
   (a) Write a C Program to find largest and smallest element in an array
   (b)Write a C Program to count vowels and consonants

4. **Functions and Recursion:**
   Concepts: User-defined functions, parameter passing, recursion
   Write a C Program to Print Fibonacci Series

5. **Structures and File I/O:**
   Concepts: Structures, unions (basic idea), file handling (fopen, fread, fwrite)
   Write a C Program Student record management using structures

6. **Dynamic Array Implementation*:***
   Concepts: Dynamic memory allocation (malloc, calloc, realloc, free)
   Write a C Program Create dynamic array and perform insertion/deletion

7. **Singly Linked List Operations:**
Concepts: Linked list creation, traversal, insertion, deletion
Write a C Program to Reverse a linked list and count number of nodes

8**. Doubly Linked List Operations:**
Concepts: Forward and backward traversal, insertion, deletion
Write a C Program to Create and display doubly linked list, Forward and backward traversal, insertion, deletion

9. **Searching and Sorting Techniques:**
Concepts: Searching (Linear, Binary) and Sorting Techniques (Bubble, Selection, Insertion, Quick, Merge)
(a) Write a C Program to Implement Linear and Binary Search
(b) Write a C Program to Implement Sorting Techniques

10. Tree Traversals:
Concepts: Binary Trees, traversal techniques
Write a C Program to Create a Binary Tree and Counting leaf nodes

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1 describe and implement basic control structures to solve mathematical problems

CO2 apply iterative and conditional logic to perform data validation tasks, such as determining if a number is a palindrome

CO3 demonstrate the ability to store, traverse, and perform aggregate calculations (sum and average) on data sets using arrays

CO4 construct and analyse linear data structures by implementing Stack, Queue operations and Singly Linked Lists

CO5 analyse and execute fundamental algorithms for data organization and retrieval, specifically implementing Linear Search and Bubble Sort

Year: First	**CORE COURSE - II**	**Semester: II**
Code :	**PROGRAMMING IN PYTHON (Theory)**	**Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- Identify core language features—including reserved keywords, identifiers, and variables—and interpret
- Explain and apply decision-making constructs, nested loops, and various data types.
- Design modular solutions by defining functions with multiple return values, utilizing recursive logic, and organizing code
- analyse and implement Object-Oriented principles such as encapsulation, inheritance, and polymorphism
- Construct integrated applications that perform sophisticated text processing

UNIT– I: INTRODUCTION TO PYTHON

Features of Python - How to Run Python - Identifiers - Reserved Keywords - Variables - Comments in Python - Indentation in Python - Multi-Line Statements - Multiple Statement Group (Suite) - Quotes in Python - Input, Output and Import Functions - Operators. Data Types and Operations: Numbers – Strings – List – Tuple – Set – Dictionary – Data type conversion.

UNIT– II: FLOW CONTROL

Decision Making – Loops – Nested Loops – Types of Loops. Functions: Function Definition – Function Calling - Function Arguments - Recursive Functions - Function with more than one return value.

UNIT– III: MODULES AND PACKAGES

Built-in Modules - Creating Modules - import Statement - Locating Modules - Namespaces and Scope - The dir() function - The reload() function - Packages in Python - Date and Time Modules. Python Strings: String operations - Immutable Strings - Built-in String Methods and Functions - String Comparison - File Handling- Directories in Python.

UNIT– IV: OBJECT-ORIENTED PROGRAMMING

Class Definition - Creating Objects - Built-in Attribute Methods - Built-in Class Attributes- Destructors in Python – Encapsulation - Data Hiding – Inheritance - Method Overriding- Polymorphism.

UNIT– V: EXCEPTION HANDLING

Built-in Exceptions-Handling Exceptions- Exception with Arguments - Raising Exception - User-defined Exception - Assertions in Python. Regular Expressions: The match() function - The search() function - Search and Replace - Regular Expression Modifiers: Option Flags-Regular Expression Patterns- Character Classes-Special Character Classes - Repetition Cases - findall() method - compile() method.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Reema Thareja, "PYTHON Programming", Oxford University Press, New Delhi, Third Edition, 2025
2. Jeeva Jose and P. Sojan Lal, "Introduction to Computing and Problem Solving with PYTHON", Khanna Book Publishing Co, 2016.

REFERENCES:

1. Mark Summerfield. — Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009.
2. Martin C. Brown, —PYTHON: The Complete Reference‖, McGraw- Hill, 2001
3. Wesley J. Chun, "Core Python Programming", Prentice Hall Publication, 2006.
4. Timothy A Budd, "Exploring Python", Tata McGraw Hill, New Delhi, 2011
5. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly Media, 2016.
6. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/O Reilly Publishers, 2016
7. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1 describe the core features of Python and utilize fundamental syntax

CO2 apply decision-making constructs and various loop types to manipulate collections

CO3 design modular applications by implementing recursive functions, custom modules, and hierarchical packages

CO4 analyse and implement Object-Oriented principles, including inheritance and polymorphism

CO5 synthesize complex programs that perform advanced text processing using regular expressions

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	2	3	1	1	2	1	1	2	0	2	3	1	1	2	1	1.53
CO2	2	3	2	2	2	1	1	3	1	2	3	2	2	3	1	2.00
CO3	2	3	2	3	2	1	1	3	1	2	3	2	2	3	2	2.13
CO4	1	3	3	3	2	1	1	3	2	2	3	3	2	3	2	2.27
CO5	1	3	3	3	3	1	1	3	2	2	3	3	3	3	2	2.40
	1.6	3.0	2.2	2.4	2.2	1.0	1.0	2.8	1.2	2.0	3.0	2.2	2.0	2.8	1.6	**2.07**

3 - Strong, 2 - Medium, 1- Low

Year: First **CORE PRACTICAL 2** **Semester: II**

Code : **PROGRAMMING IN PYTHON LAB (Practical)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- identify and define core Python elements, including reserved keywords, identifiers, variables,
- explain the mechanics of decision-making statements and iterative loops used to solve computational problems
- implement functional programming by creating reusable code blocks and recursive functions
- analyse and organize code using Object-Oriented principles—including inheritance and polymorphism.
- construct comprehensive applications that integrate file handling for persistent storage with regular expressions

LIST OF EXERCISES

1. Basic Syntax & Input/Output
2. Flow Controls & Loops
3. Lists & Iterables
4. Functions and Recursive Functions
5. Build in Modules
6. String Operations
7. Lists, Tuples, & Sets
8. Exception Handling
9. Object-Oriented Programming (OOP) – Inheritance, Polymorphism
10. Basic File I/O & Error Handling
11. Regular expression Modifiers
12. Advanced File & Data Handling (Eg. Directory Tree Generator, JSON Configuration Parser)

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1 demonstrate Python syntax, i/o operations, and control flow
CO2 apply functions, recursion, and built-in modules
CO3 utilize Python data structures such as lists, tuples, and sets
CO4 implement object-oriented programming concepts polymorphism
CO5 develop programs using file handling and exception handling

Year: Second **CORE COURSE 3** **Semester: III**

Code: **RELATIONAL DATABASE SYSTEMS (Theory)** **Credits: 4**

COURSE OBJECTIVES

This course aims to:

- provide a strong foundation in database systems concepts, architecture, and models.
- enable understanding of relational database design, including keys and normalization techniques.
- develop skills in Relational Algebra and query processing.
- Familiarize learners with transaction control, constraints, and advanced SQL features.
- equip students with concepts of exception handling and triggers for robust database applications

UNIT I: INTRODUCTION:

Database System-Characteristics of Database Management Systems-Architecture of Database Management Systems-Database Models-System Development Life Cycle-Entity Relationship Model.

UNIT II: RELATIONAL DATABASE MODEL:

Structure of Relational Model-Types of keys. Relational Algebra: Unary operations-Set operations-Join operations. Normalization: Functional Dependency- First Normal form-Second Normal Form-Third Normal form- Boyce-Codd Normal Form-Fourth Normal Form.

UNIT III: SQL:

Introduction -Data Definition Language - Data Manipulation Language - Data Retrieval Language - Transaction Control Language- Single row functions using dual - Group/Aggregate functions - Set Functions – Subquery – Joins - Defining Constraints.

UNIT IV: PL/SQL:

Introduction-PL/SQL Basic-Character Set- PL/SQL Structure-SQL Cursor-Subprograms-Functions-Procedures.

UNIT V: EXCEPTION HANDLING:

Introduction-Predefined Exception-User Defined Exception-Triggers-Implicit and Explicit Cursors-Loops in Explicit Cursor.

UNIT – VI :CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Elmasri, R., &Navathe, S. B. (2017). Fundamentals of database systems (7th ed.). Pearson Education.
2. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2021). Database system concepts (7th ed.). McGraw Hill.
3. Das Gupta, P. K., & Radhakrishnan, P. Database management systems: Oracle SQL and PL/SQL (Latest ed.). PHI Learning Private Limited.

REFERENCES:

1. Coronel, C., & Morris, S. Database systems: Design, implementation, and management Cengage Learning.
2. Connolly, T., &Begg, C. Database systems: A practical approach to design, implementation, and management, Pearson Education.

COURSE OUTCOMES

Upon successful completion of this course, students would be able to:

CO1: explain the fundamentals of database systems architecture, and data models.
CO2: design relational databases using appropriate keys and normalization.
CO3: apply Relational Algebra operations to formulate database queries.
CO4: Construct& execute SQL queries for data definition, manipulation& retrieval
CO5: Handle exceptions and triggers to ensure data integrity and reliability

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	1	2	1	1	1.40
CO2	1	3	2	3	2	1	1	3	1	2	3	2	2	3	1	2.00
CO3	1	3	3	3	2	1	1	3	1	2	3	3	2	3	2	2.20
CO4	2	3	2	3	2	1	1	3	1	2	3	2	2	3	2	2.13
CO5	1	3	2	3	3	1	1	3	2	2	3	3	2	3	2	2.27
	1.2	3.0	2.0	2.8	2.2	1.0	1.0	2.6	1.0	2.0	2.8	2.2	2.0	2.6	1.6	**2.00**

3 - Strong, 2 - Medium, 1- Low

Year: Second **CORE PRACTICAL 3** **Semester: III**

Code: **RELATIONAL DATABASE SYSTEMS LAB (Practical)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand relational database concepts including keys and constraints.
- develop skills in writing SQL queries using DDL and DML commands.
- apply relational algebra& advanced SQL operations such as joins and subqueries.
- implement PL/SQL programs using control structures, procedures, functions, and cursors.
- handle exceptions, create triggers, and develop a mini database application.

LIST OF EXERCISES

1. Identify and implement **different types of keys** (Primary, Foreign, Candidate, Composite).
2. Perform **Relational Algebra operations** (Selection, Projection, Union, Intersection, Join).
3. **SQL – DDL Commands**
    - Create tables using **CREATE statement** with constraints.
    - Modify table structure using **ALTER statement**.
    - Remove tables using **DROP, TRUNCATE, and RENAME** commands.
4. **SQL – DML Commands**
    - Perform **INSERT, UPDATE, DELETE** operations on tables.
    - Retrieve data using **SELECT statement** with conditions (WHERE, ORDER BY).
    - Use **Single Row Functions** (Date, Numeric, Character functions).
    - Apply **Aggregate Functions** (COUNT, SUM, AVG, MIN, MAX).
    - Perform **Set Operations** (UNION, UNION ALL, INTERSECT, MINUS).
    - Write queries using **Subqueries**
    - Implement **Joins** (Inner Join, Left/Right Outer Join).
    - Apply **Constraints** (Primary Key, Foreign Key, Unique, Check, Not Null).
5. **Transaction Control- D**emonstrate **COMMIT, ROLLBACK, and SAVEPOINT** statements.

PL/SQL Programming

6. Write simple **PL/SQL programs** using variables and control structures.
7. Develop **PL/SQL procedures and functions**.
8. Implement **Implicit and Explicit Cursors**.
9. Use **loops with cursors** (FOR loop, WHILE loop).

Exception Handling & Triggers

10. Handle **Predefined Exceptions** in PL/SQL.
11. Create and handle **User Defined Exceptions**.
12. Develop **Triggers** for insert, update, and delete operations.

COURSE OUTCOMES

CO1 Explain the fundamentals of database systems, architecture, and data models.

CO2 Design relational database schemas and implement keys and constraints.

CO3 Apply SQL queries for data definition, manipulation, and retrieval.

CO4 Develop PL/SQL programs using control structures, functions, and procedures.

CO5 Implement exception handling, triggers, and simple database applications.

Year: Second **CORE COURSE 4** **Semester: IV**

Code: **DATA WAREHOUSING AND DATA MINING (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the basic concepts of data warehousing and data mining.
- learn data pre-processing techniques for preparing data.
- study association, classification, and clustering methods.
- apply data mining algorithms to analyse data.
- evaluate the performance of data mining models.

UNIT– I: INTRODUCTION TO DATA WAREHOUSE

Introduction to Data warehouse, Difference between operational database systems and data warehouses, Data warehouse Characteristics, Data warehouse Architecture and its Components, Extraction-Transformation-Loading, Logical(Multi-Dimensional), Data Modelling, Schema Design, Star and Snow-Flake Schema, Fact Constellation, Fact Table, OLAP Cube, OLAP Operations, OLAP Server Architecture.

UNIT– II: INTRODUCTION TO DATA MINING

Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or Data Warehouse System, Major issues in Data Mining. Data Pre-processing: Need for Pre-processing the Data, Data Cleaning, Data Integration &Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT– III: ASSOCIATION RULES

Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation; APRIOIRI Algorithm

UNIT– IV: CLASSIFICATION

Problem Definition, General Approaches to solving a classification problem, Evaluation of Classifiers , Classification techniques, Algorithm for Decision tree Induction ; Naive-Bayes Classifier, K- Nearest neighbor classification-Algorithm and Characteristics. Prediction: Accuracy and Error measures, Evaluating the accuracy of classifier or a predictor, Ensemble methods

UNIT V: CLUSTERING

Clustering Overview, A Categorization of Major Clustering Methods, Partitioning Clustering-K-Means Algorithm, Hierarchical Clustering-Agglomerative Methods and divisive methods, Outlier Detection.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Data Mining- Concepts and -Techniques- Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.
2. Introduction to Data Mining, Psng-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

REFERENCES:

1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2. Data Warehousing Fundament's, PualrajPonnaiah, Wiley Student Edition.
3. Parteek Bhatia, 'Data Mining and Data Warehousing: Principles and Practical Techniques', Cambridge University Press, 2019.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1 understand the basic concepts and the functionality of the various data mining and data warehousing component
CO2 know the concepts of Data mining system architectures
CO3 analyse the principles of association rules
CO4 get analytical idea on Classification and prediction methods.
CO5 Gain knowledge on Cluster analysis and its methods

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	Mean CO Score
CO1	1	3	1	2	2	1	1	1	-	2	2	2	3	1	1	1.53
CO2	1	3	2	2	2	1	1	2	1	2	2	3	2	2	2	1.87
CO3	1	3	3	3	2	1	1	3	1	2	3	3	3	2	2	2.2
CO4	1	3	3	3	3	1	1	3	2	2	3	3	3	3	2	2.4
CO5	1	3	3	3	2	1	1	3	2	2	3	3	3	3	3	2.4
Average	1.0	3.0	2.4	2.6	2.2	1.0	1.0	2.4	1.2	2.0	2.6	2.8	2.8	2.2	2.00	**2.08**

3 - Strong, 2 - Medium, 1- Low

Year: Second **CORE PRACTICAL 4** **Semester: IV**

Code: **DATA WAREHOUSING AND DATA MINING LAB (Practical)** **Credits: 4**

COURSE OBJECTIVES:

The course aims to:

- understand the process of data collection, pre-processing, and exploratory analysis.
- develop skills in data visualization and interpretation of patterns.
- apply data mining techniques for knowledge discovery.
- implement classification, clustering, and association rule mining algorithms.
- evaluate models using appropriate metrics and validation techniques.

LIST OF EXERCISES

1. Data Collection and Exploration

Design a simple data warehouse and perform ETL, OLAP Operations.

2. Data Pre-processing

Handle missing values &perform data cleaning.

3. Data Visualization

Create visual representations such as bar charts, histograms, and scatter plots.

4. Attribute Selection

Apply feature selection methods to identify relevant attributes for analysis.

5. Classification using Naive Bayes

Train and test a Naive Bayes classification model.

6. Clustering using K-Means

Perform K-Means clustering and determine the optimal number of clusters.

7. Association Rule Mining

Implement the Apriori algorithm to discover frequent item sets.

8. Data Transformation and Normalization

Apply normalization and transformation techniques to scale and standardize the dataset.

9. Outlier Detection

Identify outliers in the dataset using statistical methods such as the Z-score technique.

10. Model Evaluation Techniques

Evaluate models using various metrics (Accuracy, Precision, Recall&F1-score).

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1	apply data collection and pre-processing techniques on datasets
CO2	visualize and interpret data using statistical and graphical methods
CO3	Implement classification techniques such as Naive Bayes
CO4	Implement clustering and association rule mining techniques
CO5	Evaluate models using performance metrics and validation techniques

Year: Three **CORE COURSE 5** **Semester: V**

Code : **BIG DATA ANALYTICS (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the fundamentals and importance of Big Data.
- learn distributed computing concepts and Hadoop ecosystem.
- develop skills in Map Reduce programming for large-scale data.
- gain practical knowledge of Big Data tools such as Pig, Hive, and HBase.
- explore NoSQL databases like MongoDB for scalable data storage.

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.

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. White, T. Hadoop: The definitive guide to distributed storage and processing, O'Reilly Media.
2. George, L. HBase: The definitive guide, O'Reilly Media.

REFERENCES:

1. Chodorow, K., MongoDB: The definitive guide: Powerful and scalable data storage (4th ed.). O'Reilly Media.
2. Hewitt, E., & Carpenter, J. Cassandra: The definitive guide, O'Reilly Media.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: Explain Big Data concepts, taxonomy, and enterprise applications.
CO2: Demonstrate the working of Hadoop ecosystem and HDFS architecture.
CO3: Develop Map Reduce programs for processing large datasets.
CO4: Analyse and query Big Data using Pig, Hive, and HBase tools.
CO5: Apply NoSQL database concepts using MongoDB and Cassandra

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	2	2	1	2	1.53
CO2	1	3	2	2	2	1	1	3	1	2	3	3	2	2	3	2.07
CO3	1	3	3	3	2	1	1	3	2	2	3	3	3	3	3	2.40
CO4	1	3	3	3	2	1	1	3	2	2	3	3	3	3	3	2.40
CO5	1	3	3	3	3	1	1	3	2	2	3	3	3	3	3	2.53
	1.0	3.0	2.4	2.6	2.2	1.0	1.0	2.6	1.4	2.0	2.8	2.8	2.6	2.4	2.8	**2.19**

3 - Strong, 2 - Medium, 1- Low

Year: Three **CORE COURSE 6** **Semester: V**

Code : **FUNDAMENTALS OF ALGORITHMS (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the fundamentals of algorithm design and complexity analysis.
- learn tree and graph representations and traversal techniques.
- study searching, sorting, and heap-based algorithms.
- apply greedy and backtracking techniques to solve optimization problems.
- analyse graph algorithms for shortest path and network-related problems.

UNIT – I: INTRODUCTION

Algorithm Specification, Pseudo code for expressing algorithms, Performance Analysis- Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation, Performance Measurement, Randomized algorithms.

UNIT – II: BINARY TREE

Binary tree representations – Tree Traversal – Threaded Binary Trees – Binary Tree Representation of Trees – Graphs and Representations – Traversals, Connected Components and Spanning Trees – Shortest Paths and Transitive closure – Activity Networks – Topological Sort and Critical Paths.

UNIT – III: SORTING ALGORITHMS

Priority Queues - Heaps – Heap Sort – Merge Sort – Quick Sort – Binary Search – Finding the Maximum and Minimum.

UNIT – IV: GREEDY METHOD

The General Method – Optimal Storage on Tapes – Knapsack Problem – Job Sequencing with Deadlines – Optimal Merge Patterns.

UNIT – V: BACK TRACKING:

The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Ellis Horowiz, SartajSahni, "Fundamentals of Data Structure",Galgotia Publications, 2008.

2. Ellis Horowiz, Sartaj Sahni and SanguthevarRajasekaran, "Computer Algorithms", University Press, 2008.

REFERENCES:

1. Seymour Lipschutz, "Data Structures",TataMcgraw Hill, Schaum's Outline Series, 2014.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: explain asymptotic notations, and performance analysis techniques.
CO2: apply tree and graph traversal techniques to solve computational problems.
CO3: implement searching, sorting, heap, and priority queue algorithms.
CO4: apply greedy and backtracking techniques to solve optimization problems.
CO5: analyze and implement graph algorithms.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	2	2	2	1	1	2	0	2	2	1	2	1	1	1.53
CO2	1	3	2	3	2	1	1	3	1	2	3	2	2	2	1	1.93
CO3	1	3	3	3	2	1	1	3	1	2	3	2	2	3	2	2.13
CO4	1	3	3	3	3	1	1	3	2	2	3	3	3	3	2	2.40
CO5	1	3	3	3	3	1	1	3	2	2	3	3	3	3	2	2.40
	1.0	3.0	2.6	2.8	2.4	1.0	1.0	2.8	1.2	2.0	2.8	2.2	2.4	2.4	1.6	**2.08**

3 - Strong, 2 - Medium, 1- Low

Year: Three **CORE COURSE 7** **Semester: V**

Code : **CLOUD COMPUTING (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the fundamental concepts and types of cloud computing.
- learn cloud computing architecture, virtualization, and cloud technologies.
- study cloud storage systems and cloud-based services.
- analyse security issues and protection mechanisms in cloud environments.
- explore cloud applications and major cloud service providers.

UNIT - I: INTRODUCTION

Introduction to Cloud Computing – Types of Cloud – Evolution of Cloud Computing – Meaning of Cloud Computing – Need for Cloud Computing - Characteristics of Cloud Computing - Benefits of Cloud Computing.

UNIT - II: CLOUD COMPUTING ARCHITECTURE &SERVICE MODELS

Cloud Computing Technology – Cloud Architecture – Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) - Deployment Models: Public Cloud, Private Cloud, Community Cloud and Hybrid Cloud

UNIT - III: DATA STORAGE ANDTYPES OF SCALABILITY

Data Storage – Cloud Storage – Cloud Storage from LANs to WANs – Horizontal Scalability, Vertical Scalability - Load Balancing -Designing for Scalability: Scale out, Scale in – Capacity Planning Vs Scalability.

UNIT - IV: CLOUD COMPUTING AND SECURITY

Risks in Cloud Computing – Data Security in Cloud – Cloud Security Services – Cloud Computing Tools: Tools and Technologies for Cloud – Cloud Mashaps – Apache Hadoop – Cloud Tools

UNIT - V: CLOUD APPLICATIONS

Moving Applications to the Cloud – Google Cloud Applications – Amazon Cloud Services – Cloud Applications

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. A. Srinivasan and J.Suresh, “Cloud Computing – A Practical Approach for Learning and Implementation”, Pearson India Publications, 2014.

2. Rajkumar Buyya, James Broberg, Andrzej, “Cloud Computing: Principles and

Paradigms", Wiley India Publications, 2011.

3. Kris Jamsa, "Cloud Computing SaaS, Paas, IaaS, Virtualization Business Models, Mobile, Security and more", Published by Jones &BartletLearning, 2012.

REFERENCES:

1. Anthony T.Velte , Toby J. Velte Robert Elsenpeter, "Cloud computing a practical approach", TATA McGraw- Hill , New Delhi – 2010

2. Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online" - Que 2008

3. Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, "Cloud computing for dummies", Wiley Publishing, Inc, 2010

4. Comer, Douglas, The Cloud Computing Book: The Future of Computing Explained, CRC Press, 2021.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: explain the fundamentals, types, and working principles of cloud computing.
CO2: describe cloud architecture and cloud computing technologies.
CO3: apply cloud storage and cloud-based services for data management.
CO4: analyse security challenges and protection mechanisms in cloud.
CO5: evaluate cloud applications and services provided by platforms.

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	1	2	1	2	1.47
CO2	1	3	2	2	2	1	1	2	1	2	3	2	2	2	2	1.87
CO3	1	3	2	3	2	1	1	3	1	2	3	3	2	2	3	2.13
CO4	1	3	3	3	3	1	1	3	2	2	3	2	2	3	2	2.27
CO5	1	3	3	3	2	1	1	3	2	3	3	3	2	3	3	2.40
	1.0	3.0	2.2	2.6	2.2	1.0	1.0	2.4	1.2	2.2	2.8	2.2	2.0	2.2	2.40	**2.03**

3 - Strong, 2 - Medium, 1- Low

Year: Three **CORE COURSE 8** **Semester: V**

Code : **BLOCK CHAIN TECHNOLOGY (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the architecture, and applications of blockchain technology.
- learn consensus mechanisms and blockchain implementation platforms.
- explore Bitcoin blockchain operations, transactions, and smart contracts.
- analyse security, challenges, and practical aspects of blockchain networks.
- apply blockchain technology to solve real-world business problems.

UNIT – I: BLOCKCHAIN FUNDAMENTALS

Tracing Blockchain's Origin - The shortcomings of current transaction systems - The emergence of Bitcoin - The birth of blockchain - Revolutionizing the Traditional Business Network. Blockchains - The Structure of Blockchains - Blockchain Applications - The Blockchain Life Cycle

UNIT – II: CONSENSUS

The Driving Force of Blockchains - Blockchains in Use -Blockchain applications - Picking a Blockchain - Blockchains Substance - determining needs - Defining goal - Choosing a Solution - Drawing a blockchain decision tree Comparing Popular Blockchain Implementations - Making digital currency work - Providing computation control -Scaling to meet enterprise needs

UNIT – III: DIVING INTO THE BITCOIN BLOCKCHAIN

Creating Bitcoin wallet - Generating a Bitcoin vanity address - Transferring vanity address - Making an entry into the Bitcoin blockchain - Reading a blockchain entry in Bitcoin - Using Smart Contracts with Bitcoin - Building your first smart bond -Checking the status of contract - Blockchain For Dummies Building a Private Blockchain with Docker - Preparing your computer - Building your blockchain.

UNIT – IV: BEHOLDING THE BITCOIN BLOCKCHAIN

Getting a Brief History of the Bitcoin Blockchain - Debunking Some Common Bitcoin Misconceptions - Bitcoin: The New Wild West - Fake sites - Mining for Bitcoins - Making First Paper Wallet - The Ten Rules to Never Break on the Blockchain

UNIT – V: BLOCKCHAIN IN ACTION

Use Cases: Determining How Blockchain Fits in Industry - Identifying Speed Bumps in Business Processes- Determining How Blockchain Can Help - Choosing an Appropriate Use Case - Determining the Goal of Your Blockchain Network - Identifying Dependencies - Choosing a Blockchain Provider and Platform - Developing and Deploying Smart Contracts - Testing and Fine-Tuning Your Application and Network

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Manav Gupta, "BlockchainFor Dummies", IBM Limited Edition, John Wiley & Sons, Inc., 2018.
2. Bashir, Imran, "Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks", 2017.

REFERENCES:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, "Bitcoin and cryptocurrency technologies: a comprehensive introduction" Princeton University Press, 2016.
2. Joseph Bonneau et al, "SoK: Research perspectives and challenges for Bitcoin and cryptocurrency", IEEE Symposium on security and Privacy, 2015.
3. Srinivas Mahankali, Blockchain for Non IT Professionals: An Example Driven, Metaphorical Approach, Notion Press, 2020.
4. Laurence, Tiana., Introduction to Blockchain Technology: The many faces of blockchain technology in the 21st century, Van Haren, 2019.

COURSE OUTCOMES

Upon successful completion of this course, students would be able to:

CO1: explain the fundamentals, types, and working principles of cloud computing.
CO2: describe cloud architecture and cloud computing technologies.
CO3: apply cloud storage and cloud-based services for data management.
CO4: analyse security challenges and protection mechanisms in cloud.
CO5: evaluate cloud applications and services provided by platforms.

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	1	2	1	2	1.47
CO2	1	3	2	2	2	1	1	2	1	2	3	2	2	2	2	1.87
CO3	1	3	2	3	2	1	1	3	1	2	3	3	2	3	2	2.13
CO4	1	3	3	3	3	1	1	3	2	2	3	2	2	3	2	2.27
CO5	1	3	3	3	3	1	1	3	2	3	3	3	3	3	3	2.53
	1.0	3.0	2.2	2.6	2.4	1.0	1.0	2.4	1.2	2.2	2.8	2.2	2.2	2.4	2.20	**2.05**

3 - Strong, 2 - Medium, 1- Low

Year: Three **CORE PRACTICAL 5** **Semester: V**

Code : **BIG DATA ANALYTICS LAB (Practical)** **Credits: 4**

COURSE OBJECTIVES:

The course aims to:

- gain hands-on experience with Hadoop and distributed file systems.
- implement MapReduce-based solutions for big data processing.
- utilize Pig and Hive for large-scale data analysis.
- apply Big Data technologies to analyse real-world datasets.
- develop practical skills required for Big Data applications.

LIST OF EXERCISES

1. **HDFS Commands**
   - Installation of Hadoop.
   - Perform basic HDFS operations such as creating directories, uploading files, downloading files, viewing file contents, copying, moving, and deleting files and directories.
2. **Word Count Using Map Reduce**
   - Develop and execute a Map Reduce program to count the frequency of words in a text file stored in HDFS.
3. **Data Loading and Processing Using Pig**
   - Load datasets into Pig. Perform filtering, projection, sorting, and basic transformations using Pig.
4. **Grouping and Aggregation Operations in Pig**
   - Apply GROUP, COGROUP, and FOREACH operators.
   - Perform aggregate functions such as COUNT, SUM, AVG, MIN, and MAX on large datasets.
5. **Hive Table Creation and Data Loading**
   - Load data from local files and HDFS into Hive tables.
   - Explore Hive metadata and table properties.
6. **Querying Data Using HiveQL**
   - Execute HiveQL queries for data retrieval, filtering, sorting, grouping, joins, and aggregation.
7. **CRUD Operations in MongoDB**
   - Create databases and collections.Perform Insert, Find, Update, and Delete operations on MongoDB documents.
8. **Data Aggregation and Indexing in MongoDB**
   - Perform aggregation operations. Implement functions such as Count, Sort, Limit, Skip, and Group. Create and analyse indexes to improve query performance.
9. **CRUD Operations in Cassandra**
   - Create keyspaces and tables using CQL.
   - Perform Insert, Select, Update, and Delete operations.
10. **Querying in Cassandra**
    - Work with collections, counters, TTL, and query system tables for metadata retrieval.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: explain Big Data concepts, taxonomy, and enterprise applications.
CO2: demonstrate the working of Hadoop ecosystem and HDFS architecture.
CO3: develop MapReduce programs for processing large datasets.
CO4: analyse and query Big Data using Pig, Hive, and HBase tools.
CO5: apply NoSQL database concepts using MongoDB and Cassandra

Year: Three **CORE COURSE 9** **Semester: VI**

Code : **NATURAL LANGUAGE PROCESSING (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to

- introduce NLP concepts using Python (NLTK)
- understand text processing, linguistic structures, and corpora
- apply classification, tagging, and parsing techniques
- develop practical NLP applications
- gain hands-on experience with real datasets

UNIT - I: INTRODUCTION TO NLP

Overview of Natural Language Processing- Applications of NLP- Challenges in NLP- Basic Text Processing Techniques- Introduction to Python for NLP

UNIT - II: TEXT PREPROCESSING

Tokenization- Stop Words Removal- Stemming and Lemmatization- Regular Expressions- Text Normalization.

UNIT - III: LANGUAGE MODELING

N-gram Models- Probability Basics- Smoothing Techniques- Evaluation of Language Models.

UNIT - IV: MACHINE LEARNING FOR NLP

Feature Extraction (Bag of Words, TF-IDF)- Classification Algorithms- Naive Bayes and Logistic Regression- Model Evaluation Metrics.

UNIT - V: DEEP LEARNING IN NLP

Introduction to Neural Networks- Word Embeddings (Word2Vec, GloVe)- Recurrent Neural Networks (RNN)- LSTM and GRU Transformers and BERT

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Jurafsky, D., & Martin, J. H. (2025). Speech and language processing: An introduction to natural language processing, computational linguistics, and speech recognition (3rd ed.). Pearson.
2. Bird, S., Klein, E., &Loper, E. (2023). Natural language processing with Python (Updated ed.). O'Reilly Media.

REFERENCES:

1. Sarkar, D. (2024). Text analytics with Python: A practical real-world approach to gaining actionable insights from text data (3rd ed.). Apress.
2. Eisenstein, J. (2019). Introduction to natural language processing. MIT Press.
3. Aggarwal, C. (2023). Neural networks and deep learning: A textbook (2nd ed.). Springer.
4. Lewis, M. (2024). Deep learning for natural language processing. CRC Press.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: explain the fundamental concepts, applications & Challenges of NLP.
CO2: apply text pre-processing techniques such as tokenization& stemming.
CO3: analyse language models using N-gram techniques.
CO4: Implement machine learning techniques for text classification.
CO5: Apply deep learning models and Transformers, for NLP tasks.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	2	2	1	1	1.47
CO2	1	3	2	2	2	1	1	3	1	2	3	2	2	2	1	1.87
CO3	1	3	3	3	2	1	1	3	1	2	3	3	3	2	2	2.20
CO4	1	3	3	3	3	1	1	3	2	2	3	3	3	3	2	2.40
CO5	1	3	3	3	3	1	1	3	2	3	3	3	3	3	3	2.53
	1.0	3.0	2.4	2.6	2.4	1.0	1.0	2.6	1.2	2.2	2.8	2.6	2.6	2.2	1.8	**2.09**

3 - Strong, 2 - Medium, 1- Low

Year: Three **CORE COURSE 10** **Semester: VI**

Code: **MACHINE LEARNING (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the fundamental concepts and applications of Machine Learning.
- learn probabilistic models and Bayesian learning techniques.
- study supervised learning algorithms for prediction and classification.
- explore unsupervised learning techniques and dimensionality reduction methods.
- evaluate machine learning models using appropriate performance metrics.

UNIT - I: INTRODUCTION

Introduction, easy for human hard for machines, a simple predicting machine, classifying is not very different from predicting, training a simple classifier, one classifier is not enough, Types of machine learning, Applications of Machine Learning, Perspectives and issues in machine learning.

UNIT - II: PROBABILISTIC AND STOCHASTIC MODELS

Bayesian Learning – Bayes theorem, Concept learning, Maximum likelihood, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, Expectation maximization and Gaussian Mixture Models, Hidden Markov models

UNIT - III: SUPERVISED LEARNING

Introduction, Regression, Linear regression, Classification: Decision trees, k-Nearest Neighbours, Support Vector Machine, Logistic regression, Random Forest. Artificial Neural Network: Introduction, Perceptron's, multi-layer networks and back propagation.

UNIT - IV: UNSUPERVISED LEARNING

Introduction, Supervised vs Unsupervised Cluster Analysis, K-means clustering, Hierarchical clustering. Dimension reduction: Principal Component Analysis, Linear Discriminant Analysis

UNIT - V: MODELLING AND EVALUATION

Building the model, Training a model, evaluating a model, improving a model. Performance metrics - accuracy, precision, recall, sensitivity, specificity, AUC, RoC, Bias Variance decomposition.

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, —MachineLearning, Pearson Education, 2018.
2. EthemAlpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.

REFERENCES:

1. Tariq Rashid, "Make your own neural network", Create Space Independent Publishing Platform, US 2016, ISBN:978-1-5308-2660-5
2. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2015
3. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer, 2013
4. Charu C. Aggarwal, "DATA CLUSTERING Algorithms and Applications", CRC Press, 2014.
5. C. Bishop, "Pattern Recognition and Machine Learning", Springer,2006
6. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", Packt Publishing, Third Edition, 2019

COURSE OUTCOMES

Upon successful completion of this course, students would be able to:

CO1: explain the basic concepts and applications of Machine Learning.
CO2: apply probabilistic models such as Bayesian learning.
CO3: implement supervised learning algorithms for classification.
CO4: apply clustering &dimensionality reduction techniques to analyse data.
CO5: evaluate machine learning models using performance metrics

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	2	2	1	1	1.47
CO2	1	3	2	3	2	1	1	3	1	2	3	3	3	2	2	2.13
CO3	1	3	3	3	3	1	1	3	2	2	3	3	3	3	2	2.40
CO4	1	3	3	3	2	1	1	3	2	2	3	3	3	2	3	2.33
CO5	1	3	3	3	3	1	1	3	2	3	3	3	3	3	3	2.53
	1.0	3.0	2.4	2.8	2.4	1.0	1.0	2.6	1.4	2.2	2.8	2.8	2.8	2.2	2.2	2.17

3 - Strong, 2 - Medium, 1- Low

Year: Three **CORE COURSE 11** **Semester: VI**

Code: **NETWORK SECURITY (Theory)** **Credits: 4**

COURSE OBJECTIVES:

This course aims to:

- understand the basics of network and information security.
- learn encryption and decryption techniques used in data security.
- study authentication methods, digital signatures, and cryptographic algorithms.
- understand network security protocols and secure communication systems.
- analyse security threats and protection mechanisms in computer systems.

UNIT - I: INTRODUCTION

Security Trends – The OSI Architecture – Security Attacks –Security Services – Security Mechanisms – A model for Network Security – Classic Encryption Techniques – Symmetric Cipher Model – Substitution Techniques –Transposition techniques – Rotor Machines – Steganography.

UNIT - II: BLOCK CIPHERS AND DATA ENCRYPTION STANDARDS

Block Cipher - Principles - Data Encryption Standard – The strength of DES – Differential and Linear Cryptanalysis – Block Cipher design principles – Advanced encryption Standard – The AES Cipher

UNIT - III: PUBLIC KEY ENCRYPTION AND HASH FUNCTIONS

Principles of Public Key Crypto Systems – The RSA algorithm – Message Authentication – Authentication Requirements – Authentication Functions – Message Authentication codes – Hash Functions – Security of Hash Functions and MAC – Whirlpool - Digital Signatures – Authentication Protocols – Digital Signature standard

UNIT - IV: AUTHENTICATION APPLICATIONS

Kerberos – X.509 Authentication Service – PKI – Electronic Mail Security - Pretty Good Piracy – S/MIME – IP Security – IP Security Overview – IP Security Architecture – Authentication Header – Key Management – Web Security – Web Security Considerations-SSL and Transport Layer Security

UNIT - V: SYSTEM SECURITY

Intruders – Intrusion Detection – Password Management – Viruses – DOS and DDOS Attacks – Firewalls – Firewall Design Principles –Trusted Systems – IT Security Evaluation

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. William Stallings, "Cryptography and network Security", Principles and Practices‖, Prentice Hall (Pearson Education), Fourth Edition, 2006.
2. Kevin Mitnick (Author), Robert VamosiMikkoHypponen, "The Art of Invisibility: The World's Most Famous Hacker Teaches You How to Be Safe in the Age of Big Brother and Big Data Hardcover" , 2017 (ISBN13: 9780316380522)

REFERENCES:

1. AtulKahate, "Cryptography and Network Security", Tata McGraw Hill Publications, New Delhi.
2. Stallings, "Data and Computer Communications", Pearson Education 2012, 7th Edition.
3. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill 2007, 4th Edition.
4. F. Halsall, "Data Communications, Computer Networks and Open Systems", Pearson Education 2008

COURSE OUTCOMES

Upon successful completion of this course the students would be able to:

CO1: explain the basic concepts of network security and cryptography.
CO2: apply encryption algorithms to secure data.
CO3: describe public key cryptography and digital signatures.
CO4: explain authentication protocols and network security applications.
CO5: identify security threats and implement protection mechanisms.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	1	3	1	2	2	1	1	1	0	2	2	1	2	1	1	1.40
CO2	1	3	2	2	3	1	1	3	1	2	3	2	2	3	2	2.00
CO3	1	3	2	3	3	1	1	3	1	2	3	2	3	2	2	2.13
CO4	1	3	2	3	2	1	1	3	2	2	3	2	2	3	2	2.00
CO5	1	3	3	3	3	1	1	3	2	2	3	3	2	3	3	2.40
	1.0	3.0	2.0	2.6	2.6	1.0	1.0	2.6	1.2	2.0	2.8	2.0	2.2	2.4	2.0	**1.99**

3 - Strong, 2 - Medium, 1- Low

Year :Three **Semester: VI**

PROJECT WORK (WITH VIVA-VOCE)

Code : **(Core Project Work)** **Credits: 4**

The candidate shall be required to take up a Project Work by group or individual and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External)
   - I. Plan of the Project - 20 marks
   - II. Execution of the Plan/collection of - 45 marks

Data / Organisation of Materials /
Hypothesis, Testing etc. and presentation of the report.

   - III. Individual initiative - 15 marks

2. Viva-Voce / Internal & External - 20 marks

TOTAL **- 100 marks**

PASSING MINIMUM:

Project	**Dissertation 80 Marks**– 40% out of 80 marks (i.e. 32 marks)	**Viva-Voce (20 Marks)** – Project 40% out of 20 Marks (i.e. 8 Marks)

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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SKILL ENHANCEMENT COURSE

Code : **1. MOBILE APPLICATION DEVELOPMENT (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to :

- Gain a comprehensive understanding of the basic concepts of mobile app using Android Platform
- Learn the detail framework of Android Platform
- Acquire the knowledge on the design aspects in Creating intuitive, reliable mobile apps using the android services and components
- Explore the various additional features of mobile app development
- Impart skills on Graphical features to design attractive web apps

UNIT - I: ANDROID PLATFORM

Introducing the Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine-The Directory Structure of an Android Project-Common Default Resources Folders-The Values Folder- Leveraging Android XML- Screen Sizes-Desktop Clocks- Using Android Application Resources-Launching Application: The Android Manifest.xml File - Creating Your First Android Application

UNIT - II: ANDROID FRAMEWORK

Android Framework Overview: The Foundation of OOP: The Object-The Blue print for an Object: The Class-Providing Structure for Classes: Inheritance-Defining an Interface Bundling Classes-An overview of XML- The APK File-Android Application Components Android Activities- Android Services - Broad cast Receivers - Content Providers - Android Manifest XML.

UNIT - III: WORKING WITH SCREEN LAYOUTS

Screen Layout Design- Android View Hierarchies - Nesting Views-Defining Screen Layouts - Editing the main.xml File-Using Relative Layouts- Sliding Drawers-Using Padding and Margins with Views and Layouts.

UNIT - IV: WORKING WITH BUTTONS, MENUS, AND DIALOGS

UI Design: Buttons, Menus, and Dialogs: Using Common UI Elements- Adding an Image Button to Your Layout-Defining Multistate Image Button - Replacing the Default Background- Adding a Text to Your Layout- Adding an Image-Using Menus in Android-Creating the Menu Structure with XML- Running the Application in the Android Emulator

UNIT - V: GRAPHICS IN ANDROID

An Introduction to Graphics Resources in Android: Introducing the Drawables-Implementing Images - Creating Animation in Android- Tween Animation in Android-Using Transitions

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOK:

1. Jackson W, "Android Apps for Absolute Beginners", 1st Edition, Apress.

REFERENCES:

1. Barry Burd and John Paul Mueller,Android Application Development All-in-One For Dummies, 3rd Edition, 2020
2. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2011.
3. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd,2010
4. Mark L Murphy, "Beginning Android3", Apress Publications, 2011.

COURSE OUTCOMES

Upon successful completion of this course the students would be able to:

CO1	Recall the elements of software development platform to build android programming
CO2	Understand the UI-component layouts, event handling, and screen orientations to develop mobile applications
CO3	Apply the Screen Layout and UI Design in Android Framework to implement the android apps
CO4	Organize the various resources and examine the parameter passing mechanism among them
CO5	Design and evaluate the user interfaces to support mobile application development

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	1	3	2	1	1	2	1	1	1	3	2	2	3	1	1	1.67
CO2	2	3	2	2	1	2	2	2	1	3	3	3	2	1	2	2.07
CO3	2	3	3	3	1	2	2	3	2	3	3	3	2	2	2	2.40
CO4	1	3	3	3	1	2	2	3	2	3	3	3	2	1	1	2.20
CO5	3	3	3	3	1	3	2	3	3	3	3	3	3	1	1	2.53
Average	1.80	3.00	2.60	2.40	1.00	2.20	1.80	2.40	1.80	3.00	2.80	2.80	2.40	1.20	1.40	2.17

3 - Strong, 2 - Moderate, 1 - Low

SKILL ENHANCEMENT COURSE

Code: **2. INTERNET OF THINGS (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- Understand the fundamental concepts, architecture, technologies, and applications of the Internet of Things (IoT).
- Analyse IoT communication models, M2M systems, network management protocols, and enabling technologies.
- Apply IoT design methodologies to develop domain-specific IoT solutions.
- Develop IoT applications using Python programming and Raspberry Pi-based embedded systems.
- Explore cloud computing platforms and web services for IoT data storage, processing, and application deployment.

UNIT-I: INTRODUCTION

Definition & characteristics of IoT - physical design of IoT - logical design of IoT - IoT enabling Technologies - IoT levels & Deployment templates.

UNIT-II: DOMAIN SPECIFIC IOT

Home Automation - cities - Environment - Energy - retail - logistics - Agriculture - Industry Health and life style.

UNIT – III: IoT and M2M

Deference between IoT and M2M - SDN and NFV for lot - IoT systems management - SNMP - YANG – NETOPEER.

UNIT-III: IoT SPECIFICATION

IoT platforms design Methodology - Domain model specification - Information model specification - IoT level specification - functional view specification - Application Development.

UNIT-IV: LOGICAL DESIGN USING PYTHON

Logical design using python - IoT physical devices and Endpoints, building blocksof IoT device- Raspberry Pi-Linuxon Raspberry Pi - Raspberry Pi interfaces.

UNIT-V: IoT AND CLOUD COMPUTING

IoT physical servers & cloud computing-WAMP-Xively cloud for IoT- python Web application framework-Amazon web services for IoT.

UNIT-VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Bahga, A., &Madisetti, V. K. (2015). Internet of things: A hands-on approach. Universities Press.
2. Srinivasa, K. G., Siddesh, G. M., & Raju, R. H. (2018). Internet of things. Cengage Learning India.

REFERENCES:

1. Greengard, S. (2015). The Internet of things. MIT Press.
2. Tripathy, B. K., & Anuradha, J. (2017). Internet of things (IoT): Technologies, applications, challenges and solutions. CRC Press.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: Explain the basic concepts, characteristics, and architecture of IoT.

CO2: Identify IoT applications in various domains such as smart homes, cities, agriculture, and healthcare.

CO3: Describe IoT communication, management concepts, and related protocols.

CO4: Apply IoT design methodologies and specifications to develop IoT solutions.

CO5: Develop simple IoT applications using Python, Raspberry Pi, and cloud platforms

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	3	3	2	2	2	1	1	2	1	2	3	2	2	2	1	1.93
CO2	3	3	2	2	2	1	1	3	2	2	3	2	2	3	2	2.20
CO3	3	3	3	2	2	1	1	2	2	2	3	3	2	2	2	2.20
CO4	3	3	3	3	2	1	1	3	2	2	3	3	2	3	2	2.40
CO5	3	3	2	3	2	2	1	3	2	2	3	3	3	3	2	2.47
Average	3.0	3.0	2.4	2.4	2.0	1.2	1.0	2.6	1.8	2.0	3.0	2.6	2.2	2.6	1.8	2.24

3 - Strong, 2 - Medium, 1 – Low

SKILL ENHANCEMENT COURSE

Code: **3. CYBER SECURITY** **Credits: 2**
(Theory)

COURSE OBJECTIVES:

This course aims to:

- Understand the fundamental concepts of cyber security.
- Learn common cyber-attacks and security vulnerabilities.
- Gain knowledge of network and Internet security practices.
- Understand cyber laws, ethics, and digital safety measures.
- Develop awareness of cyber security tools and protection systems.

UNIT – I: INTRODUCTION TO CYBER SECURITY
Introduction to Cyber Security – Need for Cyber Security – Cyber Space – Cyber Threats – Cyber Crimes – Types of Cyber Attacks.

UNIT – II: CYBER ATTACKS AND MALWARE
Phishing – Spoofing – Social Engineering – Malware – Viruses – Worms – Trojans – Ransomware – Spyware.

UNIT – III: NETWORK AND INTERNET SECURITY
Network Security Basics – Firewalls – Intrusion Detection Systems – Password Security – Secure Browsing – Email Security.

UNIT – IV: DATA SECURITY AND PRIVACY
Data Protection – Data Encryption – Authentication and Authorization – Privacy Issues – Safe Use of social media.

UNIT – V: CYBER ETHICS AND CYBER LAWS
Cyber Ethics – Digital Footprints – Cyber Laws – Information Technology Act – Cyber Safety Best Practices.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):
Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Stallings, W., & Brown, L. (2024). *Computer security: Principles and practice* (5th ed.). Pearson.
2. Whitman, M. E., &Mattord, H. J. (2024). *Principles of information security* (8th ed.). Cengage Learning.

REFERENCES:

1. Easttom, C. (2022). *Computer security fundamentals* (5th ed.). Pearson.
2. Vacca, J. R. (2021). *Computer and information security handbook* (3rd ed.). Elsevier.
3. Hadnagy, C. (2021). *Social engineering: The science of human hacking* (2nd ed.). Wiley.
4. Brooks, C. J., Grow, C., Craig, P., & Short, D. (2022). *Cybersecurity essentials*. Wiley.

COURSE OUTCOMES

Upon successful completion of this course, students would be able to:

CO1: Explain the basic concepts of cyber security, threats, and cyber-crimes.

CO2: Identify common cyber-attacks affecting information systems.

CO3: Apply security measures to protect networks and systems.

CO4: Demonstrate awareness of data security, and safe Internet practices.

CO5: Explain cyber ethics, cyber laws, and best practices for responsible digital citizenship.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	3	2	2	2	2	1	1	2	1	2	3	2	2	2	1	1.87
CO2	3	3	2	2	2	1	1	2	1	2	3	3	2	2	1	2.00
CO3	3	3	3	3	2	1	1	2	2	2	3	3	2	3	1	2.27
CO4	3	3	2	3	3	1	1	2	2	2	3	3	2	3	2	2.33
CO5	2	3	2	2	3	2	2	2	2	3	2	2	2	2	3	2.27
Average	2.8	2.8	2.2	2.4	2.4	1.2	1.2	2.0	1.6	2.2	2.8	2.6	2.0	2.4	1.6	**2.15**

3 - Strong, 2 - Medium, 1 – Low

SKILL ENHANCEMENT COURSE

Code: **4. VIRTUAL REALITY AND AUGMENTED REALITY (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- To understand the basic concepts and evolution of Virtual Reality (VR) and Augmented Reality (AR).
- To identify the hardware and software components used in VR and AR systems.
- To understand the design and development aspects of VR and AR applications.
- To explore the current trends and future scope of immersive technologies.
- To examine the applications of VR and AR in various domains.

UNIT - I: INTRODUCTION TO VR AND AR

Definition and concepts of Virtual Reality and Augmented Reality – Types of VR and AR – History and evolution – Technology hype cycle.

UNIT - II: VR AND AR TECHNOLOGIES

VR and AR hardware – Head-mounted displays and controllers – Features and functionalities – Current challenges and adoption trends.

UNIT - III: DESIGN AND DEVELOPMENT OF VR AND AR

Consumer-grade VR and AR systems – Design principles for immersive environments – Planning and development of VR/AR applications.

UNIT - IV: FUTURE OF VR AND AR

Emerging trends in VR and AR – Social experiences in virtual environments – Future opportunities and challenges.

UNIT - V: APPLICATIONS OF VR AND AR

Applications in Education, Entertainment, Tourism, Retail, Healthcare, Real Estate, and Marketing – Mobile AR applications such as Google Translate, Amazon AR View.

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Jonathan Linowes, Augmented Reality for Developers: Build Practical Augmented Reality Applications with Unity, ARCore, ARKit, and Vuforia, 2nd Edition, Packt Publishing, 2023.
2. Tony Parisi, Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, 2nd Edition, O'Reilly Media, 2024.

REFERENCES:

1. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Addison-Wesley Professional, 2022.
2. Paul Mealy, "Virtual & Augmented Reality For Dummies" Published by: John Wiley & Sons, Inc., John Wiley & Sons, Inc., 2018.

COURSE OUTCOMES

Upon successful completion of the course, students will be able to:

CO1: Explain the fundamentals and evolution of VR and AR.
CO2: Identify the key hardware and software components of VR and AR.
CO3: Apply basic design principles for VR and AR applications.
CO4: Analyse VR and AR applications in various domains.
CO5: Evaluate current trends and future challenges in VR and AR technologies.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	3	2	2	2	1	1	1	2	1	1	3	2	2	2	1	1.73
CO2	3	3	2	2	1	1	1	2	1	2	3	2	2	2	1	1.87
CO3	3	3	3	3	2	1	1	2	2	2	3	3	2	3	1	2.27
CO4	2	3	3	2	2	1	1	2	2	2	2	3	2	3	2	2.13
CO5	3	3	2	3	2	1	1	3	2	2	3	3	2	3	2	2.33
Average	2.8	2.8	2.4	2.4	1.6	1.0	1.0	2.2	1.6	1.8	2.8	2.6	2.0	2.6	1.4	**2.07**

3 - Strong, 2 - Medium, 1 – Low

SKILL ENHANCEMENT COURSE

Code: **5. WEB TECHNOLOGY (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- understand the fundamentals of web technologies and web page creation.
- learn client-side scripting using JavaScript and VBScript.
- develop interactive web pages using Dynamic HTML (DHTML) and CSS.
- understand event handling and document object manipulation in web applications.
- learn XML and related technologies for data representation, validation, and transformation.

UNIT – I: HTML

Introduction–Outline of an HTML Document–Head Section– Body Section – HTML Forms.

UNIT – II: JAVA SCRIPT

Introduction – Language Elements – Objects of Java Script – Other Objects – Arrays

UNIT – III: VB SCRIPT

Introduction – Embedding VBScript Code in an HTML Document Comments –– Object and VB Script – Cookies.

UNIT – IV: DYNAMIC HTML(DHTML)

Introduction–Cascading Style Sheets(CSS) –DHTML Document Object Model and Collections–Event Handling.

UNIT – V: EXTENSIBLE MARK-UP LANGUAGE (XML)

Introduction –XML Document – XML Attributes – XML Validation – XML DTD – XSL

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. N.P. Gopalan and J. Akilandeswari, Web Technology – A Developer's Perspective, Prentice Hall of India Private Ltd, New Delhi, Second Edition, 2016.
2. C.Xavier, Web Technology and Design, NEW AGE; First edition, 2018

REFERENCES:

1. Steven M. Schafer, "HTML, XHTML, and CSS Bible", Wiley Publication, 2011
2. Keith Grant, "CSS in Depth", Manning Publication, 2018.
3. William Alvin Newton, Steven Webber, "Computer Programming JavaScript, Python, HTML, SQL, CSS", Independently Published, 2019.
4. Hasanraza ANSARI, "Learn VBScript", Independently Published, 2021.
5. https://www.geeksforgeeks.org/web-technology/

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: Create web pages using HTML elements, forms, and document structures.

CO2: Develop client-side scripts using JavaScript to create interactive web applications.

CO3: Apply VBScript constructs, procedures, and cookies in web development.

CO4: Design dynamic web pages using DHTML, CSS, and event handling techniques.

CO5: Create and validate XML documents and apply DTD and XSL transformations for data processing.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	3	2	2	3	1	1	1	2	1	1	3	2	2	3	1	1.87
CO2	3	3	2	3	1	1	1	2	1	2	3	3	2	3	1	2.07
CO3	3	2	2	3	1	1	1	2	1	2	3	2	2	3	1	1.93
CO4	3	3	3	3	2	1	1	2	2	2	3	3	2	3	1	2.27
CO5	3	3	3	3	2	1	1	2	2	2	3	3	3	3	2	2.40
Average	3.0	2.6	2.4	3.0	1.4	1.0	1.0	2.0	1.4	1.8	3.0	2.6	2.2	3.0	1.2	2.11

3 - Strong, 2 - Medium, 1 – Low

SKILL ENHANCEMENT COURSE

Code: **6. R PROGRAMMING** **Credits: 2**
(Theory)

COURSE OBJECTIVES:

This course aims to:

- understand the fundamentals of R programming and its applications.
- learn data structures such as matrices, data frames, and lists in R.
- develop R programs using control structures and statistical operations.
- perform data import, export, and management using files.
- create graphical visualizations for effective data analysis.

UNIT – I: INTRODUCTION TO R
Introduction to R – Features and Applications of R – RGui and RStudio – Creating and Managing Vectors – Vector Operations – Logical Vectors – Handling Missing Values and Basic Mathematical Functions.

UNIT – II: DATA STRUCTURES IN R
Character Vectors and String Manipulation – Factors – Matrices and Matrix Operations – Arrays – Data Frames – Lists and Basic Operations.

UNIT – III: CONTROL STRUCTURES AND FUNCTIONS
Conditional Statements (if, if-else, switch) – Loops (for, while) – Functions and Function Arguments – Basic Statistical Functions: Mean, Median, Mode, Correlation, and Covariance.

UNIT – IV: DATA HANDLING IN R
Importing Data from CSV and Excel Files – Exporting Data – Working with Files and Folders – Installing, Loading, and Updating R Packages.

UNIT – V: DATA VISUALIZATION
Box Plot – Scatter Plot – Line Chart – Pie Chart – Bar Chart – Introduction to Lattice Graphics.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):
Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. De Vries, A., &Meys, J. (2015). *R programming for dummies* (2nd ed.). Wiley India.
2. Grolemund, G. (2023). *Hands-on programming with R* (2nd ed.). O'Reilly Media.

REFERENCES:

1. Wickham, H., &Grolemund, G. (2023). *R for data science* (2nd ed.). O'Reilly Media.
2. Kabacoff, R. I. (2024). *R* in action: Data analysis and graphics with R (3rd ed.). Manning Publications.

COURSE OUTCOMES

Upon successful completion of this course, students would be able to:

CO1: explain the basic concepts of R programming.
CO2: apply matrices, arrays, data frames, and lists for data manipulation.
CO3: develop R programs using control structures and functions.
CO4: import, export, and manage data using files and R packages.
CO5: create and interpret graphical visualizations using R.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	3	2	2	2	1	1	1	2	1	1	3	2	2	2	1	1.73
CO2	3	3	2	3	1	1	1	2	1	2	3	3	2	3	1	2.07
CO3	3	3	3	3	1	1	1	2	1	2	3	3	2	3	1	2.13
CO4	3	3	2	3	2	1	1	2	2	2	3	3	2	3	1	2.20
CO5	3	3	3	3	2	1	1	3	2	2	3	3	3	3	2	2.47
Average	3.0	2.8	2.4	2.8	1.4	1.0	1.0	2.2	1.4	1.8	3.0	2.8	2.2	2.8	1.2	2.12

3 - Strong, 2 - Medium, 1 – Low

SKILL ENHANCEMENT COURSE

Code: **7. SHELL PROGRAMMING (Theory)** **Credits: 2**

COURSE OBJECTIVES

This course aims to:

- Understand the fundamentals of shell environments.
- learn essential Linux commands for file, directory, and process management.
- develop shell scripts using variables, control structures, and loops.
- analyse process scheduling and resource management techniques.
- perform system administration tasks related to user management, file systems, and system security.

UNIT – I: INTRODUCTION

Types of shells - Creating files – Listing files and directories – Masking file permissions – Directory permissions – access files, disk related commands - Directory related commands.

UNIT – II: ESSENTIAL COMMANDS

Introduction – Password – calendar – The banner command – The touch command – printouts – File compression – I/O redirection and piping

UNIT – III: PROCESSES

Introduction – Background processes – Killing a process – Changing processes priorities – Scheduling of processes.

UNIT – IV: SHELL PROGRAMMING INTRODUCTION

The first shell script – Interactive shell scripts – The if-then-fi statement – The if-then-else-fi statement – Nested if-else –Use of logical operators – Loops.

UNIT – V: SYSTEM ADMINISTRATION

Adding and removing users – Disk management – Formatting a disk – Making a file system – Mounting a file system – Unmounting a file system – Using a raw disk – Monitoring system usage – Ensuring system security – Providing assistance to users.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Yashavant P. Kanetkar, “Unix Shell Programming”, BPB Publications, New Delhi, 2003.
2. Wood, Patrick H., and Kochan, Stephen G. UNIX Shell Programming. United Kingdom, Sams, 2003.

REFERENCES:

1. Parker, Steve. Shell Scripting Tutorial. United States, Createspace Independent Pub, 2014.
2. Tansley, D. S. W., and Tansley, David V. Linux and UNIX Shell Programming, Addison-Wesley, 2000.
3. Newham, Cameron, and Rosenblatt, Bill. Learning the Bash Shell: Unix Shell Programming, O'Reilly Media, 2005.
4. Wood, Patrick, and Kochan, Stephen G. Shell Programming in Unix, Linux and OS X: The Fourth Edition of Unix Shell Programming. United Kingdom, Pearson Education, 2016.

COURSE OUTCOMES

Upon successful completion of this course, the students would be able to:

CO1: explain shell concepts and perform file and directory management operations.
CO2: apply Linux commands for create and explore files.
CO3: analyse and manage processes using scheduling and priority control mechanisms.
CO4: develop shell scripts using decision making and looping constructs.
CO5: perform basic system administration tasks including system security.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean CO
CO1	3	2	2	2	1	1	1	2	1	1	3	2	2	2	1	1.73
CO2	3	3	2	2	1	1	1	2	1	2	3	2	2	2	1	1.87
CO3	3	3	3	2	1	1	1	2	1	2	3	2	2	2	1	1.93
CO4	3	3	3	3	2	1	1	2	2	2	3	3	2	3	1	2.27
CO5	3	3	2	3	3	2	1	2	2	2	3	3	2	3	2	2.40
	3.0	2.8	2.4	2.4	1.6	1.2	1.0	2.0	1.4	1.8	3.0	2.4	2.0	2.4	1.2	2.04

3 - Strong, 2 - Medium, 1 – Low

Year: First **INTERDISCIPLINARY COURSE 1** **Semester: I**

Code: **FUNDAMENTALS OF INFORMATION TECHNOLOGY (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- Understand the fundamental concepts and evolution of computers.
- Learn the components of computer systems.
- gain knowledge of software, operating systems, and database systems.
- understand computer networks, the Internet, email, and web technologies.
- explore applications and computer security concepts.

UNIT – I:
Introduction to Computers – Generation of Computers – Classification of Digital Computer - Anatomy of Digital Computer.

UNIT – II:
CPU and Memory – Secondary Story Devices – Input Devices - Output Devices.

UNIT – III:
Introduction to Computer Software – Programming Language – Operating System – Introduction to Database Management System.

UNIT – IV:
Computer Networks - WWW and Internet – Email – Web Design

UNIT – V:
Computers at Home, Education, Entertainment, Science, Medicine and Engineering - Introduction to Computer Security - Computer Viruses, Bombs, Worms.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):
Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Alexis Leon and Mathews Leon, Fundamentals of Information Technology, Vikas Publishing House Pvt. Ltd, 2009
2. Fundamentals of Computers and Information Technology, M.N Doja,2005

REFERENCES:

1. Ramesh Bangia,"ComputerFundamentals and Information Technology", Laxmi Publications Pvt Limited, 2008.
2. Bharihoke, "Fundamentals of Information Technology", Excel Books, 2009.
3. Ralph Stair, George Reynolds, "Fundamentals of Information Systems" Cengage Learning, 2015

COURSE OUTCOMES

Upon successful completion of this course, students will be able to:

CO1: Explain the basic concepts, generations, classifications, and architecture of computers.
CO2: Describe the functions of CPU, memory, input devices, output devices, and storage devices.
CO3: Explain computer software, programming languages, operating systems, and database management systems.
CO4: Demonstrate knowledge of computer networks, the Internet, email, and web design concepts.
CO5: Analyse the applications of computers and identify common security threats such as viruses, worms, and malware.

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	3	3	2	2	2	1	1	2	1	2	3	2	2	2	1	1.9
CO2	3	3	2	2	2	1	1	3	2	2	3	2	2	3	2	2.2
CO3	3	3	3	2	2	1	1	2	2	2	3	3	2	2	2	2.2
CO4	3	3	3	3	2	1	1	3	2	2	3	3	2	3	2	2.4
CO5	3	3	2	3	2	2	1	3	2	2	3	3	3	3	2	2.5
Average	3.0	3.0	2.4	2.4	2.0	1.2	1.0	2.6	1.8	2.0	3.0	2.6	2.2	2.6	1.8	**2.3**

3 - Strong, 2 - Medium, 1- Low

Year: First **INTERDISCIPLINARY COURSE 2** **Semester: II**

Code: **WORKING PRINCIPLES OF INTERNET (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- Understand the fundamentals and architecture of the Internet.
- Learn various methods of Internet connectivity and online communication.
- Explore the World Wide Web and common Internet tools.
- Understand multimedia, e-commerce, and intranet applications.
- Gain awareness of Internet security and safe online practices.

UNIT – I: INTRODUCTION TO THE INTERNET

Basics of Internet – Internet Architecture – Basic Internet Services.

UNIT – II: INTERNET CONNECTIVITY AND COMMUNICATION

Connecting to the Internet – Internet Service Providers – E-mail – Online Communication Tools.

UNIT – III: WORLD WIDE WEB

How the World Wide Web Works – Web Browsers – Search Engines – Common Internet Tools.

UNIT – IV: INTERNET APPLICATIONS

Multimedia on the Internet – Intranet – E-Commerce and Online Shopping.

UNIT – V: INTERNET SECURITY

Internet Security Basics – Safe Browsing Practices – Cyber Threats – Privacy and Data Protection.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOK

1. Xavier, C. (2021). Fundamentals of Internet and emerging technologies (1st ed.). New Age International Publishers.

REFERENCES

1. Comer, D. E. (2018). The Internet book: Everything you need to know about computer networking and how the Internet works (5th ed.). CRC Press.
2. Fox, R., & Hao, W. (2017). Internet infrastructure: Networking, web services, and cloud computing. CRC Press.

COURSE OUTCOMES

Upon successful completion of this course, students will be able to:

CO1: Explain the basic concepts and architecture of the Internet.

CO2: Use Internet services and communication tools effectively.

CO3: Demonstrate the use of the World Wide Web and common Internet tools.

CO4: Apply Internet-based services such as multimedia applications and online shopping.

CO5: Identify Internet security threats and adopt safe online practices.

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	2	3	2	2	2	2	1	1	1	1	2	3	2	2	1	1.8
CO2	3	3	2	2	2	2	1	1	2	2	3	3	3	3	2	2.3
CO3	3	3	3	1	2	3	2	3	3	2	3	2	2	2	1	2.3
CO4	3	3	3	3	3	2	2	3	1	2	3	3	3	3	2	2.6
CO5	3	3	1	3	2	3	1	2	2	3	3	3	2	2	2	2.3
Average	2.8	3.0	2.2	2.2	2.2	2.4	1.4	2.0	1.8	2.0	2.8	2.8	2.4	2.4	1.6	2.3

3 - Strong, 2 - Medium, 1 – Low

Year: Second **INTERDISCIPLINARY COURSE 3** **Semester: III**

Code: **DIGITAL MARKETING (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- Understand the fundamentals of digital marketing and e-business.
- Learn the components of the online marketing mix.
- Explore digital media channels and online promotional strategies.
- Analyse online consumer behaviour and website characteristics.
- Evaluate digital branding concepts and brand performance metrics.

UNIT – I: INTRODUCTION TO DIGITAL MARKETING

Digital Marketing – Transition from Traditional Marketing to Digital Marketing – Growth of E-Concepts – Growth of E-Business.

UNIT – II: ONLINE MARKETING MIX

Online Marketing Mix – E-Product – E-Promotion – E-Price – E-Place.

UNIT – III: DIGITAL MEDIA CHANNELS

Digital Media Channels – Search Engine Marketing (SEM) – Electronic Public Relations (ePR) – Affiliate Marketing – Interactive Display Advertising.

UNIT – IV: ONLINE CONSUMER BEHAVIOR

Online Consumer Behavior – Factors Influencing Online Consumers – Cultural Implications of Key Website Characteristics**.**

UNIT – V: DIGITAL BRAND ANALYSIS

Digital Brand Analysis – Meaning – Benefits – Components – Brand Share Dimensions – Brand Audience Dimensions.

UNIT – VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Chaffey, D., & Ellis-Chadwick, F. (2024). Digital marketing: Strategy, implementation and practice (9th ed.). Pearson Education.
2. Ryan, D. (2024). Understanding digital marketing: Marketing strategies for engaging the digital generation (6th ed.). Kogan Page.

REFERENCES:

1. Kingsnorth, S. (2022). Digital marketing strategy: An integrated approach to online marketing (3rd ed.). Kogan Page.
2. Tuten, T. L., & Solomon, M. R. (2024). Social media marketing (5th ed.). Sage Publications.

COURSE OUTCOMES

Upon successful completion of this course, students will be able to:

CO1: Explain the concepts of digital marketing, e-business, and online business models.

CO2: Apply the online marketing mix elements in digital business environments.

CO3: Analyse the role of digital media channels and online promotional strategies.

CO4: Evaluate online consumer behaviour and website characteristics influencing customer decisions.

CO5: Assess digital brand performance using brand share and audience dimensions.

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	2	3	2	2	2	2	1	1	1	1	2	3	2	2	1	1.8
CO2	3	3	2	2	2	2	1	1	2	2	3	3	3	3	2	2.3
CO3	3	3	3	1	2	3	2	3	3	2	3	2	2	2	1	2.3
CO4	3	3	3	3	3	2	2	3	1	2	3	3	3	3	2	2.6
CO5	3	3	1	3	2	3	1	2	2	3	3	3	2	2	2	2.3
Average	2.8	3.0	2.2	2.2	2.2	2.4	1.4	2.0	1.8	2.0	2.8	2.8	2.4	2.4	1.6	2.3

3 - Strong, 2 - Medium, 1 – Low

Year: Second **INTERDISCIPLINARY COURSE 4** **Semester: IV**

Code: **INTRODUCTION TO DATA SCIENCE (Theory)** **Credits: 2**

COURSE OBJECTIVES:

This course aims to:

- Understand the fundamental concepts& applications of Data Science.
- Identify various types of data and perform data preparation tasks.
- Apply visualization techniques to explore data.
- Understand the fundamentals of data-driven decision making.
- Recognize ethical, privacy &societal issues associated with Data Science.

UNIT - I: INTRODUCTION TO DATA SCIENCE

Overview of Data Science – Data Science Lifecycle – Types of Data – Data Sources – Role of Data Science in Business, Healthcare, Education, Agriculture, and Social Media – Data-Driven Decision Making.

UNIT - II: DATA COLLECTION AND PREPARATION

Data Acquisition – Structured, Semi-Structured, and Unstructured Data – Data Cleaning – Data Transformation – Handling Missing Data – Data Quality and Data Preparation.

UNIT - III: DATA VISUALIZATION AND EXPLORATORY ANALYSIS

Data Exploration – Descriptive Statistics – Data Visualization Techniques – Charts, Graphs, Dashboards – Introduction to Visualization Tools and Storytelling with Data.

UNIT - IV: FUNDAMENTALS OF MACHINE LEARNING

Introduction to Artificial Intelligence and Machine Learning – Supervised and Unsupervised Learning – Classification and Clustering Concepts – Applications of Machine Learning.

UNIT - V: DATA SCIENCE APPLICATIONS AND ETHICS

Applications of Data Science in Various Domains – Data Privacy and Security – Ethical Issues in Data Science – Responsible AI – Future Trends in Data Science.

UNIT - VI: CURRENT CONTOURS (Self-directed learning activities for Continuous Internal Assessments Only):

Contemporary Developments Related to the Course during the Semester Concerned.

RECOMMENDED BOOKS:

1. Igual, L., &Seguí, S., Introduction to data science: A Python approach to concepts, techniques and applications. Springer, 2017.
2. Joel Grus, *Data Science from Scratch: First Principles with Python*, Second Edition, O'Reilly Media, 2019.

REFERENCES:

1. Rafael A. Irizarry, *Introduction to Data Science: Data Analysis and Prediction Algorithms with R*, Second Edition, CRC Press, 2023.
2. Chirag Shah, A Hands-On Introduction to Data Science, Cambridge University Press, 2020.
3. Cathy O'Neil and Rachel Schutt, Doing Data Science: Straight Talk from the Frontline, O'Reilly Media, Updated Edition, 2023.

COURSE OUTCOMES

Upon successful completion of the course, the students would be able to:

CO1: Explain the fundamental concepts, processes, and applications of Data Science.
CO2: Identify different types of data and perform data collection and pre-processing tasks.
CO3: Apply data visualization methods to explore and interpret data.
CO4: Describe the basic principles of machine learning and data-driven decision making.
CO5: Analyse the ethical, societal implications of Data Science in real-world applications.

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	Mean COs
CO1	3	3	2	2	2	1	1	2	1	2	3	2	2	3	2	2.07
CO2	3	3	3	2	2	1	1	3	2	2	3	3	2	3	2	2.33
CO3	3	3	3	3	2	1	1	3	2	2	3	3	2	3	2	2.40
CO4	3	3	3	3	2	1	1	3	2	2	3	3	3	3	2	2.47
CO5	2	3	3	3	3	2	1	2	2	2	2	3	3	3	2	2.40
Average	2.8	3.0	2.8	2.6	2.2	1.2	1.0	2.6	1.8	2.0	2.8	2.8	2.4	3.0	2.0	**2.33**

3 - Strong, 2 - Medium, 1 – Low