PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE

(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE

UNDERGRADUATE PROGRAMME

THREE YEAR BACHELOR'S DEGREE IN COMPUTER SCIENCE / FOUR YEAR

HONOURS IN COMPUTER SCIENCE

2025-2026

PO's of the Institution :

PO-1	Enhancement of Knowledge and Lifelong Learning
PO-2	Multidisciplinary Approach and Adaptability
PO-3	Vocational Skills and Research Aptitude
PO-4	Ethics and Social Responsibility

PSO's for BSc Computer Science:

PSO-1	Understand and apply the fundamental knowledge in core areas of Computer Science.
PSO-2	Demonstrate proficiency in different programming paradigms needed for Problem Solving.
PSO-3	Develop verified, tested, efficient and secure computerized solutions to real world problems through the application of principles in Computer Science and current technologies.
PSO-4	Ability to engage and contribute to providing socially responsible design, environment friendly solutions, adapting professional ethics in the broader context of technological change.

COURSE STRUCTURE

DEPARTMENT OF COMPUTER SCIENCE						
S E M	Major subject/ discipline (3T+1P)	Minor Stream (Disc./Voc) (3T+1P)	(MDC for Others) (2T + 1P)	VAC (2 credits)	SEC (2T+1P)	INTE NSHI
I	UG-COM-101 Introduction to Programming	UG-COM-101 Introduction to Programming	UG-COM-MD C	UG-COM-VAC	UG-COM-SEC	
			UG-COM-MD C			
II	UG-COM-102 Database Management Systems	UG-COM-102 Database Managemer Systems	UG-COM-MD C	UG-COM-VAC	UG-COM-SEC	
			UG-COM-MD C			
III	UG-COM-201: Data Structures	UG-COM-207: Foundations of Data Science with Python	UG-COM-MD C		UG-COM-SEC	
	UG-COM-202: Object Oriented Programming					
IV	UG-COM-203: Computer Architecture and Operating System	UG-COM-VOC-1: Mobile Application Development				
	UG-COM-204:					

	Mathematical Foundations for Computer Science					
	UG-COM-205: Web Development with php					
	UG-COM-206: Software Engineering					
V	UG-COM-301: Full Stack Development	UG-COM-VOC -2: Digital Marketing				Interns p (4 credit
	UG-COM-302: Advanced DBMS	UG-COM-VOC -3: Internet of Things				
	UG-COM-303: Computer Networ					
VI	UG-COM-304: Data Science	UG-COM-VOC -4:Software Testing(voc)				
	UG-COM-305: Cloud Computing					
	UG-COM-306: Artificial Intelligence					
	UG-COM-PRJ: Project					
VII	UG-COM-401: Design and Analysis of Algorithms	UG-COM-VOC -5: Image Processing				
	UG-COM-402: Software					

	Architecture, Design Patterns ar Frameworks					
	UG-COM-403: Information Retrieval					
	UG-COM-404: Machine Learning and Deep Learnin					
VIII	UG-COM-406: Compiler Design	UG-COM-VOC -6: Network Security				
	UG-COM-407: Advanced Operating System	UG-COM-VOC -7: Educational Technology				
	UG-COM-408: NLP					
	UG-COM-409: Parallel Computin					

Note : SEC will be offered from the pool of approved syllabus.

SEC Pool

Sr. No.	**Course Code and Title**
1	UG-COM-SEC 1 - Programming with R
2	UG-COM-SEC 2 - Programming in Python
3	UG-COM-SEC 3 - UI/UX Design
4	UG-COM-SEC 4 - E-Commerce
5	UG-COM-SEC 5 - Graphic Design
6	UG-COM-SEC 6 - Front End Web Development

MDC Pool

Sr. No.	Course Code and Title
UG-COM-MDC1	Office Automation
UG-COM-MDC2	Introduction to Python Programming
UG-COM-MDC3	E-Learning
UG-COM-MDC4	R Programming
UG-COM-MDC5	Fundamentals of Data Analysis
UG-COM-MDC6	Multimedia
UG-COM-MDC7	Fundamentals of Human-Computer Interaction
UG-COM-MDC8	Web Design
UG-COM-MDC9	Document Development and Data Analysis
UG-COM-MDC10	Technology in Teaching and Learning

VAC Course :

Sr. No.	Course Code and Title
UG-COM-VAC1	Cyber Security
UG-COM-VAC2	Cyber Fraud Prevention and Response
UG-COM-VAC3	Design Thinking

Courses to be offered to Double Major Students

Semester	First Major Discipline Core	Second Major Discipline Core (3T+1P)
I		**UG-COM-101** Introduction to to Programming
II		**UG-COM-102** Database Management
III		**UG-COM-201:**Data Structures **UG-COM-202:** Object Oriented Programming
IV		***** **UG-COM-203:** Computer Architecture an Operating System **UG-COM-204:** Mathematical Foundations for Computer Science **UG-COM-205:** Web Development with ph **UG-COM-206:** Software Engineering
V		**1 Core Course**
VI		**1 Core Course + 1 VOC course**
Total	**48**	**36**

*** For Semester IV Double Major students to mutually decide on two courses that they would like to opt for.**

SEMESTER I

DISCIPLINE SPECIFIC CORES
Revised Syllabus
(To be implemented w.e.f. Acad. Year 2024 - 2025)

Course Title: Introduction to Programming
Course Code: UG-COM-101
Credits: 3
Marks: 75

Course Objectives :

- To understand the concept of basic computer algorithm and flowchart and use the algorithm for various problem solving.
- To implement algorithms using a high level programming language.
- To understand basic principles of structured programming –example C.

Course Learning Outcome:

Upon completion of the course students will be able to:

CLO1: Understand problem solving strategies.
CLO2: Draw a flowchart and write an algorithm for a given problem.
CLO3: Apply programming constructs such as loops, decision-making, functions, arrays, and strings in developing programs that meet specified requirements.
CLO4: Implement programming concepts including structures, pointers, and file handling to develop applications that address real-world scenarios.

Module I **[10 HRS]**

Introduction to Computer Problem Solving : Algorithms, Flowchart, The Problem-Solving Aspect, General problem-solving strategies, Top-Down Design, Implementation of Algorithms, Efficiency of Algorithms, Recursive algorithms.

Basic Algorithms : Exchanging the values, Summation of a set of numbers, factorial computation, generation of the Fibonacci series, reversing the digits of an integer, base conversion.

Factoring Methods : Finding divisors of an integer, finding the Greatest Common Divisor of two integers, generating prime numbers, computing prime factors of an integer.

Module II **[20 HRS]**

C Language : History, Structure of a C program, Keywords, Identifiers, variables, constants, data types, Arithmetic Operators & Expressions, Logical operators and Relational Operators, Precedence and Associativity rules.

Conditions and Iterations : Conditions and Actions, Condition statement, Simple control statement (if, if-else,switch), Iterative control statements (for, while, do-while).

Functions : What is a function, Advantages of functions, Standard library functions; User define functions – declaration, definition, function call, parameter passing, return keyword. Scope of variables, Storage classes, Recursion.

Arrays : One- and Two-dimensional arrays: Array declaration, initialization, accessing the values, passing arrays to functions.

Pointers : Pointer declaration, initialization, Pointer arithmetic, Pointer to Pointer, Arrays and Pointers, Functions and Pointers – passing pointers to functions, function returning pointer, dynamic memory allocation.

Module III **[15 HRS]**

Strings : Declaration and initialization, standard library string functions, strings and pointers, array of strings.

Structure and Union : Creating structures, accessing structure members, array of structures, passing structure to functions, nested structure, pointers and structures, union, difference between structures and unions.

File Handling : FILE variable, file access modes, operations on files, random access to files, command line arguments.

Pre-processing : Format of Preprocessor directive, File Inclusion directive, Macro substitution, conditional compilation.

Practical: Introduction to Programming

Credit: 1

Marks: 25

Duration: 30 Hrs

Programs using C language that covers the following concepts:

1. Conditions **(1P)**
   - if..else
   - nested if

2. Iterative Control Statements **(2P)**
   - for
   - while
   - do…while

3. Functions. **(2P)**
   - Standard Library functions
   - Call by Value
   - Call by reference
   - Recursive functions

4. Arrays. **(2P)**
   - One Dimensional Arrays
   - Two Dimensional Arrays

5. Pointers. **(2P)**
   - Arrays and Pointers
   - Function returning pointers
   - Dynamic memory allocation

6. Strings. **(2P)**
   - Standard Library string functions
   - Strings and Pointers
   - Array of Strings

7. Structure and Union **(2P)**
   - Array of structures
   - Passing Structure to functions
   - Nested structure
   - Structure and Pointer
   - Union

8. File Handling. **(2P)**
   - Text file

- Binary file
- Random Access to a file
- Command Line arguments

REFERENCE BOOKS:

MANDATORY:

1. Dromey, R. G. (1982). How to Solve it by Computer. Prentice-Hall, Inc..
2. Kanetkar,Y. (2012). Let us C, BPB Publications,
3. Forouzan, B. A., & Gilberg, R. F. (2000). Computer Science: A structured programming approach using C. Brooks/Cole Publishing Company..

SUPPLEMENTARY:

1. Horowith,E.,Sahni ,S.,Sanguthevar,R. (2008). Fundamentals of Computer algorithm, Orient Longman.
2. Gottfried,B. (2010). Programming with C, Tata McGraw Hill.

WED REFERENCES:

1. GNU GCC (GNU Compiler Collection) @http://gcc.gnu.org, with source codes.
2. Bjarne Stroustrup's C++11 FAQ @http://www.stroustrup.com/C++11FAQ.html.
3. https://www.tutorialspoint.com/cprogramming
4. https://www.javatpoint.com/c-programming-language-tutorial
5. https://www.w3schools.in/c-tutorial/
6. https://www.guru99.com/c-programming-tutorial.html
7. https://www.geeksforgeeks.org/c-programming-language/
8. E Book - https://www.edutechlearners.com/download/books/Let%20Us%20C%20by%20Yashavant%20Kanetkar%20PDF.pdf
9. E Book - http://www2.cs.uregina.ca/~hilder/cs833/Other%20Reference%20Materials/The%20C%20Programming%20Language.pdf
10. E Book - http://www.kciti.edu/wp-content/uploads/2017/07/cprogramming_tutorial.pdf

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SEMESTER II

Course Title: Database Management Systems - I
Course Code: UG-COM-102
Marks: 75
Credits: 3
Duration: 45 Hrs
Course Prerequisite: Nil

Course Objectives:

- To provide basic knowledge of a database management system.
- To understand the importance of Entity Relationship diagram.
- To formulate queries in Relational Algebra and SQL for Database manipulation.
- Familiarity with any RDBMS during practical sessions.

Course learning outcomes:

Upon completion of the course students will be able to:

CLO-1: Explain the fundamental concepts of database systems, including data models, database languages, and database design
CLO-2: Design and model a database using Entity-Relationship diagrams.
CLO-3: Formulate queries in Relational Algebra, and SQL to create and manipulate the databases.
CLO-4: Apply Normalization techniques to databases to eliminate data redundancy and ensure data integrity.

SYLLABUS

Module I: Overview of DBMS, Design and ER model. [15 HRS]

Overview of database management : Data, information, database, database management system; Managing data; File systems versus a DBMS, advantages of a DBMS; Data abstraction, instances and schemas, data models; Data manipulation language, data definition language; Architecture of a DBMS; Users of a DBMS, database administrator.

Database design and the ER model: Design phases – conceptual design, logical design, physical design; ER model – entities, attributes, and relationships, mapping cardinalities, keys; ER diagrams – strong entities, weak entities, generalization,

specialization, aggregation; Converting ER diagram to relational schemes.

Module II : Functional dependency and normalization [10 HRS]

Atomic domain, nested relation; Key, super key, primary key, candidate key; Functional dependency, axioms, closure of a set of attributes, closure of a set of functional dependencies; Purpose of normalization; 1NF; 2NF;3NF; BCNF.

Module III : Relational model and SQL [20 HRS]

Relational model: Relation, properties of relational model; Entities, integrity constraints, referential integrity constraints; Relational algebra – select, project, cross product, set operations, rename operation; Other relational operations – natural join, outer join.

SQL: Basic structure of SQL query – Create, select, where, from, rename operation; Set operations; Aggregate functions; Group by, having clauses; DDL Nested queries; Views; Insert, delete, update.

Practical: Database Management Systems - I
Credit :1
Marks :25
Duration: 30 Hrs

1. ER diagram (2P)
2. ER diagram with specialization/generalization and aggregation. (1P)
3. Converting ERD into Schema. (2P)
4. SQL (2P)
5. Nested Queries (2P)
6. Normalization (2P)
7. Mini Project (4P)

REFERENCES

MANDATORY:

1. Silberschatz, A. (2006). Database system concepts.—6th ed.

SUPPLEMENTARY:

1. Ramakrishnan, R., & Gehrke, J. (2000). Database management systems. McGraw Hill.
2. Elmasri, R., & Navathe, S. (2017). Fundamentals of database systems. Pearson.

WEB BASED:

1. https://www.db-book.com/db6/slide-dir/ (Sixth edition Powerpoint , PDF of A Silberschatz, H F Korth, S Sudarshan, Database system concepts,)
2. https://www.db-book.com/db7/
3.https://www.tutorialspoint.com › dbms
4.https://www.w3schools.in › dbms
5.https://www.studytonight.com › dbms
6.https://www.oracletutorial.com

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SEMESTER III

DISCIPLINE SPECIFIC COURSES

(Revised Syllabus to be offered to students taking admissions to Second Year BSc-Computer Science in the Academic Year 2025 - 2026)

Course Title: Data Structures (CORE : THEORY)
Course Code: UG-COM-201
Semester : III
Credits: 3
Marks: 75
Duration : 45 hours

Course Prerequisites: Nil

Course Objectives :

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques.
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To understand writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

Course Learning Outcome:

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

CLO1: Understand and apply core concepts of data structures, such as lists, stacks, queues, trees, and graphs, including their implementation and operations.

CLO2 : Describe and compute space and time complexity for basic algorithms and apply sorting and searching techniques to solve simple problems.

CLO3 : Illustrate and implement basic operations on binary search trees, AVL trees, and graphs, and explain their usage in solving specific computational tasks.

CLO4 : Apply fundamental data structures to implement basic solutions in computational applications.

Module I: **[15 HRS]**

Introduction to data structures: Concept, Data type, Data object, ADT, Need of Data Structure, Types of Data Structure.

Algorithm Analysis: Algorithm – definition, characteristics, Space complexity, time complexity, Asymptotic notation (Big O).

Review on Arrays: Definition, Operations (Access, Insertion, Deletion, Traversal), Multidimensional Arrays, Applications of Arrays.

LinkedList:

Introduction to List, Types of Linked List, Operations on List, Applications of Linked List, Implementation of List – static & dynamic representation, polynomial manipulation, Generalized linked list – concept & representation.

Module II **[15 HRS]**

Stacks:

Introduction, Representation-static & dynamic, Operations

Stack Applications:

Application - infix to postfix & prefix, postfix evaluation, Simulating recursion using stack.

Queues:

Introduction, Representation -static & dynamic, Operations, Circular queue, priority queue (with implementation), Concept of doubly ended queue, Applications: CPU Scheduling, Printer Queue.

Trees:

Concept & Terminologies, Binary tree, binary search tree, Representation – static & dynamic, Operations on BST – create, Insert, delete, traversals (preorder, inorder, postorder), counting leaf, non-leaf & total nodes, non recursive inorder traversal, Expression Tree. Introduction to AVL Trees.

Module III **[15 HRS]**

M-Way Search Trees: Introduction, B Tree, B+ Tree.

Searching and Sorting:

Searching Algorithms: Linear Search, Binary Search, Complexity Analysis of Searching Algorithms.

Use of various data structures for searching and sorting, selection sort, merge sort, quick sort, heap sort, Comparison of Sorting Algorithms (Time and Space Complexity).

Hashing : Hashing: Hash Functions, Hash Tables, Collision Handling: Chaining, Open Addressing, Applications of Hashing: Hash Map.

Graph:
Concept & terminologies, Graph Representation – Adjacency matrix, adjacency list, Traversals – BFS & DFS, Application of BFS, DFS, Backtracking.

Course Title: Data Structures (CORE : PRACTICAL)
Course Code: UG-COM-201
Semester : III
Credits : 01
Marks : 25
Duration : 30 hours

List of Experiments:

Programs using C / Java language that covers the following concepts:

1. **Implement a singly linked list with fundamental operations.** *(2)*
    - Implement node creation, insertion (beginning, end, specific position), deletion, and traversal.
    - **Use Case :** Develop a program to store and manage student records (Name, Roll Number, Marks).
2. **Implement a Doubly linked list** *(2)*
    - Implement forward and backward traversal, insertion, and deletion at different positions.
    - **Use Case:** Used in browser history (back/forward navigation), music players, and scheduling applications.
3. Represent polynomials using linked lists and perform addition of two polynomials. (1)
4. Implement Stack and push, pop, peek, and isEmpty operations. (1)
5. Convert an infix mathematical expression to postfix notation using a stack. (1)
6. Evaluate a postfix expression using a stack. (1)
7. Implement Queue and perform enqueue, dequeue, front, and isEmpty operations. (1)
    - **Use Case :** Implement Movie Ticket Booking Queue
8. Implement a BST with fundamental operations. *(1)*
9. Implement preorder, inorder, and postorder traversals in BST. (1)
10. Represent a graph using adjacency matrix and adjacency list. *(2)*
11. Implement **Graph Traversal** (DFS & BFS). *(2)*
    - **Use Case :** Develop a social network graph, where nodes represent users and edges

represent friendships.

REFERENCES:

Mandatory Reading:

1. Horowitz,E., Sahni,S. (2008). Fundamentals of Data Structures in C, University Press.

Supplementary Reading

1. LangsamYedidyah, Augenstein J. Moshe, Tenenbaum M.A aron ,(2018),Data Structure using C, Pearson Education.
2. Richard.G, Behrouz.F, Data Structures: A Pseudocode Approach with C, Cengage Learning.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms
2. https://www.w3schools.in/data-structures-tutorial
3. https://www.programiz.com/dsa
4. https://www.geeksforgeeks.org/data-structures/
5. https://www.javatpoint.com/data-structure-tutorial

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Course Title: Object Oriented Programming (CORE: THEORY)
Course Code: UG-COM-202
Semester: III
Marks: 75
Credits: 3
Duration: 45 hours

Course Prerequisites: Nil

Course Objectives:

- To teach the basic concepts and techniques which form the object oriented programming paradigm.
- To introduce object oriented programming (OOP) using Java.

Course Outcomes:

Upon completion of the course students will be able to:

CLO-1: Apply fundamental object-oriented concepts in problem solving.

CLO-2: Identify classes, their members and relationships between them.

CLO-3: Implement the object oriented model in any object oriented language.

CLO-4: Develop applications to solve real world problems.

SYLLABUS:

Module I: Introduction [15 HRS]

Principles of OOP: Programming paradigms. Basic concepts in OOP. OOP: major principles - encapsulation, abstraction, inheritance, polymorphism. Benefits of OOP. Applications of OOP.

Introduction to Java : Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, java.Math class, Arrays in java.

Module II Principles of OOP [15 HRS]

Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, object serialization, Inbuilt classes like String, Character, String Buffer, File, this reference.

Inheritance and Polymorphism: Inheritance in java, Super and subclass, Overriding, java.lang. Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, java.util package.

Module III: Exceptions, Multi-threading and GUI programming: [15 HRS]

Event and GUI programming: Design patterns – what and why? It's classification. Introduce the Observer design pattern. Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout.

Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle.

Multithreading in java: Multithreading in java, Thread life cycle and methods, Runnable interface, Thread synchronization.

Exception handling: Exception handling – what and why? Try and catch blocks. Multiple catch blocks. Nested try, finally block, throw keyword, throw keyword. Custom Exception. Introduction to the Collections Framework.

Course Title: Object Oriented Programming (CORE: PRACTICAL)
Course Code: UG-COM-202
Semester: III
Marks: 25
Credits: 1
Duration: 30 hours

List of Practical Work:

1. **Classes and Instances (2 hours)**

    - Create classes with attributes and methods.
    - Instantiate objects from those classes.
    - Demonstrate different object states using constructor methods.

2. **Working with the java.Math class (2 hours)**

- Use methods from the java.lang.Math class, such as Math.pow(), Math.sqrt(), Math.random(), and others.
- Implement a program that calculates the area of a circle or solves quadratic equations.

3. **Inheritance (2 hours)**

    - Create a base class and derived classes.
    - Demonstrate method overriding and constructor chaining.
    - Show how inheritance allows reuse and extension of existing classes.

4. **Composition vs. Inheritance (2 hours)**

    - Implement a problem using inheritance and then refactor the same problem using composition.
    - Compare the advantages and limitations of both approaches.

5. **Polymorphism, Abstract Classes, and Interfaces (2 hours)**

    - Implement polymorphic behavior by overriding methods in subclasses.
    - Use abstract classes to define common behavior.
    - Demonstrate interface usage for contract-based programming.

6. **Algorithm and Data Structures (2 hours)**

    - Implement simple algorithms like sorting (e.g., Bubble Sort) and searching (e.g., Binary Search).
    - Work with basic data structures like arrays, linked lists, and stacks.

7. **Utilizing the java.util Package (2 hours)**

    - Use commonly used utility classes like ArrayList, HashMap, and LinkedList.
    - Perform operations such as adding, removing, and retrieving elements from collections.

8. **Event Handling and GUI (2 hours)**

    - Create a GUI application using components such as buttons, labels, text fields.
    - Implement event handling for user interactions like mouse clicks or keyboard input.
    - Use layout managers to arrange components in the window.

9. **I/O Programming (4 hours)**

    - Implement file reading and writing using Java I/O streams (e.g., FileReader, BufferedReader).
    - Work with file handling in various formats like text files and CSV files.

10. **Exception Handling (4 hours)**

- Implement try-catch blocks to handle exceptions.
- Demonstrate custom exceptions.
- Practice exception chaining and multi-level exception handling.

11. **Multi-threading (4 hours)**

- Create threads using Thread class or Runnable interface.
- Synchronize threads to avoid conflicts while accessing shared resources.
- Demonstrate the lifecycle of a thread (start, run, and finish).

12. **Collections Framework (2 hours)**

- Work with different collection classes like ArrayList, HashSet, and HashMap.
- Perform operations such as sorting, filtering, and iterating through collections.

REFERENCES:

MANDATORY:

Deitel, P., & Deitel, H. (2011). Java How to program. Prentice Hall Press.

SUPPLEMENTARY:

1. Naughton.P, Schildt.H, (2000), Java 2 – The Complete Reference TMH publications

2. Patrick,N. (1997). The Java Handbook –TMH publications

3. Mughal, K. A., & Rasmussen, R. W. (2003). A programmer's guide to Java certification:

A comprehensive primer. Addison-Wesley Professional.

4. Flanagan, D. (2004). Java examples in a nutshell.

5. Arnold, G., H.(2005)"The Java Programming Language" Addison-Wesley Professional.

WEB BASED:

1. www.javapoint.com

2. www.tutorialspoint.com

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SEMESTER IV

DISCIPLINE SPECIFIC CORES

Course Title: Computer Architecture and Operating Systems
Course Code: UG-COM-203
Marks: 75
Credits: 3
Duration: 45 Hrs

Course Prerequisites: Nil

Course Objectives:

- Study of Processor architecture, memory and I/O subsystems including basic Assembly Language Programming.
- To Understand the Basic objectives, functions and types of Operating System
- To study various aspects of operating system like Process Management, Memory
- Management, Storage management etc.
- To understand different algorithms used for CPU scheduling, Memory allocation.

Course Outcomes:
Upon completion of the course students will be able to:

CLO1: Classify and explain the function of various modules of the modern computer system and their communication.
CLO2: Identify the functions of operating system
CLO3: Analyze the process, its states and process scheduling algorithms
CLO4 :Explain deadlocks and synchronization, memory management, and disk scheduling. .
CLO5: Implement Assembly Language Program and Shell Script for a given task.
CLO6: Implement algorithm of CPU Scheduling, Memory Scheduling.

SYLLABUS:

Module I: Computer System and Components: [20 HRS]

Processor:Function and structure of a computer, Interconnection of components, Performance of a computer. Computer Architecture – Princeton (Von Neumann) and Harvard architecture.Architecture of 8086 processor - Registers, ALU and Control unit, Data path in a CPU.Instruction cycle, Organization of a control unit – Block Diagram of Hardwired andMicroprogrammed control unit. Instruction set architectures – CISC and RISC architectures. Memory Subsystem: Characteristics of memory system, the memory hierarchy, Semiconductormemories, Types of ROM & RAM, Cache memory unit.
Input/Output Subsystem: General block diagram of External device and I/O module, Programmed I/O, Interrupt driven I/O, DMA, I/O channels and I/O processors.

Module II: Operating system overview and Process Management [15 HRS]

Overview: Operating system Objectives and Functions, Evolution of operating system, major achievements.

Process Management: Process Definition, Process Control Block, Process States, Operations on Process; Interprocess communication, Process Scheduling, Scheduling Criteria, Scheduling Algorithms, Process Coordination: Process Synchronization, Principles, Mutual Exclusion, The Critical-Section Problem, Peterson's Solution.

Deadlocks- system models, Deadlock characterization, Deadlock Handling Methods, Prevention, Avoidance, Detection, Recovery from Deadlock.

Module III: Memory Management and Storage Management [10HRS]

Memory Management: Introduction, Swapping, Contiguous Memory Allocation, Paging, PageTable, Segmentation, Virtual Memory: Introduction, Demand Paging, Page Replacement, Allocation of Frames, Thrashing

Secondary Storage Structure : Overview, disk structure, Disk attachment, Disk scheduling.

Practicals: Computer Architecture and Operating Systems
Credit: 1
Marks: 25
Duration: 30 Hrs

1. Study of Motherboard, Peripherals and the Computer System:O.S. Installation (DualBoot): BIOS; Manage disk partitions: understand MBR-style partitions, (primary, extended, logical); list/create/delete partitions; Manage logical volumes: create/remove physical volumes, create/delete logical volumes, Boot loader.Installation of drivers; updating softwarepackages DOS Commands, Tools for Computer Management (Disk Management, Disk Cleanup, Defragmentation, Performance Monitor, System Restore etc). [1]

Assembly language programs for 8086 using MASM / compatible assembler or Simulator, either in Windows or Linux.

1. Study of addressing modes. [1]
1. Programs for data transfer and arithmetic operations and logical operations [1]
2. Study of Basic commands of Linux [1]
3. Shell Programming in Unix/Linux, arithmetic operations, loops. [1]
4. .Shell Programming – advanced [1]
5. Filters and Pipes in LINUX. [2]
6. Implementation of Inbuilt Linux/UNIX commands like cp, rename etc. [1]
7. Implementation of CPU scheduling policies. [1]
8. 10.Implementation of Memory allocation Techniques. [1]

REFERENCES:

MANDATORY:

1. Stallings, W. (2003). Computer organization and architecture: designing for performance. Pearson Education India.
2. Silberchatz, A., Galvin, ,& Gagne. (2008). Operating System Concepts (8th ed.). Wiley publication.

SUPPLEMENTARY:

1. Stallings, W. (2001). Operating systems: Internals and design principles.(6th ed.). Upper Saddle River, N.J: Prentice Hall.
2. David A. Patterson and John L. Hennessy (2021), Computer Organization and Design: The Hardware/Software Interface, Elsevier
3. Douglas V. Hall, (2012), Microprocessors and its Interfacing, McGraw Hill Education (India) Private Limited
4. Sumitabha Das , UNIX Concepts and Applications, Tata McGraw-Hill

WEB BASED:

1. http://williamstallings.com/ComputerOrganization/
2. https://www.tutorialspoint.com/computer_fundamentals/index.htm
3. https://www.geeksforgeeks.org/operating-systems/

Video Links and Animations

1. 4.https://www.youtube.com/watch?v=WP3uDglbPiI
1. 5.http://williamstallings.com/OS-Animation/Animations.html
2. 6.Linux Tutorials for Practical
3. 7.https://www.tutorialspoint.com/unix/index.htm

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Course Title: Mathematical Foundations for Computer Science
Course Code: UG-COM-204
Marks: 75
Credits: 3
Duration: 45 Hrs

Course Prerequisites: Basic Knowledge of Programming.

Course Objectives:
- To introduce students to the fundamental concepts of systems of linear equations and matrices.
- Enable students to be able to apply mathematical principles to solve real-world problems.

Course Outcomes:
Upon completion of the course students will be able to:

CLO-1: Represent and solve linear systems using matrices.
CLO-2: Demonstrate competence in working with linear transformations and explain their applications in various contexts.
CLO-3: Define and work with vector spaces, subspaces, and basis, emphasizing their role in computer graphics and linear algebra applications.
CLO-4: Compute eigenvalues and eigenvectors of matrices, particularly in the context of data analysis, machine learning, and optimization.
CLO-5: Apply interpolation methods to estimate values between data points and analyze their accuracy.
CLO-6: Use matrices and vectors to model and solve real-world problems

SYLLABUS:

Module I: Systems of Linear Equations and Matrices, Linear Combinations and Linear Independence [10 HRS]

Matrices and its representations, Types of Matrices, Matrix Operations, The Inverse of a Square Matrix, Matrix Equations, Elementary Row Operations, Applications of Matrices in Computer Science, Adjoint of matrix and Rank.

Systems of Linear Equations, Applications of Systems of Linear Equations, Linear Combinations and Linear Independence. Linear Dependence and Consistency of Systems.

Module II: Vector Spaces, Linear Transformations, Eigenvalues and Eigenvectors [15 HRS]

Definition of a Vector Space, Subspaces, Basis and Dimension, Coordinates and Change of Basis Linear Transformations, The Null Space and Range, Isomorphisms, Matrix Representation of Linear Transformations, Similarity. Eigenvalues and Eigenvectors, Diagonalization.

Module III: Interpolation, Numerical Integration, algebraic and transcendental equation [20 HRS]

Introduction; Various methods of interpolation; Various methods of curve fitting; Newton's method of forward interpolation formula; Newton's method of backward interpolation formula. Lagrange's formula.
General quadrature formula; Trapezoidal rule; Simpson's one-third rule; Simpson's three-eighth rule; Weddle's rule.

Graphical method; Bisection method; Method of false position; Secant method; Newton-Raphson method. Linear equations; Characteristics roots and vectors.

Practicals: Mathematical Foundation of Computer Science
Credit: 1
Marks: 25
Duration: 30 Hrs

Programs using Java language that covers the following concepts:

1. Implementing Matrices **(1P)**
2. Performing Basic Matrix Operations. **(1P)**
3. Performing Elementary Row operations **(1P)**
4. Finding the rank of a matrix. **(1P)**
5. Finding solutions of a system of equations using Matrices. **(1P)**
6. Matrix Representation of Linear Transformations. **(1P)**
7. Finding the Eigenvalues and Eigenvectors. **(1P)**
8. Implementing Newton's forward formula to estimate a value. **(1P)**
9. Implementing Newton's backward formula to estimate a value. **(1P)**
10. Estimate a value using Lagrange's formula. **(1P)**
11. Apply Simpson's three-eighth rule to find the value of integration. **(2P)**
12. Apply Newton-Raphson method OR secant method to estimate the root of a equation **(2P)**

REFERENCES:

MANDATORY:

1. Iyengar,S.N.,(2010) Matrices, Anmol Publications.
2. Defranza, J., & Gagliardi, D. (2015). Introduction to Linear Algebra with applications. Waveland Press.
3. Goel,B., & Mittal,S. (1998) Numerical Analysis, Pragati Prakashan,

SUPPLEMENTARY:

1. Chatterjee,P. (1996) Numerical Analysis, RajhansPrakashanMandir.
2. Krishnamurthy,V. (1976) Introduction to Linear Algebra, Affiliated East-West Press.

WEB BASED:

1.https://www.cse.iitb.ac.in
2. https://www.wolframalpha.com/
2. https://www.khanacademy.org/
3. https://web.stanford.edu/class/cs357/

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Course Title: Web Development with PHP
Course Code: UG-COM-205
Marks: 75
Credits: 3
Duration: 45 Hrs

Course Prerequisites: Basic Knowledge of HTML and CSS, Programing and Database Management.

Course Objectives:

- To Provide students with a foundational understanding of web development and the role of PHP and MySQL in building dynamic websites.
- Enable students to create dynamic web pages using PHP, including displaying data from a database, processing user input, handling sessions and generating dynamic content.
- Cover user authentication and authorization mechanisms to secure web applications, including user registration and login systems.

Course Outcomes:
Upon completion of the course students will be able to:

CLO-1: Understand the fundamentals of PHP, including syntax, variables, data types, operators, and control structures, and set up a local development environment for PHP web development.
CLO-2: Establish and manage connections between PHP and MySQL databases, handling potential errors effectively and executing CRUD operations.
CLO-3: Design and develop user authentication systems in PHP and apply best practices in web development security
CLO-4: Implement a complete dynamic Web Application using php.

SYLLABUS:

Module I : Introduction to PHP [15 HRS]
Introduction to PHP- PHP syntax and basics, Setting up a local development environment.
PHP Variables, Data types (integers, strings, arrays), Operators (arithmetic, comparison, logical). Control Structures-Conditional statements (if, else, switch), Loops (for, while, foreach). Functions and Includes - Defining and using functions, Including external files.

Module II : Database Connectivity with PHP [15 HRS]
MySQL Database Basics - Creating databases and tables, Data types and constraints. Connecting to MySQL - PHP database connections, Error handling for database connections. CRUD Operations with PHP and MySQL - SELECT, INSERT, UPDATE, DELETE operations, Prepared statements for security.

Module III : Building Dynamic Web Pages using best practices in security [15 HRS]
Form Handling with PHP - Creating HTML forms, Processing form data with PHP. Displaying Database Data - Retrieving and displaying data from the database, Pagination and sorting. User Authentication -

Building user registration and login systems, Password hashing and security. Security and Best Practices - Input validation and sanitation, Cross-site scripting (XSS) and SQL injection prevention.

Practicals : Web Development with php
Credit : 1
Marks : 25
Duration: 30 Hrs

List of suggested PRACTICALS :

1. Set up a local development environment for PHP web development and configure it. **(1P)**
2. Define and utilize functions in PHP, and incorporate external files into PHP scripts using includes. **(2P)**
3. Establish connections between PHP and MySQL databases and handle potential errors effectively during database interactions. **(2P)**
4. Create HTML forms for user input and develop PHP scripts to handle form submissions securely. **(2P)**
5. Conduct CRUD (Create, Read, Update, Delete) operations with PHP and MySQL, involving the retrieval, insertion, updating, and deletion of data. **(2P)**
6. Implement prepared statements to enhance security and prevent SQL injection vulnerabilities in PHP and MySQL interactions. **(2P)**
7. Design and build user registration and login systems, applying password hashing and security measures for user authentication. **(2P)**
8. Mini Project **(2P)**

REFERENCES:
MANDATORY:
1. Larry Ullman. (2018). "PHP and MySQL for Dynamic Web Sites." Peachpit Press.
2. Janet Valade. (2016). "PHP 7 for Dummies." For Dummies.
3. Robin Nixon. (2018). "Learning PHP, MySQL & JavaScript." O'Reilly Media.

SUPPLEMENTARY:
1. Luke Welling and Laura Thomson. (2016). "PHP and MySQL Web Development." Addison-Wesley.
2. Chris Snyder, Michael Southwell, and Tom Myer. (2005). "PHP Security." O'Reilly Media.
3. Bryan Sullivan and Vincent Liu. (2011). "Web Application Security, A Beginner's Guide." McGraw-Hill Education.

WEB BASED:
1. https://www.php.net/
2. https://www.w3schools.com/php/
3. https://phptherightway.com/
4. https://www.tutorialrepublic.com/php-tutorial/php-mysql-crud-application.php
5. https://www.geeksforgeeks.org/how-to-design-username-and-password-using-html-and-php/

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Course Title: Software Engineering
Course Code: UG-COM-206
Marks: 75
Credits: 3
Duration: 45 Hrs

Course Prerequisites: Nil

Course Objectives:

- To understand the various software development methodologies and estimation of software projects.
- To analyze and design software projects.
- To study the various phases of a S/W Development Project.

Course Outcomes:
Upon completion of the course students will be able to:

CO1: Understand the various Software Development Methodologies.
CO2: Apply Estimation techniques to live projects.
CO3: Analyze Software Projects.
CO4: Design Software Projects.

SYLLABUS:

Module I: **[15 HRS]**
SOFTWARE PROCESS:
Characteristics of software process.
Software Development Processes and Methodologies: waterfall, prototyping, iterative, spiral, unified process. Benefits of iterative and incremental approach with emphasis on Unified process, CASE Tools, Agile methodologies.

PROJECT MANAGEMENT:
Planning a Software Project – Cost estimation, Project Scheduling, Software configuration management plans, Quality Assurance plans, Project Monitoring plans and Risk Management.
Techniques such as Interviewing, Requirement Workshop, brainstorming, prototyping. Characteristics of SRS.

Module II: **[15 HRS]**
OOAD and UML:
OOAD: Definition; object oriented analysis; object oriented design and modeling; Assigning responsibilities.

UML: Main UML diagrams – Class diagram, sequence diagram, activity diagram, use case diagram.
Use case model – use case diagram, use case descriptions, use case realization using sequence and activity diagrams. Supplementary requirements. Advanced use case model features.

Requirements: Functional and non-functional
System Design : Class diagram, sequence diagram, activity diagram, state chart diagram, deployment diagram. Brief introduction to other UML diagrams.

SOFTWARE ARCHITECTURE PATTERNS:
Major Architectural Styles (patterns) like Layered Architecture, Pipe and Filter, Shared (Central)Data Store, Event Driven, Model-View-Controller (MVC), "Distributed & Emerging" Service Oriented Architecture (SOA) and Elementary GRASP Patterns.

Module III **[15 HRS]**

HUMAN COMPUTER INTERACTION:
HCI Definition; User categories, Interface Design-Internal & External Interface design, user interface design, Interface design guidelines.

CODING:
Coding styles, standards, peer reviews, checklist.

TESTING:
Testing Fundamental, Functional Testing, Structural Testing, Testing Object-Oriented Programs, Testing Process and Metrics.

DOCUMENTATION and MAINTENANCE:
Need for Software Documentation. Types of documentation, Need for Maintenance; Types of Maintenance.

REENGINEERING:
Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering, The Economics of Reengineering.

Practicals : Software Engineering
Credit : 1
Marks : 25
Duration: 30 Hrs

List of suggested PRACTICALS :

For a given project/case study

1) Requirements Gathering Techniques	[2P]
2) Gantt Chart	[2P]
3) USE Case diagram and Use Case descriptions for the Use Cases	[3P]
4) Class Diagram	[2P]
5) Sequence Diagram	[2P]
6) Activity Diagram	[2P]
7) State Chart Diagram	[2P]

REFERENCES:

MANDATORY:

1. Pressman, R. S. (2005). Software engineering: a practitioner's approach. Palgrave Macmillan.
2. Larman C.,(2015) Applying UML and patterns. Addison Wesley.
3. Bourque, P., & Fairley, R. E. (2014). Guide to the software engineering body of knowledge (SWEBOK (R)): Version 3.0. IEEE Computer Society Press.

SUPPLEMENTARY:

1.Jalote, P. (2012). An integrated approach to software engineering. Springer Science & Business Media.
2. Sommerville I.,(2015) Software Engineering .Adison Wesley.
3. Fowler, M. (2003). UML Distilled: A Brief Guide to the Standard Modelling Object Language. Object Technology Series, 3rd edition, Addison-Wesley.

WEB BASED:

1.https://www.tutorialspoint.com/software_engineering
2.https://www.w3schools.in/sdlc-tutorial
3.https://www.geeksforgeeks.org/software-engineering
4.https://www.javatpoint.com/software-engineering-tutorial

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SEMESTER V

Course Title: Full-Stack Development (CORE : THEORY)
Course Code: UG-COM-301
Semester : V
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: UG-COM-102 Database Management, UG-COM-201: Data Structures, UG-COM-202: Object Oriented Programming, UG-COM-SEC 6 - Front End Web Development or Equivalent.

Course Objectives :

- Understanding JavaScript Fundamentals
- Advanced Front-End Development with React.js
- Implementing Responsive Design with CSS Frameworks
- Building Back-End Applications with Node.js and Express.js
- Integrating Databases in an Application

Course Learning Outcome:

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

CLO1: Build dynamic and responsive user interfaces using React.js,

CLO2: Effectively managing state and component lifecycle with React Hooks and Routing.

CLO3: Develop and deploy back-end applications using Node.js and Express.js, implementing efficient routing, middleware, and error handling.

CLO4: Integrate various types of databases (relational and NoSQL) into web applications, ensuring data integrity and optimized performance.

CLO5: Develop and deploy applications using Node.js.

Module I **[20 HRS]**

Introduction to JavaScript : DOM Structure and Navigation, Selecting and Manipulating DOM Elements, Event Handling and Delegation, Introduction to the Event Loop and Asynchronous JavaScript ES6+ Features (let/const, arrow functions, promises), Asynchronous JavaScript (AJAX, Fetch API)

Advanced Front-End Development (React.js Basics): Components, Props, State, JSX Syntax, React Hooks such as useState, useEffect, useParam.

Responsive Design and CSS Frameworks : Responsive Design Techniques, CSS Frameworks like Bootstrap or Tailwind CSS or Material.

Module II **[15 HRS]**

Advanced Back-End Development (Node.js and Express.js Basics): Setting Up Express.js, Middleware, Routing

Introduction to Node.js: Node.js Architecture and Event-Driven Programming, Node.js Core Modules (CORS, Express, File System, HTTP, Mysql2, Bcrypt).

Database Integration and Testing : Using ORM such as Prisma and Integrating with relational, no sql and object relational databases such as Mysql, MongoDB and PostgreSQL.

Module III **[10 HRS]**

Introduction to Next.js: Overview of Next.js and its benefits, Differences between Next.js and traditional React apps, Setting up a Next.js project, File-based routing in Next.js

Pages and Routing: Dynamic routes and nested routes, Link component and client-side navigation, Layouts and the _app.js and _document.js files, Pre-rendering and Static Generation vs. Server-side Rendering (SSR), Introduction to getStaticProps and getServerSideProps, Client-side navigation with the Link component

API Routes and Data Fetching : Creating and structuring API routes, Fetching data from APIs and using it in pages

Authentication: Setting up authentication with NextAuth.js, Securing pages with basic authentication, Managing sessions and tokens. Security and Ethical Considerations: Best practices for securing user data and maintaining privacy.

Deployment : Preparing a Next.js app for production. Environmental Impact of Deployment: Discussing cloud service options with a focus on sustainability.

Course Title :Full-Stack Development (CORE - PRACTICAL)
Course Code **:** UG-COM-301
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

React Practical Exercises

1. Create a Simple React Component *(1)*
2. Build a Component with Props *(1)*
3. Implement State Management with useState *(1)*
4. Fetch and Display Data with useEffect *(1)*
5. Set Up React Router for Navigation *(1)*
6. Develop a Controlled Form with Submission Handling *(1)*

Node.js and Express.js Practical Exercises

1. Set Up a Basic Express.js Server *(1)*
2. Create Multiple Routes with Express.js *(1)*
3. Implement Custom Middleware and Error Handling *(1)*
4. Handle Form Data Submission with Express.js *(1)*
5. Connect to a MySQL Database and Perform CRUD Operations *(1)*

Next.js Practical Exercises

1. Building a Simple Next.js Application *(1)*
2. Data Fetching and API Routes *(1)*
3. Authentication and Securing Pages *(1)*
4. Deploying a Next.js Application *(1)*

WED REFERENCES:

JavaScript Fundamentals:

1. **MDN Web Docs: JavaScript Guide**
   https://developer.mozilla.org/en-US/docs/Web/JavaScript/Guide
2. **MDN Web Docs: Document Object Model (DOM)** -
   https://developer.mozilla.org/en-US/docs/Web/API/Document_Object_Model/Introduction
3. **Event Handling and Asynchronous JavaScript:-**
   https://developer.mozilla.org/en-US/docs/Web/Events

React.js Basics:

1. React Official Documentation - https://reactjs.org/docs/getting-started.html
2. JavaScript.info: React Components - https://javascript.info/react-components

Responsive Design and CSS Frameworks:

1. MDN Web Docs: Responsive Design Basics -
   https://developer.mozilla.org/en-US/docs/Learn/CSS/CSS_layout/Responsive_Design

2. Bootstrap Documentation - https://getbootstrap.com/docs/5.0/getting-started/introduction/
3. Tailwind CSS Documentation - https://tailwindcss.com/docs
4. Material-UI Documentation - https://mui.com/getting-started/installation/

Node.js Basics:

1. Node.js Official Documentation https://nodejs.org/en/docs/guides/getting-started-guide/
2. Express.js Official Documentation - https://expressjs.com/en/starter/installing.html

Database Integration:

1. Prisma Documentation - https://www.prisma.io/docs
2. MySQL Official Documentation - https://dev.mysql.com/doc/
3. MongoDB Documentation - https://docs.mongodb.com/
4. PostgreSQL Official Documentation - https://www.postgresql.org/docs/

Next.js Development

1. Next.js Official Documentation - https://nextjs.org/docs
2. Next.js: File-based Routing - https://nextjs.org/docs/routing/introduction
3. Next.js: Data Fetching - https://nextjs.org/docs/basic-features/data-fetching
4. Next.js: API Routes - https://nextjs.org/docs/api-routes/introduction
5. NextAuth.js Documentation - https://next-auth.js.org/getting-started/introduction
6. Next.js: Deployment - https://nextjs.org/docs/deployment

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Course Title: Advanced DBMS (CORE : THEORY)
Course Code: UG –COM- 302
Semester : V
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: UG-COM-102 Database Management or Equivalent

Course Objectives :

- To understand and formulate complex queries.
- To understand the need for Stored Procedures and Functions
- To understand indexing and hashing techniques.
- Explore transaction management and concurrency control.
- Analyze and Implement NoSQL and Object Relational Databases.

Course outcome:
Upon completion of the course students will be able to:

CLO1: Formulate and execute advanced SQL queries, utilizing complex joins, subqueries, stored procedures, and functions to efficiently manipulate and retrieve data from relational databases.

CLO2: Analyze and compare various indexing and hashing techniques, assessing their effectiveness in optimizing database performance.

CLO3: Evaluate and implement different concurrency control mechanisms and their implications for transaction management and data integrity.

CLO4: Understand the various types of NoSQL and Object-Relational Databases, including their architectures and use cases, enabling informed decision-making for database selection.

CLO5: Design and develop a full database application using either RDBMS or NoSQL databases, tailored to meet specific application requirements and business cases.

Module I: Advanced SQL [20 HRS]

SQL data types and schemas, Integrity constraints and user privileges, Authorization, Embedded SQL, Dynamic SQL, Triggers, Stored Procedures, views .

Indexing and Hashing

Basic concepts of indexing, Ordered Indices - Dense and Sparse Indices. B and B+ trees. Hashing – Static hashing, Dynamic Hashing, Extendable hashing. Performance comparison of Ordered Indexing and Hashing techniques.

Module II : **Transaction, Concurrency Control, Recovery System. [10 HRS]**
Transaction concepts – definition, state, atomicity and durability.
Concurrency Control – Lock-Based Protocols. Deadlock detection and resolution strategies.
Recovery System – Types of failures and their classification, Stable storage implementation, Log-Based Recovery and its importance in maintaining atomicity.

Module III: **Introduction to Big data , NoSQL and Object Relational Database [15 HRS]**
Introduction to the Big Data problem - current challenges, trends, and applications. Comparison between SQL and NOSQL Databases. Overview of different NoSQL database types - Column, Document, Key-value, Graph, Multi-model. MongoDB – introduces concepts of Collections, documents, queries, advantages, data types, projections, indexing, and sharding. Introduction to Object Relational Database – Focus on PostgreSQL and its features.

Course Title :Advanced DBMS (CORE - PRACTICAL)
Course Code **:** UG-COM-302
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:
1. SQL Revision *(1)*
2. Advanced SQL- Dynamic SQL, Triggers, Advance SQL- Stored Procedures. *(3)*
3. Using ODBC API for CRUD operations on RDBMS *(2)*
4. Installing and creating a document using MongoDB *(1)*
5. Different types of Queries and Aggregation in MongoDB. *(2)*
6. CRUD operations on MongoDB using any frontend and backend framework. *(1)*
7. PostgreSQL**:** Basic setup and features. *(2)*
8. Mini Project: Application of concepts learned throughout the course in a practical project.*(3)*

Mandatory Reading:

1.A Silberschatz, H F Korth, S Sudarshan, Database system concepts, McGraw-Hill ,sixth Edition

Supplementary Reading

Ramakrishan, J Gehrke, ―Database management systems", McGraw-Hill , 3rd edition R Elmasri, S B Navathe, ―Fundamentals of database Systems", Pearson Education , 5th Edition Kristina Chodorow MongoDB : The Definitive Guide (English) O'Reilly 2nd Edition.

Web References

1. https://www.geeksforgeeks.org/dbms/
2. https://www.w3schools.in / dbms
3. https://www.mongodb.com
4. https://www.w3schools.com/mongodb/
5. https://www.postgresql.org/

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Course Title: Computer Networks (CORE : THEORY)
Course Code: UG –COM- 303
Semester : V
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: Nil

Course Objectives :

- To understand the basic concepts of Computer Networking.
- To understand the layered architecture of computer networks.
- To understand various transmission media used for networking.
- To understand the working of various protocols in different layers.

Course outcomes:

Upon completion of the course students will be able to:

CLO1: Understand the need for Network and various layers of OSI and TCP/IP reference models.

CLO2: Explain various Data Communications media, network topologies and Switching methods.

CLO3: Describe various Data link Layer Protocols.

CLO4: Differentiate between various Classless and Classful IP addresses with Subnetting concept.

CLO5: Analyze and interpret various Network and Transport Layer protocols.

CLO6: Explain different application layer protocols.

Module I **[20 HRS]**

Introduction

Basics of Computer Networks, Classification: transmission technology, scale; Applications; Data Communications: data, signal, bandwidth, bit interval and bit rate, Modes of Communication. Layered network architecture, Networks models: OSI model, TCP / IP protocol suite; Guided and Unguided Transmission media, Multiplexing: FDM, TDM. Switching: Circuit switching, message switching, Packet Switching.

Data link layer

Data link control: Framing: Character Count, Character Stuffing, Bit Stuffing; , Error Detection and correction, Flow and error control, HDLC; Multiple access: Random access – Controlled

access, ALOHA, CSMA, CSMA/CD and CSMA/CA; Ethernet : IEEE standards, standard Ethernet, Fast Ethernet, Gigabit Ethernet.

Module II **[15 HRS]**

Network layer

Connecting devices: repeater/hub, bridge, router and gateway, Backbone networks - Virtual LANS. Functions of Network layer; Network Service types: Virtual Circuits, Datagrams; Logical addressing: IPv4, private and public IP addressing, special IP addresses, subnetting, IPV6 addressing Internet Protocol: Internetworking:IPv4, Fragmentation and reassembly , Address mapping : ARP, RARP, BOOTP, DHCP, ICMP . Routing: classification of routing, Shortest path routing, Distance Vector routing, Link State routing;

Module III: Transport layer, Application layer and Wireless network **[10HRS]**

Transport layer**:** Process-to-Process delivery: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Quality of services (QoS)

Application Layer: Domain Name System (DNS), E-mail, FTP, HTTP.

Basics of Wireless Networking

Course Title :Computer Networks (CORE - PRACTICAL)
Course Code : UG-COM-303
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. Setting Up a LAN Network and Ethernet Cabling *(2P)*
2. IP address manipulation -Extract network id and Host id given netmask *(2P)*
3. Configuring routing tables *(2P)*
4. TCP Socket programming *(2P)*
5. UDP Socket programming *(2P)*
6. Simulation of IP fragmentation *(2P)*
7. Mini Project / Packet Capturing tool (wireshark or equivalent) *(3P)*

REFERENCES:

Mandatory Reading:

1. Tanenbaum A., W.(2010) Computer Networks (5th ed.) . Pearson Education.

Supplementary Reading:

1. Behrouz A. Forouzan B.(2017) Data communication and Networking(5th ed.). McGraw Hill Education
2. Kurose J, K.(2017) Computer Networking – A Top-Down Approach (6th ed.) Pearson Education,
3. Mir N. (2006) Computer and Communication Networks, Prentice Hall Publishers.

Web References:

1. https://www.youtube.com/watch?v=tj7f244tubM
2. https://www.youtube.com/watch?v=vFypCugyFoM
3. https://www.geeksforgeeks.org/computer-network-tutorials/
4. Slides of the Book . Andrew S. Tanenbaum, David J. Wetherall"Computer Networks", Prentice-Hall, 5thEdition.: https://www.pearson.com/us/higher-education/product/Tanenbaum-Power-Point-Lecture-Slides-for-Computer-Networks-5th-Edition/9780132127066.html?tab=downloadable-resources
5. https://www.tutorialspoint.com/data_communication_computer_network/index.htm
6. https://www.cisco.com › training-events › netacad › course _catalog › docs
7. Slides for the book Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw – Hill, 2011, 4thEdition: http://www.mhhe.com/engcs/compsci/forouzan/dcn/index.mhtml

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SEMESTER VI

Course Title: Data Science (CORE : THEORY)
Course Code: UG-COM-304
Semester : VI
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: UG-COM-101 Introduction to Programming or Equivalent

Course Objectives :

- Understand the foundational concepts of data science.
- Develop practical skills in data processing, analysis, and visualization.
- Apply machine learning techniques to real-world data problems.

Course learning outcomes:

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

CLO1: Explain the fundamental concepts of data science and interpretation using visualization.

CLO2: Apply Statistical Techniques for Data Analysis.

CLO3: Develop and Evaluate Machine Learning Models**.**

CLO: Apply Data Science Techniques to Real-World Problems.

Module I: Fundamentals of Data Science and Data Visualization. [10 HRS]

Introduction to Data Science: Overview and importance of data science. The data science lifecycle. Types of data analysis. Roles and responsibilities in data science.

Data Pre-processing: Introduction to data pre-processing, Data types and forms, Possible data type errors, Various data pre-processing operations: Data cleaning, Data integration, Data transformation, Data reduction, Data Discretization.

Data Plotting and Visualization: Introduction to data visualization. Visual encoding, Data visualization libraries, Basic data visualization tools, Specialized data visualization tools, Advanced data visualization tools, visualization of geospatial data, tools used for geospatial data, data visualization types.

Module II: Statistical Analysis and Supervised machine learning. [20 HRS]

Statistical Data Analysis: Role of statistical in data science, kinds of statistics: descriptive statistics, inferential statistics, Probability theory: Conditional Probability, Dependent/Independent events, Random variables, Multiplication rule of probability, Bayes theorem, Sample space, Expected values, Standard errors, Monte Carlo simulation, Four perspective on probability, Bayesian probability, Probability distribution.

Supervised machine learning: Regression methods: Linear regression, Polynomial regression, Logistic regression. Classification methods: KNN classification, Support Vector Machine(SVM), Decision tree classification, Random Forest classification, Naïve Bayes classification.

Module III: Unsupervised machine learning and Time Series Analysis [15 HRS]

Unsupervised machine learning: Clustering methods**:** K-means**,** Fuzzy c-means clustering**,** Principle Component Analysis(PCA) clustering: Covariance, Correlation, Eigenvalue and Eigenvector, PCA, Chi-square test.

Time-Series Analysis: Overview of time-series analysis, Components of time-series, Time-series forecasting models.

Data Science and Ethical Issues:
Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists

Course Title :Data Science (CORE - PRACTICAL)
Course Code **:** UG-COM-302
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. **Data Collection, Cleaning and Pre-processing a raw dataset.** ***(2P)***
    a. Obtain a dataset from an open data repository (e.g., Kaggle, UCI Machine Learning Repository).
    b. Identify and handle missing data, outliers, and noise.
    c. Apply techniques such as data rescaling, normalization, and standardization.
- **Tools**: Python, Pandas, NumPy.

2. **Data Visualization Techniques** ***(2P)***
    a. Generate various plots, including histograms, bar charts, scatter plots, box plots, and heatmaps.
    b. Customize plots with titles, labels, legends, and colors.

c. Analyze how visualization techniques can highlight data insights.

- **Tools**: Python, Matplotlib, Seaborn, Tableau (optional)

3. **Statistical Analysis of a Dataset** ***(3P)***
   a. Mean, Median, and Mode: For central tendency.
   b. Variance and Standard Deviation: For variability.
   c. Skewness and Kurtosis: To understand the distribution shape.
   d. Formulate null and alternative hypotheses for a real-world problem.
   e. Conduct T-tests, chi-square tests, and ANOVA.
   f. Probability Distribution.

- **Tools**: Python, SciPy, Statsmodels.

4. **Supervised Learning** ***(3P)***
   a. Train a Linear regression model on a dataset to predict a continuous variable.
   b. Evaluate model performance using metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared.
   c. Visualize the regression line and residuals.
   d. Implement and evaluate a logistic regression model for binary classification.
   e. Implement and evaluate a K-Nearest Neighbors (KNN) model for classification,

- **Tools**: Python, Scikit-learn, Matplotlib.

5. **Unsupervised Learning – Clustering** ***(3P)***
   a. Implement the K-means clustering algorithm on a dataset.
   b. Choose the optimal number of clusters using the elbow method.
   c. Visualize the clusters and interpret the results.
   d. To implement and evaluate a Random Forest model for both classification and regression tasks.

- **Tools**: Python, Scikit-learn, Matplotlib, Seaborn.

6. **Basic Time-Series Plotting** *(2P)*
   a. Use a dataset with a time component (e.g., daily stock prices, monthly sales data).
   b. Plot the time series using line graphs to identify trends, seasonality, and outliers.
   c. Observe and describe any apparent patterns or anomalies.

- **Tools**: Python (matplotlib, pandas), R (ggplot2).

REFERENCES

Mandatory Reading:

1. Nandi, G., Sharma, R. K. (2020). Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next (English Edition). India: Bpb Publications.

Supplementary Reading:

1. Jure.L,, Anand. R,Jeffrey.U(2014). Mining of Massive Datasets v2.1(2nd ed.).Cambridge University Press.
2. Kevin P. Murphy,(2012).Machine Learning: A Probabilistic Perspective .MIT Press.

1. Provost, F., & Fawcett, T. (2013). Data Science for Business: What you need to know about data mining and data-analytic thinking. " O'Reilly Media, Inc.".
2. Hastie, T., Tibshirani, R., & Friedman, J. (2009). The elements of statistical learning: data mining, inference, and prediction. Springer Science & Business Media.
3. Blum, A., Hopcroft, J., & Kannan, R. (2020). Foundations of data science. Cambridge University Press.

Web References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline, O'Reilly
   https://classroom.google.com/u/0/w/NDA4ODg4MTQ3MjZa/t/all
2. Data Science E-Learning Course:
   https://onlinecourses.nptel.ac.in/noc19_cs60/unit?unit=5&lesson=6
3. Simple Linear Regression Example:
   https://www.spss-tutorials.com/simple-linear-regression/
4. https://www.kaggle.com/pavansanagapati/a-simple-tutorial-on-exploratory-data-analysis
5. https://paldhous.github.io/ucb/2016/dataviz/week2.html
6. https://www.targetprocess.com/articles/visual-encoding/

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Course Title: Cloud Computing (CORE : THEORY)
Course Code: UG-COM-305
Semester : VI
Credits: 3
Marks: 75
Duration : 45

Course Prerequisite: UG-COM-203: Computer Architecture and Operating System or Equivalent.

Course Objectives:

- To make students understand the key elements of cloud computing.
- To understand the difference between deploying applications on the cloud and the local infrastructure.
- To understand various cloud service models.

Course Learning Outcomes:

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

CLO1: Explain the core concepts of the cloud computing paradigm.
CLO2: Identify various cloud deployment models and service models, and discuss their use cases.
CLO3: Develop and deploy applications using cloud platforms development tools and frameworks.
CLO4: Apply advanced cloud concepts to real-world scenarios, demonstrating the ability to solve complex cloud challenges.

Module I: Introduction to Cloud Computing [15 HRS]

Recent trends in Computing- Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Cloud Computing definition, History of Cloud Computing, How Cloud Computing Works, 5-4-3 Principles of Cloud Computing, Cloud Ecosystem, Benefits and challenges of cloud computing, Issues for Cloud Computing.

Module II: Cloud Computing Architecture [15 HRS]

Comparison with traditional computing architecture (client/server), Cloud Architecture - Benefits of Cloud Architecture, Cloud Computing Architectural components. Cloud Computing Service Models- IaaS, PaaS and SaaS. Deployment Models- Public cloud, Private cloud, Hybrid cloud and Community cloud, Key drivers to adopting cloud, Impact of cloud on users, Governance in the cloud. Introduction to Virtualization, Different approaches to Virtualization, Hypervisors, Types of Virtualization, Machine Image, Virtual Machine(VM).

Module III: Cloud Service Providers [15 HRS]

Amazon Web Services (AWS)- Business and Technical benefits of Cloud Services, Elasticity, IAM, Security Groups, VPC, EC2, Traditional IP v/s Elastic IP, Amazon Machine Image, Elastic Load Balancing, CloudWatch, Elastic Block Storage, S3, SQS, SNS, RDS, Dynamo DB, Ops Works, Server less Architecture- API Gateways, Lambda. Hadoop MapReduce, HDFS, Hadoop on AWS.

Microsoft Windows Azure: Azure Virtual Machines, Cloud Services, Application scenarios.

Course Title :Cloud Computing (CORE - PRACTICAL)
Course Code : UG-COM-305
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. Virtualization *(2P)*

a. Install Oracle VirtualBox/VMware and create two VMs on your laptop.
b. Install VirtualBox/VMware Workstation with Linux and windows OS on top of windows.
c. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
d. Find a procedure to transfer the files from one virtual machine to another virtual machine.
e. Test ping command to test the communication between the guest OS and Host OS

2. Docker container *(3P)*

a. Installation and Setup of Docker container Linux/Windows
b. Containerizing the Python/Java/Node.js application
c. Creating a persistent Data Base.
d. Logging into Docker Hub
e. Pushing the container to the Docker hub.
f. Running the application from the container in pushed Docker hub

3. **Kubernetes** *(3P)*

a. Set up a Kubernetes cluster
b. Deploy containerized application
c. Verifying the deployment
d. Scaling and Managing the Application

4. Own Cloud(Iaas) *(2P)*

a. Installation and setup of Own Cloud
b. Explore the features of Own Cloud

c. Create, Manage and groups User accounts in own Cloud by Installing Administrative Features.
d. Federated sharing

5. Microsoft Azure **(***3P)*

a. Manage Resource Groups in Azure.
b. Create and upload a Blob storage.
c. Create, configure and deploy Azure VM
d. Create and configure VNet-VNet peering.
a. Create Azure Web App and Deploy the Application.
b. Create Order confirmation Service with Azure Functions.

6. Case study illustrating practical application of AWS services. **(***2P)*

REFERENCES

Mandatory Reading:

1. Chandrasekaran, K.. Essentials of Cloud Computing. United Kingdom, CRC Press, 2014.
2. Tim mather, subra kumarswamry and sharhed Latif, "Cloud Computing Security and Privacy", O'Reilly publication.
3. Richard Hill, Laurie Hirsch, Peter Lake, Siavash Moshiri, "Guide to Cloud Computing Principles and Practices",Springer.
4. Buyya, R., Broberg, J., & Goscinski, A. M. (Eds.). (2010). Cloud computing: Principles and paradigms (Vol. 87). John Wiley & Sons.

Supplementary Reading:

1. Nikos Antonopoulos, Lee Gillam"Cloud Computing: Principles, Systems and Applications", Springer.
2. Vines, R. L. K. R. D., & Krutz, R. L. (2010). Cloud security: A comprehensive guide to secure cloud computing (pp. 35-41). Wiley Publishing, Inc.

Web References:

1. https://azure.microsoft.com/
2. https://aws.amazon.com/what-is-cloud-computing/
3. https://cloud.google.com/appengine
4. https://www.ibm.com/cloud/learn/cloud-computing
5. https://www.salesforce.com/in/learning-centre/tech/cloudcomputing/

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Course Title: Artificial Intelligence (CORE : THEORY)
Course Code: UG-COM-306
Semester : VI
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: UG-COM-101 Introduction to Programming or Equivalent.

Course Objectives :

- To understand the concept of Artificial Intelligence (AI).
- To learn various important search strategies, Planning & knowledge representation in AI
- To acquaint with the fundamentals of Learning, Computer Vision & Expert Systems.
- To develop a mind to solve real world problems in AI.

Course learning Outcomes:

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

CLO1: Discuss the structure of an A.I. Problem and requirement, representation and application of the knowledge to solve an AI problem, planning of heuristic based search algorithms and need of machine learning algorithms
CLO2: Develop a heuristic-based state space search techniques, knowledge and planning models for AI applications.
CLO3: Design a solution strategy and an expert system in any domain to transfer human expertise into machine
CLO4: Analyze the suitability of knowledge models, search algorithms and the machine learning algorithms to solve any AI application.

Module I: Introduction, State Space Search and Heuristic Search [15 hrs]

Artificial Intelligence: Introduction, State Space Search: Breadth First Search, Depth First Search, Depth Bounded DFS (DBDFS), Depth First Iterative Deepening (DFID). Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Variable Neighbourhood Descent. Optimal Search: A* algorithm, Iterative Deepening A*, Recursive Best First Search.

Module II: Problem Decomposition and Planning and Constraint Satisfaction [15 hrs]

Problem Decomposition: Goal Trees, Rule Based Systems, Rule Based Expert Systems. **Planning:** STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning.

Constraint Satisfaction: N-Queens, Constraint Propagation.

Game Playing: Alpha-Beta Pruning.

Module III: Logic and Reasoning , Knowledge Representation and Applications **[15 hrs]**

Knowledge Based Reasoning: Agents, Facets of Knowledge.

Logic and Inferences: Formal Logic, Propositional Logic, Resolution method in Propositional Logic, and First Order Logic, Resolution Refutation in FOL, Forward & Backward Chaining.

Knowledge Representation: Frames, Semantic nets

Applications of AI Learning: Introduction, Types of Learning: Rote Learning, Learning by taking advice, Learning by Induction

Computer Vision: Human Vision Processing, Edge detection, The Waltz algorithm.

Expert System: Architecture of Expert System, Role of Expert system in Knowledge acquisition.

Course Title :Artificial Intelligence (CORE - PRACTICAL)
Course Code : UG-COM-306
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. Program to implement depth first search algorithm. *(1P)*
2. Program to implement breadth first search algorithm. *(1P)*
3. Program to implement Best First Search algorithm. *(1P)*
4. Program to simulate 4-Queen / N-Queen problem. *(2P)*
5. Program to implement alpha beta search. *(1P)*
6. Program for implementing Hill climbing problems. *(1P)*
7. Program to implement A* search algorithm. *(2P)*
8. Program to solve water jug problem. *(2P)*
9. Program to simulate tic – tac – toe game using min-max algorithm. *(2P)*

10. Program to implement Constraint satisfaction problem. *(2P)*

REFERENCES

Mandatory Reading:

1. "A First Course in Artificial Intelligence", Deepak Khemani, ISBN: 978-1-25-902998-1, McGraw Hill Education (India) 2013.

Supplementary Reading:

1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson

2. Artificial Intelligence, Elaine Rich and Kevin Knight 3rd Edition, TATA McGraw-Hill Education.

3. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015

Web References:

1. An Introduction to Artificial Intelligence - Course (nptel.ac.in)
2. https://www.codecademy.com/catalog/subject/artificial-intelligence
3. https://www.coursera.org/learn/introduction-to-ai
4. https://www.geeksforgeeks.org/What-is-ai-artificial-intelligence/
5. https://www.cloudskillsboost.google/course_templates/536

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SEMESTER III

MINOR COURSE
New Syllabus
(To be implemented w.e.f. Acad. Year 2024 - 2025)

Course Title: Foundations of Data Science with Python
Course Code: UG-COM-207
Credits: 3
Marks: 75

Course Objectives:

- To understand the concept of data science and its role in extracting insights from data
- To understand the basic Python syntax, data types, control structures, and functions
- Utilize Python libraries such as NumPy and Pandas for data manipulation and analysis tasks.

Course Outcomes:

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

CLO1: Explain key principles related to data manipulation, analysis, visualization, and interpretation using Python programming language.
CLO2: Apply Python programming fundamentals to perform data manipulation, analysis, and visualization tasks efficiently.
CLO3: Employ data manipulation libraries such as NumPy and Pandas to clean, transform, and explore datasets effectively.
CLO4: Describe the basic principles and types of machine learning algorithms, including supervised and unsupervised learning approaches.

Module I: Introduction to Data Science and Python Basics [15 hrs]

Introduction to Data Science: Understanding the role and importance of data science in various fields, Introduction to key concepts: data, information, knowledge, and insights, Overview of data science tools and techniques.

Introduction to Python Programming: Introduction to Python programming language, Installing Anaconda distribution for Python, Basic Python syntax: variables, data types, operators, and expressions, Control structures: if statements, loops, and functions, Hands-on exercises and practice problems using Jupyter notebooks.

Working with Data in Python:Introduction to data structures in Python: lists, tuples, dictionaries,

Accessing and manipulating data in Python, Introduction to libraries for data manipulation: NumPy and Pandas, Reading and writing data from/to different file formats (e.g., CSV, Excel), Practical exercises and projects to manipulate and analyze data

Module II: Data Visualization and Analysis [15 hrs]

Data Visualization with Matplotlib and Seaborn: Introduction to data visualization principles, Overview of Matplotlib and Seaborn libraries for data visualization, Creating basic plots: line plots, scatter plots, bar charts, histograms, Customizing plots: labels, colors, markers, and legends, Exploratory data analysis through visualization, Hands-on exercises and projects to visualize data using Jupyter notebooks

Statistical Analysis with Python: Introduction to statistical analysis concepts, Descriptive statistics:mean, median, mode, variance, standard deviation, Inferential statistics: hypothesis testing, t-tests, chi-square tests, Introduction to statistical libraries in Python: SciPy and StatsModels, performing statistical analysis on datasets using Jupyter notebooks, Practical exercises and projects to apply statistical techniques.

Module III: Introduction to Machine Learning [15 hrs]

Fundamentals of Machine Learning: Introduction to machine learning concepts and terminology, Types of machine learning: supervised learning, unsupervised learning, and reinforcement learning, Overview of popular machine learning algorithms: linear regression, logistic regression, decision trees, k-nearest neighbors, Introduction to scikit-learn library for machine learning in Python,

Time-Series Analysis: Overview of time-series analysis, Components of time-series, time-series forecasting model.

Practicals :Foundations of Data Science with Python.

Credit: 01

Marks: 25

Duration: 30 Hrs

1. Python Basics: [3P]

a) Write Python code to calculate the area of a circle given its radius.
b) Create a Python function that takes two numbers as input and returns their sum.

c) Write a Python program to check if a given number is prime.

2. Working with Data in Python: [3P]

a) Load a CSV file containing student grades into a Pandas DataFrame. Display the first few rows of the DataFrame.
b) Calculate the mean, median, and standard deviation of a numeric column in the DataFrame.
c) Filter the DataFrame to show only students with grades above a certain threshold.

3. Data Visualization with Matplotlib and Seaborn: [3P]

a) Create a line plot showing the trend of a stock price over a period of time.
b) Generate a scatter plot to visualize the relationship between two variables in a dataset.
c) Create a histogram to visualize the distribution of ages in a population dataset.

4. Statistical Analysis with Python: [3P]

a) Perform a t-test to compare the mean heights of two groups of individuals.
b) Calculate the correlation coefficient between two numeric variables in a dataset.
c) Conduct a chi-square test to analyze the association between two categorical variables.

5. Fundamentals of Machine Learning: [3P]

a) Implement linear regression to predict housing prices based on features like square footage and number of bedrooms.
b) Train a logistic regression model to classify email messages as spam or not spam based on text features.
c) Build a decision tree classifier to predict whether a passenger survived the Titanic disaster based on passenger attributes.

REFERENCE BOOKS:

MANDATORY:

1. Nandi, G., Sharma, R. K. (2020). Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next (English Edition). India: Bpb Publications.
2. McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. United States: O'Reilly Media.
3. Let Us Python. (2019). India: BPB Publications.

SUPPLEMENTARY:

1. Dromey R.G., How to solve it by computer, Prentice Hall of India, 2nd Edition, 2004.

2. Mark Lutz, Learning Python, O'Reilly Media, Third Edition, 2008
3. Wes McKinney, Python for Data Analysis, O'Reilly Media, 2012
4. Jure.L,,Anand. R,Jeffrey.U(2014). Mining of Massive Datasets v2.1(2nd ed.).Cambridge University Press.
5. Kevin P. Murphy,(2012).Machine Learning: A Probabilistic Perspective .MIT Press.
6. Provost, F., & Fawcett, T. (2013). Data Science for Business: What you need to know about data mining and data-analytic thinking. " O'Reilly Media, Inc.".

WEB REFERENCES:

1. https://www.python.org/doc/

2. https://www.w3schools.com/python/

3. https://matplotlib.org/stable/index.html

4. https://seaborn.pydata.org/

5. https://scikit-learn.org/stable/

6. https://www.tensorflow.org/api_docs

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Course Title: Mobile Application Development
Course Code: COM-E10
Marks: 75
Credits: 3
Duration:45 Hrs

Course Prerequisites: Object Oriented Programming

Course Objective:

- Students learn how to develop applications for mobile devices, including smartphones and tablets. Students are also introduced to the current mobile platforms, mobile application development environments and mobile device input methods. Students will design and build a variety of apps on a popular platform throughout the course to reinforce learning and to develop real competency.

Course Outcome:
Upon completion of the course students will be able to:

CO1: Explain the key components of Android applications, including activities, services, broadcast receivers, and content providers.
CO2: Analyze the principles of designing user interfaces for Android apps, including the use of XML layouts, views, and event handling.
CO3: Understand data storage options on Android, including SharedPreferences, SQLite databases, and file handling for data persistence.
CO4: Explore multimedia capabilities in Android, such as image handling, audio and video playback, and integration with the device camera.
CO5: Implement a fully functional Android application by utilizing core components
C06: Deployment of Android Application on Google play store.

SYLLABUS:

Module I: Introduction to Android Development [15 HRS]

Need of Mobile App, Different Kinds of Mobile Apps, Native vs. web app, Introduction to Android OS and its ecosystem, Comparing and Contrasting architectures of Android, iOS and Windows, Underlying OS(Darwin vs. Linux vs. Windows), Kernel structure and native level programming, Linux Kernel, Libraries, Android Runtime, Application Framework, Dalvik VM Setting up the Android development environment, Building and running the first Android app

Module II: Android Components: [15 HRS]
Activities, Services, Broadcast Receivers, Creating Broadcast receiver, Receiving System Broadcast, Understanding Broadcast action, category and data, Sending Broadcast. Content Providers, Views, layouts and Common UI components, Creating UI through code and XML,

Activity life cycle, Intents-,Intent Filters, Intent-matching rules, Filters in your manifest. Communicating data among Activities. Selection components (Grid View, List View, Spinner), Adapters, Custom Adapters, Menus, Toast, Custom Toast, Dialogs, Status bar Notifications. Overview of services in Android, implementing a Service, Service lifecycle, Inter Process Communication (AIDL Services). Web Services and WebView - Consuming web services, Receiving HTTP Response (XML, JSON), Parsing JSON and XML, Using WebView.

Module III: Data Storage: [15 HRS]

Shared Preferences, Android File System, Internal storage, External storage. SQLite- Introducing SQLite, SQLite Open Helper and creating a database, Opening and closing a database, working with cursors, inserts, updates, and deletes.

Content Provider-Accessing built in content providers, Content provider MIME types, searching for content, Adding, changing, and removing content, creating content provider, Working with content files. Consuming RESTful APIs, Integrating Google Maps and location services, Preparing apps for distribution on Google Play

Practicals: Mobile Application Development
Credit: 1
Marks: 25
Duration: 30 Hrs

1. Installing the Development Environment, Configuring Android Stack.
2. Creating the First Android Application
3. Implement a simple application such as a Calculator using GUI components.
4. Review the earlier application making use of the advanced UI components such as Layouts.
5. Implementing intents
6. Implementing Services
7. Implementing Files and Shared Preferences
8. Implementing Data storage application to perform CRUD operations.
9. Consuming and integrating API's.
10. Deployment of Mini Project on Google play store.

REFERENCES:

MANDATORY:

1. Lee, W. M. (2010). Beginning iPad application development. John Wiley & Sons.
2. Satya. K, Pro Android 4 ; Dave MacLean (Apress).
3. Burnette, E. (2009). Hello, Android introducing Google's mobile development platform 2nd.
4. Cinar, O. (2012). Android apps with Eclipse. Apress.
5. Dimarzio, J.F. Android- A Programmer's Guide (Tata McGraw Hill)

WEB BASED:

1. http://developer.android.com/index.html

2. http://www.appinventor.org/

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Course Title: Digital Marketing (VOC : THEORY)
Course Code: UG-COM-VOC -2
Semester : V
Credits: 3
Marks: 75
Duration : 45

Course Prerequisite: Nil

Course Objectives:

- To Build Accessible Websites that are optimized for the Search Engines.
- To study various online Marketing Strategies.
- Analyze and research the Internet to improve the quality and marketability of the Websites.

Course Learning Outcomes:

On completion of the course, students will learn the following:

CLO1: Describe fundamental SEO and SEM strategies, tools, and practices for optimizing search engine presence and managing ad campaigns.

CLO2: Market a company/product using Social Media and Email strategies/tools OR
Develop and implement effective social media and email marketing strategies to build relationships, engage audiences, and measure campaign success.

CLO3: Explain basic concepts, tools, and practices in web analytics and marketing automation for measuring performance and automating marketing tasks.

CLO4: Evaluate and integrate SEO, SEM, SMM, email marketing, web analytics, and marketing automation strategies to enhance digital marketing effectiveness and drive data-informed decisions.

MODULE I: Search Engine Optimisation (SEO) and Search Engine Marketing (SEM) **[15 HRS]**

SEO: Introduction to Online Search; Function of Search Engines; Google PageRank; Introduction to Search Engine Optimisation; Building Accessible Site; Keyword Research and Optimisation; Link Building Strategies; Useful Tools for SEO; The Past, Present and Future of SEO.

SEM: Introduction to Internet and Search Engine Marketing; Google Adwords; Adwords Account Structure; Navigating in Google Adwords; Working with Keywords; Creating Ads in Google Adwords; Creating and Managing your First Ad Campaign; Adwords Reporting and Account Performance Reports.

MODULE II: Social Media Marketing (SMM) and Email Marketing [15 HRS]

Social Media Marketing: Introduction to the World of SMM; Why Social Media? Getting Started with Social Media; Building Relationships via Facebook, Twitter, LinkedIn, YouTube; Handling Positive and Negative Comments; Social Media Content Base Creation.

Email Marketing: Importance of Email marketing; Email Marketing Software; Subscriber List; Email Marketing Campaign; Newsletters; Measuring the results.

MODULE III: Web Analytics and Marketing Automation [15 HRS]

Web Analytics: Web Analytics and Intelligence Tools; Basic Metrics Demystified; Introduction to Google Analytics; Goals and Actionable Insights; Data Management; Social Media Analytics; Social Media Goals and KPI's; Tools for Social Media Analytics.

Marketing Automation: Introduction to Marketing Automation; Advantages of using Marketing Automation Software; Issues with Marketing Automation.

Course Title :Digital Marketing (VOC : PRACTICAL)
Course Code : UG-COM-VOC -2
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. Using Search Engine Optimization tools (like google & bing search console, hubspot, webceo, google page speed) *(3)*
2. Using Search Engine Marketing tools (like google adwords, google adwords certifications, search, display, remarketing formats, facebook marketing, linkedin advertising) *(3)*
3. Using Social Media Marketing tools (like hootsuite, buffer, sproutsocial, klear, twitonomy, socialmention, google alerts, mention) *(3)*

4. Using SMS and Email Marketing tools (like Twilio - voice chat and call, mailchimp, campaign monitor, mailgun, mandrill, phplist, amazon ses *(3)*

5. Using Web Analytics tools (like google analytics, compete.com, crazyegg, facebook insights, twitter insights) *(3)*

REFERENCES

Mandatory Reading:

1. Damian Ryan, "*Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation",* Kogan Page Publisher, 3rd Edition, 2014.

Supplementary Reading:

1. Calvin Jones and Damian Ryan**, "***The Best Digital Marketing Campaigns in the World: Mastering The Art of Customer Engagement***",** Kogan Page Publisher, 1st edition 2011**.**
2. Nick Smith**, "***Successful Digital Marketing in a Week***",** Teach Yourself Publisher, 2014**.**
3. Nick Smith**, "***Successful Social Media Marketing in a Week",* Teach Yourself Publisher, 2013.
4. Nick Smith, *"Successful SEO and Search Marketing in a Week",* Teach Yourself Publisher, 2013.
5. Lee Odden , *" Optimize: How to Attract and Engage More Customers by Integrating SEO, Social Media, and Content Marketing"*, Wiley Publishing, 1st edition, 2012.
6. Avinash Kaushik, *"Web Analytics 2.0: The Art of Online Accountability & Science of Customer Centricity (Sybex)",* Wiley Publishing, 2nd edition 2013

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Course Title: Internet of Things (IoT) (VOC : THEORY)
Course Code: UG-COM-VOC-3
Semester : V
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: Knowledge of Programming

Course Objectives:

- To have a thorough understanding of major components of Embedded systems and IoT.
- Implement small modules of programs to solve well defined problems in an IoT.
- To familiarize with the tools to develop applications in an IoT Environment.

Course Outcomes:

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

CLO1: Describe Embedded Systems; its characteristics and design metrics.

CLO2: Summarize the performance of ARM processors and various components of Embedded Systems.

CLO3: Categorize I/O devices, Smart sensors, I/O Interfacing and Communication protocols along with their functions.

CLO4: Explore IoT technologies, characteristics, network and data communication protocols.

CLO5: Investigate IoT analytics, explore various IoT domains, and examine key concepts in IIoT.

CLO6: Design and develop Embedded / IoT Applications using Arduino/Raspberry-Pi/typical IoT boards.

MODULE I: Introduction to Embedded Systems and System Hardware [15 HRS]

Introduction to Embedded Systems, Microprocessors and Micro-controllers. Components of Embedded System & its Classification, Characteristic of embedded system. Introduction to embedded processor, Digital Signal Processor, Application Specific System Processor, Design Process in Embedded System, Design metrics, Steps in design process. Challenges in Embedded System design, Design Examples.

System hardware, Interrupt structure and Applications, ARM Processor - Architecture, Programmer's model, Modes of operation, Interrupt**,** Handling Interrupts, Comparison of ARM7, ARM9 & ARM10.

Components of Embedded Systems-Management of Power Supply, Clocking Unit, Real Time Clock and Timers, Reset Circuitry and Watchdog Timer. Processor and Memory Selection, Memory Map of Embedded System, Interfacing Processors, Memories and I/O – Analog vs Digital. Overview of Arduino, Intel Edison and Raspberry Pi boards.

MODULE II: Input/Output Devices and Communication [10 HRS]

I/O interfacing and Communication Buses, Serial vs Parallel Communication, Serial communication Protocols - UART Protocols, I2C, SPI, CAN, USB – Protocol Architecture, Topology.

I/O devices, ADC / DAC, Optical Devices such as LED / LCD Display devices, Opto-Isolator, Sensors, Relays, DC motor, Stepper motor, Timers/Counters, Parallel ports - Device interfacing.

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters –Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation

MODULE III: Internet of Things (IoT) [20 HRS]

Introduction: Overview of Internet of Things, building blocks of IOT, IOT enabling technologies-characteristics of IOT systems and IOT levels; M2M to IoT - the global context, IoT Architectural Overview, Potential and Challenges.

IoT communication: Networking basics, MANET, IoT networking connectivity protocols, Bluetooth, ZigBee, NFC, RFID**,** LoRAWAN, Lightweight M2M (LWM2M); IoT networking data messaging protocols, MQTT, MQTT publish-subscribe, MQTT architecture details, AMQP; Analysing data to infer protocol and device characteristics.

IoT Analytics for the Cloud: Introduction to elastic analytics, Decouple key components, Cloud security and analytics, designing data processing for analytics, Applying big data technology to storage.

Domains of IoT: Characteristics and applications of domain-specific IoTs - including home automation, smart environment, smart cities, logistics, retail, smart energy, smart agriculture, industrial control and smart health, IIoT.

Course Title :Internet of Things (VOC : PRACTICAL)
Course Code : UG-COM-VOC -3
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

Programs to be executed on any of the embedded/IoT boards like Arduino, Intel Edison, Raspberry Pi, Bolt, etc that covers the following tasks:

1. Interfacing sensors *(3P)*
2. Interfacing output devices *(2P)*
3. Interfacing input devices *(1P)*
4. Interfacing actuators *(1P)*
5. Programming with Raspberry Pi *(2P)*
6. Monitoring Data over Cloud *(1P)*
7. Building Web app to control devices *(2P)*
8. Mini Project. *(3P)*

REFERENCES

Mandatory Reading:

1. Rajkamal, (2010), Embedded Systems – Architecture, Programming and Design, (2nd ed.), Tata McGraw Hill.
2. Arshdeep Bahga and Vijay Madisetti, Internet of Things - A Hands-on Approach, Universities Press, 2015

Supplementary Reading:

1. Jerker Delsing, IoT Automation: Arrowhead Framework, CRC Press.
2. Surjeet Dalal, Vivek Joglan, Dac Lhuyang Le, Green Internet of Things for Smart Cities, CRC Press.
3. Raspberry Pi Cookbook, 3rd Edition, Simon Monk, Publisher: O'Reilly Media, Inc., 2019.

4. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, (2014), From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, (1st ed), Academic Press.
5. David Jensen, Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, Microsoft Azure.

Web References:

1. https://www.tutorialspoint.com/internet_of_things/index.htm
2. https://www.arduino.cc/
3. http://www.zdnet.com/article/m2m-and-the-internet-of-things-a-guide
4. https://www.raspberrypi.org/
5. www.thingspeak.com
6. https://blynk.io/

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Course Title: Software Testing (VOC : THEORY)
Course Code: UG-COM-VOC-4
Semester : V
Credits: 3
Marks: 75
Duration : 45

Course Prerequisites: UG-COM-101 Introduction to Programming, UG-COM-206: Software Engineering or equivalent.

Course Objectives:

- To understand the fundamental concepts in software testing
- To study the various software testing strategies
- To learn how to design test cases and execute them.

Course Outcomes:

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

CLO1: Understand the different software testing strategies.

CLO2: Apply testing strategies to live projects.

CLO3: Design test cases.

CLO4: Execute test cases using software testing tools.

MODULE I: [15 HRS]

Software testing principles - Software Testing- Need for testing, Psychology of testing, Testing economics, SDLC and Testing, Verification & Validation. Quality Assurance, Quality Control.

Testing strategies and types - White box testing techniques - Statement coverage, Branch Coverage , Condition coverage, Decision/Condition coverage , Multiple condition coverage, Dataflow coverage, Automated code coverage analysis, Inspections, Walkthroughs Code Review Black box testing techniques - Boundary value analysis, Robustness testing, Equivalence partitioning, Syntax testing,

Finite state testing, Levels of testing, Unit, Integration and System Testing, Compatibility Testing, Domain Testing, Adhoc Testing ,Use of Requirement, Traceability Matrix.

MODULE II: [20 HRS]

Integration Testing Waterfall - Top-down ,Bottom up ,Big bang, Sandwich System and Performance

Testing - Types of system testing ,Functional and non-functional testing Acceptance Testing , Setting entry and exit criteria for phases and typical product release scenarios ,Basic factors governing performance testing, Methodology for performance testing, Tools for performance testing.

Regression Testing - Purpose ,Timing, Choice of tests ,Smoke tests ,Best practices Internationalization and Localization testing - Preliminary concepts, Adhoc testing, Pair testing, Extreme testing, Agile testing, Exploratory testing, Defect seeding.

Usability Testing - Factors in usability testing, Aesthetics testing, Accessibility testing, Tools for usability testing.

Testing object oriented software - Definitions and Challenge differences from testing non-OO Software, Class testing strategies Class Modality, State-based Testing, Message Sequence Specification.

MODULE III: [10HRS]

People and organizational issues in testing - Common people issues and myths in testing, Providing career paths in testing, Organizational structures for testing teams, Geographically distributed testing teams and success factors.

Test Management and Automation- Test Planning, Test Management, Test Process, Test Reporting, Test Automation, Factors to consider in automation, Challenges in test automation, Test Metrics, Product Metrics, Process Metrics, Progress Metrics. Use of metrics in ascertaining product release.

Course Title :Software Testing (VOC : PRACTICAL)
Course Code : UG-COM-VOC -4
Semester : V
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. Planning Test Cases (Black Box & White Box Testing) *(3P + 2P)*

2. Generating Test Cases/Test Suite *(2P)*

3. Enhancing Tests *(3P)*

4. Debugging Tests *(1P)*

5. Running Tests *(1P)*

6. Analyzing Results *(2P)*

7. Reporting Defects *(1P)*

REFERENCES

Mandatory Reading:

1. Srinivasan D.,Gopalaswamy R.;(2009) Software Testing- Principles and Practices, 4th Edition: Pearson Publication.

Supplementary Reading:

1. Jalote P., (2010)An Integrated Approach to Software Engineering, 3rd Edition :Narosa Publishing House

2. Pressman R., (2017) ,Software Engineering: A Practitioner's Approach, 6th Edition: McGraw Hill Publication.

Web References:

1. https://www.guru99.com
2. https://www.softwaretestinghelp.com/practical-software-testing-new-free-ebook-download/
3. https://www.softwaretestinggenius.com/download/staqtpsn.pdf
4. https://www.softwaretestingclass.com/wp-content/uploads/2016/06/Beginner-Guide-To-Software-Testing.pdf
5. https://malenezi.github.io/malenezi/SE401/Books/Software-Testing-A-Craftsman-s-Approach-Fourth-Edition-Paul-C-Jorgensen.pdf

SKILL ENHANCEMENT COURSES
Revised Syllabus
(To be implemented w.e.f. Acad. Year 2024 - 2025)

Course Title: Programming with R
Course Code: UG-COM-SEC1
Credits: 2
Marks: 50

Course Objectives:

- To enable students to handle data in the R software thereby helping them to understand meaningful statistical analysis performed on the data.
- To enable students to extract data, and perform basic statistical operations.
- Data analysis such as – data cleaning, data visualization, data summarization and regression.

Course Learning Outcomes:

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

CLO1: Understand the R environment and do basic programming in R

CLO2: Analyse, extract and manipulate data by using functions in R.

CLO3: Compute various measures like central tendency, measures of dispersion by using graphical techniques.

CLO4: Compute the correlation coefficient for bivariate data, perform simple and multiple linear regression on data set and analyse time series.

Module I: Basics of R-language **[15 Hrs]**

Overview of the R language: Installing R and R Studio: Using R studio, Scripts, Text editors for R, Graphical User Interfaces(GUIs) for R, Creating and storing R workspaces, installing packages and libraries, Mathematical operations.

Data Types in R- Numeric, Integer, Character, Logical, Complex and missing data.

Data Structures in R

- Vectors-Creation, Arithmetic operations of Vectors, Vector Sub setting, Sorting and Sequencing functions.
- Matrix and Arrays-Creation Arithmetic Operations of Matrix, Sub setting, Use of drop function.
- Factors-Converting a vector into factor, assigning levels and labels, ordered Factor.

- List- Creating a List, accessing List elements, manipulating List elements, merging Lists, converting Lists to Vectors.
- Data Frames-Creation of Data Frame, adding new columns, rows and removing columns, accessing column using the $ sign, importing a data set (important file formats such as csv, txt and spreadsheet), aggregate function and subsetting of dataframes, tapply function, manipulation using dplyr package (select, filter, arrange, mutate and group by function, pipe operator).

Programming Fundamentals: Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, & vs &&, | vs ||, Conditional Statements, While Loop, For Loop, Looping Over List, Loops for Vectors, Loops for Matrices, Loops for Data Frames, Loops for Lists, writing a Function in R, Nested Functions, Function Scoping, Recursion, Mathematical Functions in R, Calculus in R, Input and Output Operations.

Reading and writing data in R (file formats such as csv, txt, and xlsx).

Module II: Basic Statistics and Regression [15 Hrs]

Summarizing and exploring data: Descriptive statistics (mean, median, mode, variance, skewness, five-point summary), dealing with missing data in R, Data cleaning (dplyr package, tidyr package and pipe operator), Exploratory Data Analysis: data visualization using inbuilt functions and ggplot2 package (pie chart, bar chart, line chart, histogram, box plot, scatter plot, normal QQ plot).

Regression analysis using R: Regression vs Correlation, Simple and multiple regression, Ordinary least square, Assumptions of Classical normal linear regression model, corrplot package, car package, lmtest package, scatter plot(using plot function and ggplot2 package) to understand the relationship between variables, lm, abline, predict, resid function, interpreting 'summary table' of the regression model, normality of residuals (qqnorm and qqPlot functions), multicollinearity (correlation matrix, corrplot and vif function), autocorrelation (acf plot and Durbin Watson test), heteroscedasticity (graphically, bptest, ncvTest).

Time series data, components of a time series data, additive and multiplicative time series model, ts function, diff function, plot of atime series data, time series data with linear trend; regression analysis using 'lm' function.

Practicals: Programming with R

Credit:1

Marks:25

Duration:30 Hrs

1. R-Programming Basics: Installing R Studio, Using R console to perform basic arithmetic operations, display strings and workspace variables.
   [1P]
2. Data Structures: Vectors, Lists, Matrices, Data Frames, Factors and Arrays
   [3P]
3. Control Flow and Iterations.
   [1P]
4. Functions in R.
   [1P]
5. Implement Problems based on measures of central tendency.
   [1P]
6. Implement Problems based on measures of dispersion.
   [1P]
7. Implement Problems based on moments, skewness and kurtosis.
   [1P]
8. Loading, data cleaning and data visualization.
   [2P]
9. Perform simple and multiple linear regression.
   [2P]
10. Perform time series analysis
    [2P]

REFERENCE BOOKS:

MANDATORY:

1. K. G. Srinivasa, G. M. Siddesh et al, Statistical Programming in R, Oxford University Press.
2. Gardener, M. (2018), Beginning R: The Statistical Programming Language, Wiley & Sons.

SUPPLEMENTARY:

1. Sekhar, S.R.M., et al. (2017), Programming with R, Cengage Learning India.
2. Wickham, H., et al. (2017), R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly'.
3. Field, A., Miles, J and Field (2012), Z. Discovering Statistics using R (Indian Reprint

2022), SAGE
4. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education.
5. Tilman M. Davies,The Book for R, No Starch Press.
6. Emmanuel Paradis, R Programming for Beginners.

WEB BASED:

1. https://intellipaat.com/blog/tutorial/r-programming/
2. https://www.geeksforgeeks.org/r-statistics/?ref=lbp
3. https://www.tutorialspoint.com/r/index.htm
4. https://www.javatpoint.com/r-tutorial
5. https://www.w3schools.com/r/
6. https://www.programiz.com/r

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Course Title: Programming in Python
Course Code: UG-COM-SEC2
Credits: 2
Marks: 50
Duration:30 Hrs.

Course prerequisite: Introduction to Programming(UG-COM-101)

Course Objectives:

- To apply various data types and control structures.
- To apply python data structures - list, tuple and dictionary.
- To structure a python program as a set of functions.
- To do input/output with files in Python.
- To provide skills of data analysis using Python programming language.

Course Learning Outcomes:

At the end of the course students should be able to :

CLO1: Understand syntax of Python Programming

CLO2: Write a program using conditional statements, loops.

CLO3: Apply required List,Tuple and dictionary function

CLO4: Write Python program specific to the domain of the given problem

Module I **[15 HRS]**

Motivation, programming paradigms, What Python can do, Python's technical strength, Python interpreter, Program execution, Execution model variations, How to run programs.

Basic Syntax :
Variable and Data Types, Operator, Conditional Statements - if, if- else, Nested if-else. Looping – For, While, Nested loops. Control Statements – Break, Continue, Pass.

Strings :
Accessing Strings, Basic Operations, String slices, Function and Methods.

Tuples and Lists :
Introduction, Accessing list, Operations, Working with lists, Function and Methods. Introduction Accessing tuples, Operations, Working, Functions and Methods.

Module II **[15 HRS]**

Dictionaries:
Introduction, Accessing values in dictionaries, Working with dictionaries, Properties.

Functions:
Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables.

Modules:
Importing module. Math module. Random Module.

Exception Handling:
Exception. Exception Handling - Except clause, Try , except,finally clause. User Defined Exceptions.

Input-Output :
Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions. Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files.

Practicals: Programming in Python

Credit: 01

Marks: 25

Duration:30 Hrs

List of Experiments using Python Language:

1. Write a python program to compute a given formula. [1P]
2. Write a python program to implement an if else statement. [1P]
3. Write a python program to implement nested if else statements. [1P]
4. Implement for and while loop in python. [2P]
5. Write a string manipulation in python. [2P]
6. Write a program to implement lists in python. [2P]
7. Write a python program to implement tuple. [1P]
8. Write a python program to implement a dictionary. [2P]
9. Write python program to implement function [1P]

10. Write a python program to implement Input-Output File Operations in python. [1P]

11. Using a Python package to manage the environmental impact of computation. [1P]

REFERENCE BOOKS:

MANDATORY:

1. Mark Lutz,Learning Python, O'Reilly Media, Fifth Edition.

SUPPLEMENTARY:

1. Alex Martelli, (2006)Python – A Nutshell, O'Reilly Media, Second Edition.
2. Wes McKinney, (2012)Python for Data Analysis, O'Reilly Media.

WEB BASED:

1. https://www.w3schools.com
2. https://www.tutorialspoint.com
3. https://www.javatpoint.com
4. https://www.geeksforgeeks.org
5. https://www.guru99.com

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Course Title: UI/UX Design
Course Code: UG-COM-SEC3
Credits: 2
Marks: 50
Duration:30 Hrs.

Course Objectives:

- To study the different aspects of UI/UX Design.
- To study computer interface design concepts.

Course Outcomes:

Upon completion of the course student will be able to:

CLO1: Understand the principles of UI/UX design interaction with a computer System.
CLO2: Understand the concept of a graphical user interface, and its design characteristics.
CLO3: Apply fundamental design principles including typography, color theory, screen design and layouts.
CLO4: To create interactive and intuitive user interfaces.

Module I: Introduction to UI and UX Design: [15 HRS]

Explain the distinctions between UI and UX design. Understand the significance of UI/UX in digital product development.

Human-Computer Interaction: Importance of user Interface, Human characteristics, Human consideration, Human interaction speeds, Understanding business functions. User centered design, Persona.

Rapid Prototyping: Storyboarding. Paper Prototyping and Mockup, Video Prototyping, Creating and Comparing Alternatives.

Graphical User Interface Design: HCI guidelines, Windows: Navigation schemes selection of window; Selection of devices based and
screen-based controls, Components, Text and messages, Icons, Multimedia, Colors., controls, help & error messages design.

Module II: Heuristic Evaluation and Visualization [15 HRS]

Web user interface design – Jessy James Garette five layers of user experience. Heuristic Evaluation: Heuristic Evaluation — Why and How?
Visualization, Amount of information, Focus and emphasis, Presentation information simply and meaningfully, Statistical graphics.

Practicals: UI/UX Design
Credit : 1
Marks : 25
Duration: 30 Hrs

List of practicals:
Suggested list of practical (Numbers in brackets indicate number of practicals)

1. Paper Prototyping using templates (1P)
2. Persona- conducting contextual interview and developing persona (1P)
3. Storyboarding (2P)
4. GUI design: Using FIGMA: (3P)
5. Web UI design: Using FIGMA: (3P)
6. Prototyping in FIGMA (3P)
7. Visualization and infographics (1P)
8. Heuristic Evaluation (1P)

A Mini Project combining all the technologies learnt using a front-end development framework such as bootstrap is recommended.

REFERENCES:

Mandatory:

1. Cooper, A., Reimann, R., & Dubberly, H. (2003). About face 2.0: The essentials of interaction design. John Wiley & Sons, Inc..
2. Alan.D, Janet.F, Gregory D. and Russell,B. (2012) Human-Computer Interaction, Prentice Hall.
3. D.T,(2018) Web Technologies, Black Book, Dream Tech

Supplementary:

1. Shneiderman, B., & Plaisant, C. (2010). Designing the user interface: strategies for effective human- computer interaction. Pearson Education India.
2. Donald.A.N. (2010) The Design of Everyday Things Basic Books.

WEB REFERENCES:

1. http://hcibib.org/
2. https://www.tutorialspoint.com/human_computer_interface/index.htm. https://www.academia.edu/4955516/Wiley_The_Essential_Guide_to_User_Interface_De sign_3rd_Edition_Apr_2007?auto=download.
3. https://www.slideshare.net/busaco/hci-2015-110-humancomputer-interaction-overview?qid=1c116f30-ec87-4eb4-a375-49b2bbe65d75&v=&b=&from_search=2
4. https://www.w3schools.com
5. https://www.tutorialspoint.com/html/index.htm
6. https://www.tutorialspoint.com/css/index.htm
7. https://www.tutorialspoint.com/javascript/index.htm
8. https://www.tutorialspoint.com/jquery/index.htm
9. https://www.udemy.com/courses/development/web-development/

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Course Title: E-Commerce
Course Code: UG-COM-SEC4
Credits: 2
Marks: 50

Course Objectives:

- To analyze different e-commerce business models and strategies
- Identify key technologies and tools used in e-commerce
- Develop a basic e-commerce website

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

- CLO1 : Understand the fundamental concepts and terminology of e-commerce.
- CLO2 : Analyze different e-commerce business models and strategies.
- CLO3 : Identify key technologies and tools used in e-commerce.
- CLO4 : Develop a basic e-commerce website.

Module I: **[15 hrs]**

Introduction to E-Commerce
Overview of e-commerce, Benefits and challenges

E-Commerce Business Models
B2C, B2B, C2C, and other models, Subscription models

E-Commerce Technologies
Internet infrastructure, Payment systems, Security and privacy

Module II: **[15 hrs]**

E-Commerce Website Development
Website design principles, Content management systems (CMS), User experience (UX) and user interface (UI) design

E-Commerce Payment and Fulfillment
Payment gateways, Shipping and logistics, Inventory management

E-Commerce Marketing
Digital marketing strategies, SEO and SEM, Social media marketing Analytics

PRACTICALS : E-Commerce
Credit : 1
Marks : 25

Duration: 30 Hrs

List of suggested practical's:

ECOMMERCE PLATFORMS:

1. WORDPRESS: (4P)
Primarily designed for creating blogs but can be used to create online store by adding appropriate themes & plugins. Basic Programming Knowledge in PHP may be required in later stages.

2. WIX: (2P)
Wix is a drag & drop website builder which can also be used to build an ecommerce website without any programming experience.

3. SHOPIFY: (2P)
Made specially to create online stores, add products, categories & handle payments all without Any Programming knowledge required.

4. BLOGGER : **(2P)**
Similar to WordPress but a blogging service provided by google which again can be customized to create an online store.

TOOLS USED TO FACILITATE ECOMMERCE (5P)

1. GOOGLE ANALYTICS: Present in most ecommerce platforms and can be integrated in almost any application, giving the owner insights of the customer base visiting the website. Can also be fine- tuned to give more detailed analysis like how many visits actually got converted into leads etc.

2. MAIL CHIMP: A service to send emails to customers. Useful in marketing.

3. ZENDESK : Zendesk is used to setup a support centre for your application users .Users can open a ticket and get their issues resolved. Useful in issue tracking and management.

4. APPOINTLET : A Service integrated with google calendar and helps manage all appointments. Useful in applications where an appointment is required.

5. UNBOUNCE : Used to create landing pages for an application . A good landing page sometimes defines whether a user will visit the site or turn away.

REFERENCE BOOKS:

MANDATORY:

1. "E-commerce for Dummies" by Don Jones and Mark D. Scott - A comprehensive guide for beginners covering everything from setting up an online store to marketing and selling products online.

SUPPLEMENTARY:

1. Ravi Kalakota and Andrew B. Whinston.(2014).Electronic Commerce A Manager's Guide .Pearson Education.
2. "Don't Make Me Think: A Common Sense Approach to Web Usability" by Steve Krug
3. "E-commerce Evolved: The Essential Playbook to Build, Grow & Scale a Successful E-commerce Business" by Tanner Larsson
4. "Invisible Selling Machine" by Ryan Deiss

WEB REFERENCES:

1) https://nptel.ac.in/
2)https://www.tutorialspoint.com/
3) http://www.wordpress.comhttp://www.wordpress.com/
4) https://www.wix.comhttp://www.wix.com/
5) https://www.shopify.comhttp://www.shopify.com/
6) https://www.blogger.comhttp://www.blogger.com/
7) https://www.google.co.in/analytics/
8)https://www.mailchimp.comhttp://www.mailchimp.com/
9)https://www.zendesk.com/
10) https://www.appointlet.com/
11) http://www.unbounce.com/

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Course Title: Graphic Design
Course Code: UG-COM-SEC5
Credits: 2
Marks: 50

Course Objectives:

- To understand the basic concept of Multimedia.
- To develop skills for designing graphical images.
- To develop skills for audio and video editing.
- To acquire skills in using audio/video editing software.

Course Outcomes:
Upon completion of the course students will be able to:

CLO1: Understand the basic concepts and skills required for Multimedia
CLO2: Demonstrate proficiency in the text, graphics, visual and audio medium via the respective tools used
CLO3: Classify and realize the types of Authoring tools and their functions.
CLO4: Assemble and deliver multimedia projects.

Module I: Introduction to Multimedia and Computer Graphics: [15 HRS]
Commonly used terms associated with multimedia like CDROM, Storyboard, Script and Authoring tools. Stages of a Multimedia Project-Planning and Costing, Designing and Producing, Testing and Delivering. The Multimedia team and their roles- Project Manager, Writer, Video specialist, Audio specialist and Multimedia programmer. Multimedia Software. Multimedia Hardware. Social & Ethical considerations, Digital Representations & Standards. A survey of Computer Graphic:
Computer Aided Design, Presentation Graphics, Computer art, Entertainment, Education and Training, Visualization, Image Processing, Graphical User Interface
Multimedia Authoring Tools:
Types of authoring tools; Card and Page based tools; Icon-based; Time-based; Object-Oriented Tools.
TEXT: Text in graphics, character set, fonts, layout.
Character Attributes, Text Attributes, Marker Attributes, Bundled Text Attributes, Bundled Marker Attributes.
Vector graphics fundamentals, shapes, transforms and filters, Bitmapped graphics: resolution, image compression, manipulation, Geometrical transformations.

Module II: Audio, Video and Color **[15 HRS]**

Basic Sound Concepts, Digitizing and processing sound, Music, Speech, Compression, formats, MIDI and Digital Audio Human vision, Camera systems, Gamma correction, Color matching, different Color models – RGB, CYMK, Transformations among color model.

Video:Analog and Digital Video, video standards, Video on PC. Introduction to graphics accelerator cards, Video Broadcast Standards - NTSC, PAL, SECAM, HDTV. Introduction to video capturing, Media & Instrument – Videodisk, DVCAM, Camcorder.

Recording Formats like S-VHA Video, Component (YUV), Component Digital, Composite Digital, and Video Hardware Resolutions.

Video Tips like shooting platforms, Lighting, Chroma Key or Blue Screen.

Practicals: Graphic Design
Credits : 1
Marks: 25
Duration: 30 Hours

Note : Practical can be done using GIMP, Audacity, Windows Video editor, Pencil 2D, Synfig2D or any other open-source image editing and audio video editing software

List of practicals:

1. Design a Brochure for a given product, give details. Learn about different Image file Formats (2P)
2. Design a poster with given information and learn about image compression (2P)
3. Record and Edit the Sound file and Learn about Effects and Filters of sound (3P)
4. Record your voice and learn about audio compression and audio mixing (3P)
5. Prepare Video content for a given information with title and special effects and filters.(3P)
6. Prepare effective video content (2P)

REFERENCE BOOKS:

MANDATORY:

1. Chapman, N., & Chapman, J. (2005). Digital multimedia. John Wiley & Sons, Inc.
2. Li, Z. N., Drew, M. S., & Liu, J. (2004). Fundamentals of multimedia (pp. 253-265). Upper Saddle River (NJ): Pearson Prentice Hall.
3. Vaughan, Tay; Multimedia: Making it Work; Tata McGraw-Hill, 9th edition.

SUPPLEMENTARY:

1. Jeffcoate, J. (1995). Multimedia in practice. Technology and Applications. Great Britain: Prentice Hall.

WEB REFERENCES:

1. https://www.gimp.org/
2. https://www.audacityteam.org/
3. https://swayam.gov.in/nd2_ugc19_hs42/
4. https://www.tutorialspoint.com/multimedia
5. https://libguides.bc.edu/

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(Revised Syllabus to be offered to students taking admissions to Second Year BSc-Computer Science in the Academic Year 2025 - 2026)

Course Title: Front End Web Development (SEC: THEORY)
Course Code: UG-COM-SEC6
Semester: -
Credits: 2
Marks: 50
Duration: 30 hours

Course objectives:

- Equip students with the necessary skills to design and build web pages using HTML5, CSS3, and JavaScript, enabling them to create interactive and visually appealing web interfaces.
- Teach students to implement essential design principles such as usability, accessibility, and responsiveness, while using advanced CSS3 features and JavaScript for dynamic functionality.

Course Outcomes:

On completion of the course students will be able to:

CLO1: Create structured and responsive web content using HTML5 and CSS3, including advanced styling techniques such as grids, animations, and transitions.

CLO2: Use JavaScript to add interactivity to web pages, including DOM manipulation, event handling, and form validation.

CLO3: Apply advanced HTML5 features (e.g., multimedia, geolocation, web storage) and CSS3 properties (e.g., 2D/3D transforms, transitions) to enhance user experience.

CLO4: Build a fully functional static web application that integrates HTML5, CSS3, and JavaScript to provide an interactive and user-friendly interface.

Module I: Web Basics, HTML5, and CSS3 [20 Hours]

Web Basics - Introduction to clients, servers, communication, and Internet protocols (HTTP, Web Clients, and Servers).
HTML5 - Basic HTML structure and tags, semantic HTML, multimedia embedding (video, audio), forms, and APIs (geolocation, web storage).
CSS3 - Styling techniques including layout management (box model, grid, flexbox), positioning, text effects, custom fonts, and background techniques. Advanced CSS3 features such as transitions, animations, 2D/3D transforms, and media queries for responsive design.

Module II: Dynamism in UI **[10 Hours]**

JavaScript Basics - Variables, data types, operators, conditionals, loops, functions, and events. DOM manipulation using JavaScript: accessing elements (getElementById, innerHTML), form validation.

Introduction to JQuery - Brief overview of JQuery and its basic functionalities focusing on simplifying DOM manipulation and event handling.

Course Title: Front End Web Development (SEC: PRACTICAL)
Course Code: UG-COM-SEC6
Semester: I/II/III
Credits : 01
Marks : 25
Duration : 30 hours

List of Practical Work:

1. **HTML Practical** [8 Hours]:
    1. Create a webpage with various HTML elements, including text formatting, tables, images, forms, and embedded videos.
    2. Tasks include using meta tags and forms to capture user input.
2. **CSS Practical** [8 Hours]:
    1. Style the created HTML content with CSS: Design a navigation bar, create a CSS Grid, round images, and build an interactive form using advanced CSS techniques.
    2. Tasks include creating CSS3 transitions, sticky footers, and animations (like hover effects and buttons).
3. **JavaScript Practical** [8 Hours]:
    1. Develop JavaScript functions for tasks such as string formatting (e.g., capitalizing the first letter of each word), form validation (e.g., validating emails and credit card numbers), and performing DOM manipulation.
    2. Tasks include manipulating data and updating the user interface based on user input.
4. **Mini Project** [6 Hours]:
    1. Design and build a simple static web application that integrates all learned concepts from HTML, CSS, and JavaScript. The project should demonstrate basic

functionality (such as dynamic interaction or form validation) and include responsive design principles.

REFERENCE BOOKS:

MANDATORY:

D.T. (2018), *Web Technologies*, Black Book, Dream Tech.

Web-Based Resources:

- W3Schools
- TutorialsPoint: HTML
- TutorialsPoint: CSS
- TutorialsPoint: JavaScript
- TutorialsPoint: JQuery
- Udemy Web Development Courses

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DEPARTMENT OF COMPUTER SCIENCE

Syllabus of Value-Added Courses (VAC) to be implemented from academic year 2024-25

Group	Department	Course Code	Course Title	Credits
	Computer Science	UG-COM-VAC1	Cyber Security	2
A. Digital and Technological Solutions	Computer Science	UG-COM-VAC2	Cyber Fraud Prevention and Response	2
B. Innovation	Computer Science	UG-COM-VAC3	Design Thinking	2

Value Added Course

Course Title: Cyber Security

Course Code : UG-COM-VAC1

Marks: 50

Credits : 2

Duration : 30 Hours

Course Prerequisites: Nil

Course Objectives:

- Learn the foundations of Cyber security
- Equip students with the technical knowledge and skills needed to protect and defend against cyber threats.
- Develop skills in students that can help them to ensure the protection of information technology assets.
- Expose students to responsible use of online social media networks.

Course Learning Outcomes:

Upon completion of the course students will be able to:

CLO1: Understand the cyber security threat landscape.

CLO2: Understand cyber laws

CLO3 : Develop a deeper understanding and familiarity with various types of cyber attacks cyber crimes, vulnerabilities and remedies thereto

CLO4 : Analyse and evaluate the digital payment system security and remedial measures against digital payment frauds.

SYLLABUS

Module I **[15HRS]**

Introduction to Cyber Security :Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web,

Advent of internet, Internet infrastructure for data transfer and governance, Internet

society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

Cyber Crime and Cyber Law : Classification of cyber crimes, Common cyber crimes-cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi ,
Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies

Module II : **[15Hrs]**

Social Media Overview and Security

Introduction to Social networks. Types of Social media, Social media platforms,Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and
pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case Studies.

E - C o m m e r c e and Digital Payments

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007.

Digital Devices Security , Tools and Technologies for Cyber Security :

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Configuration of basic security policy and permissions.

Suggested activities :

1.Setting, configuring and managing three password policy in the computer (BIOS, Administrator and Standard User).

2. Setting and configuring two factor authentication in the Mobile phone.
3. Security patch management and updates in Computer and Mobiles.
4. Managing Application permissions in Mobile phone.
5. Installation and configuration of computer Anti-virus.
6. Installation and configuration of Computer Host Firewall

References

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001)
4. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
6. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
7. Fundamentals of Network Security by E. Maiwald, McGraw
****

Course Title : **CYBER FRAUD PREVENTION AND RESPONSE**
Course Code : **UG-COM-VAC2**
Credits : **02**
Hours : **30**
Marks : **50**

Course Prerequisites: Nil

Course Objectives:

- Introduction to Cyber Fraud and their types
- Prevention strategies and Digital Forensics for Cyber Fraud
- Risk Assessment and Management
- Cyber fraud Awareness

Course Learning Outcomes:
Upon completion of the course, the student will be able to:
CLO-1: Understand Cyber fraud.
CLO-2: Demonstrate Digital Forensic knowledge
CLO-3: Implement Prevention Strategies
CLO-4: Exhibit Ethical and Legal considerations

Module I: Understanding Cyber Fraud, Digital Forensics and Cybercrime Investigation [15 hours]

Understanding the landscape of Cyber Fraud. Types of Cyber Fraud and its impact on Individuals and Organizations. Phishing Attacks and Social Engineering. Identity Theft Methods. Online Scams and Fraudulent Schemes.
Introduction to Digital Forensics. Collecting and analyzing digital evidence. Case Studies in Cybercrime Investigation.

Module II: Fraud Prevention Strategies, Cyber security and Legal Compliance [15 hours]

Best Practices in security for Individuals and Businesses. Implement multi factor authentication securing financial transactions. Understanding BEC Attacks - Recognizing and preventing. Overview of Ransomware Attacks. Responding to Ransomware incidents. Developing a Ransomware Prevention Plan.
Regulatory Framework for Cybersecurity. Legal and Ethical Considerations in Cyber Fraud Cases.
Educating Individuals on Cyber Fraud Risks. Creating a Cybersecurity Culture. Practical Tips for Staying Safe Online.

References:

Mandatory:

1. Indian Institute of Banking and Finance, (2022).“Prevention of Cyber Crimes and Fraud”, (2022), 2nd edition, Macmillan Publishers India Pvt Ltd.
2. Goldmann, P. (2009). “Anti-Fraud Risk and Control Workbook”.

Supplementary:

1. Gaurav Gupta and Garima Gupta, (2022). “Cyber Unsafe: A Handbook for Preventing Computer Frauds and Cyber Crimes”,Vilvam Publications, India.

Web References:

1. https://www.tookitaki.com/compliance-hub/cyber-fraud-real-life-examples-and-prevention-strategies
2. https://business.bofa.com/en-us/content/fraud-prevention-and-cyber-security-solutions.html
3. https://complyadvantage.com/insights/what-is-fraud-prevention/

Course Title : **DESIGN THINKING**
Course Code : **UG-COM-VAC3**
Credits : **02**
Hours : **30**
Marks : **50**

Course Prerequisites: Nil

Course Objectives:

- To apply design thinking methods to solve problems.
- To develop empathy with users to generate insights for problem-solving.
- To Prototype and test solutions to improve them iteratively.

Course Learning Outcomes:
Upon completion of the course, the student will be able to:
CLO-1: Understand the fundamental principles and processes of Design Thinking.
CLO-2: Apply Design Thinking methods to solve complex problems in various contexts.
CLO-3: Develop empathy with users to generate insights for problem-solving.
CLO-4: Prototype and test solutions to improve them iteratively.

Module I: 15 hours

Introduction to Design Thinking: Understanding Design Thinking, History and evolution of Design Thinking, Design Thinking process overview

Understanding Empathy: The role of empathy in Design Thinking, Techniques for empathetic engagement, Conducting interviews and observations

Defining the Problem: Problem definition techniques, How to frame user needs and insights, Crafting problem statements.

Case Studies to stimulate creative thinking; Empathy fieldwork, persona creation; Problem framing.

Ideation Techniques: Brainstorming and its rules, Ideation methods: SCAMPER, mind mapping, and more, Selecting and refining ideas.

Practical exercises on Ideation session and idea selection.

Module II: 15 hours

Prototyping Solutions: The purpose of prototyping, Different types of prototyping, Feedback loops and iteration. Case Studies on Prototype building and feedback session.

Testing and Iteration: Principles of testing with users, Iterative design process, Incorporating feedback into redesign. Tips on User testing workshop.

Implementing Design Thinking: Scaling Design Thinking to larger projects, Organizational challenges and strategies, Case studies of Design Thinking in action

Practical exercises on Group projects to solve a real problem.

REFERENCES:

Mandatory:

1. Nigel Cross, (2011). "Design Thinking: Understanding How Designers Think and Work", Berg Publishers.
2. Thomas Lockwood (2009)."Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press; 1st edition.

Supplementary:

1. Andrew Pressman, (2019). “Design Thinking: A Guide to Creative Problem Solving for Everyone” Routledge Publications, 1st Edition.
2. Jeanne Liedtka, Randy Salzman, and Daisy Azer, (2017). "Design Thinking for the Greater Good: Innovation in the Social Sector",Columbia Business School Publishing

Web References:

1. https://dschool.stanford.edu/
2. https://www.ideo.com/
3. https://miro.com/templates/design-thinking/
4. https://www.interaction-design.org/literature/topics/design-thinking
5. https://www.interaction-design.org/literature/article/design-thinking-a-quick-overview

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DEPARTMENT OF COMPUTER SCIENCE

Syllabus of Multidisciplinary Courses (MDC) to be implemented from academic year 2024-25

Course Code	Course Title	Credits
UG-COM-MDC1	Office Automation	03 (02 Theory & 01 Practical)
UG-COM-MDC2	Introduction to Python Programming	03 (02 Theory & 01 Practical)
UG-COM-MDC3	E-Learning	03 (02 Theory & 01 Practical)
UG-COM-MDC4	R Programming	03 (02 Theory & 01 Practical)
UG-COM-MDC5	Fundamentals of Data Analysis	03 (02 Theory & 01 Practical)
UG-COM-MDC6	Multimedia	03 (02 Theory & 01 Practical)
UG-COM-MDC7	Fundamentals of Human-Computer Interaction	03 (02 Theory & 01 Practical)
UG-COM-MDC8	Web Design	03 (02 Theory & 01 Practical)
UG-COM-MDC9	Document Development and Data Analysis	03 (02 Theory & 01 Practical)
UG-COM-MDC10	Technology in Teaching and Learning	03 (02 Theory & 01 Practical)

MULTI DISCIPLINARY COURSES

(Revised Syllabus to be offered to students taking admissions to Second Year BSc-Computer Science in the Academic Year 2025 - 2026)

Course Title : Office Automation (MDC: THEORY)
Course Code : UG-COM-MDC1
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : *This course is for students interested in focusing on practical, user-friendly office automation tools and concepts that enhance productivity and efficiency in an office environment.*

Course Objectives:

- To explore the features of a few automation tools used in office work.
- Study and implement the features of spreadsheets, and Image/Graphic design tools.

Course Learning Outcomes:

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

CLO1: Understand basic Spreadsheet and Presentation Software features.

CLO2: Analyze the data using various spreadsheet features such as lookup tables, Pivot tables, Graphs and other statistical features.

CLO3: Explore different features of GIMP and Inkscape tools.

CLO4: Design an Application using GIMP and Inkscape tools.

Module I

Spreadsheets: [1**8 HRS]**

Spread Sheet & its Applications, Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys. Entering & Deleting Data- Entering data filling. Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks, Setting Formula - finding total in a column or row.

Mathematical operations: (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae. Formatting Spreadsheets, Sorting, Filtering, Validation, Consolidation,

and Subtotal. Using Tools – Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables, Tracking Changes, Security, Customization.

Presentation Software and Graphics editor – GIMP

Introduction & area of use; Creating a New Presentation; Working with Presentation; Using Wizards; Slides & it's different views; Inserting, Deleting and Copying of Slides; Working with Notes, Handouts, Columns & Lists; Adding Graphics, Sounds and Movies to a Slide; Working with Objects; Designing &Presentation of a Slide Show; Printing Presentations, Notes, Handouts with print options.

Graphics editor – GIMP : Introduction, Introducing the Workspace, Learning all the primary Tools: Working with Layers, Colors, Filters , Dealing with text and Fonts. Basics of Photo editing.

Module II

Inkscape: - Vector Graphics design: - **[12 HRS]**

Introduction: Introduction to Inkscape, Features of Inkscape, Inkscape Interface, learning about Raster and Vector Graphics.

Basic Drawing Skills: Selecting and Manipulating Objects, Drawing and Shaping Objects, Arranging Objects.

Mastering Different Tools: Using Text and Color, layers, groups, align and distribute, transformation tools.

Applying Special Effects: Learning Blending modes, Distortion, Contour Effects on text, Envelope effect, Clip image. tracing image with different modes.

Saving, Exporting and printing: Different Saving options, exporting your designs into different formats for printing, Creating layouts and finalizing content for printing.

Course Title : Office Automation (MDC: PRACTICAL)
Course Code : UG-COM-MDC1
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of Experiments:

Spreadsheet and Presentation Software *(4)*

Using formulas and functions:

To prepare a Worksheet showing the monthly sales of a company in different branch, offices (Showing Total Sales, Average Sales).Prepare a Statement for preparing Result of 10 students in 5 subjects (using formula to get Distinction, I Class, II Class and Fail under Result column against each student).

Operating on the sheets:

Finding, deleting and adding records, formatting columns, row height, merging, splitting columns etc. Connecting the Worksheets and enter the data.

Creating a Chart:

To create a chart for comparing the monthly sales of a company in different branch offices.

Using the data consolidate command:

To use the data consolidate command to calculate the total amount budgeted for all departments (wages, travel and entertainment, office supplies and so on) or to calculate the average amount budgeted for – say, department office expenses.

2. Sorting Data, Filtering Data and creation of Pivot tables.

3. Working on presentation (any open source presentation software such as impress or equivalent).

GIMP and Inkscape *(11)*

1. Introduction to GIMP workspace.
2. Basic Drawing Skills and using the tools of GIMP.
3. Removing the background and water mark of the image using GIMP.
4. Editing the image using GIMP tools.
5. Introduction to Inkscape tools with properties.
6. Designing the posters on different themes - Inkscape
7. Adding special effects
8. Creating a logo (Vector graphics design)
9. Advanced effects
10. Trace image with different modes.
11. Use gradient tool to create realistic images.

REFERENCES:

Mandatory Reading:

1. Mark Moore, (2015), Mastering Excel: Building Dashboards, (1stEd.), CreateSpace Independent Publishing Platform.
2. Dinesh Maidasani, (2008), Straight to the Point – MS Office 2003, (1st Ed.), Firewall Publications.

Supplementary Reading:

1. Ramesh Bangia, (2017), Learning PageMaker 7, (Ed), Khanna Book Publishing Co Pvt Ltd.
2. Michael S. Toot, (2017), Master Visually Microsoft Office 2003, (Ed), Visual Publishers.
3. Mansfield, (2017), Mastering WORD 6 for Windows, (Ed), BPB
4. Townsend, (2017), Mastering EXCEL 4 for Windows, (Ed), BPB

Web References:

1. https://www.guru99.com/excel-tutorials.html
2. https://www.gimp.org
3. https://www.gimp.org/tutorials
4. https://www.javatpoint.com/gimp
5. https://inkscape.org
6. 'https://inkscape.org/learn/tutorials

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Course Title : Introduction to Python Programming (MDC: THEORY)
Course Code : UG-COM-MDC2
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : *This course is for students interested in acquiring programming skills and technological knowledge.*

Course Objectives:

- To understand the concept of basic computer algorithm and flowchart and use the algorithm for various problem solving.
- To implement algorithms using programming language.
- To provide skills of data analysis using Python programming language.

Course Learning Outcomes:

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

CLO-1: Understand fundamental programming concepts such as variables, data types, and operators.

CLO-2: Implement Python programs using conditional statements and loops.

CLO-3: Demonstrate proficiency in using Python's built-in data structures: lists, tuples and dictionaries.

CLO-4: Create and use functions to promote code reusability.

CLO-5: Apply file handling operations.

CLO-6: Create domain specific applications using Python programming.

Module I **[15 HRS]**

Basics of Python Programming: Features of Python, Applications of Python,writing and executing Python Program.

Introduction to Problem Solving Strategies, Program Design tools: Algorithms, flowcharts. Basic Algorithms: Exchanging the values, Summation of a set of numbers, factorial computation, generation of the Fibonacci series, reversing the digits of an integer, base conversion.

Basic Syntax: Variable and Data Types, Operator, Conditional Statements - if, if- else, Nested if-else. Looping – For, While, Nested loops. Control Statements – Break, Continue, Pass

Strings: Accessing Strings, Basic Operations, String slices, Function and methods.
Tuple and Lists: Introduction, accessing list, Operations, Working with lists, Function and Methods. Introduction Accessing tuples, Operations, Working, Functions and Methods.

Module II **[15 HRS]**

Dictionaries: Introduction, accessing values in dictionaries, Working with dictionaries, Properties.
Functions: Defining a function, Calling a function, Types of functions, Function arguments, Anonymous functions, global and local variables.
Module: Importing module. Math module. Random Module.
Input-Output: Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions. Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions.

Course Title : Introduction to Python Programming (MDC: PRACTICAL)
Course Code : UG-COM-MDC2
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of Experiments:

1. Write a python program to compute a given formula. *(1)*
2. Write a python program to implement an if else statement. *(1)*
3. Write a python program to implement nested if else statements. *(1)*
4. Implement for and while loop in python. *(2)*
5. Write a string manipulation in python. *(2)*
6. Write a program to implement lists in python. *(2)*
7. Write a python program to implement tuple. *(2)*
8. Write a python program to implement a dictionary. *(2)*
9. Write python program to implement function *(1)*
10. Write a python program to implement Input-Output File Operations in python. *(2)*

REFERENCES:

Mandatory Reading:

1. Dromey, R. G. (1982). How to Solve it by Computer. Prentice-Hall,
2. Inc.. Mark Lutz,Learning Python, O'Reilly Media, Fifth Edition.

Supplementary Reading:

1. Reema Thareja (2020), Python Programming Using problem solving approach, Oxford Higher Education
2. Horowith ,E.,Sahni ,S.,Sanguthevar,R. (2008). Fundamentals of Computer algorithm, Orient Longman.
3. Alex Martelli, (2006)Python – A Nutshell, O'Reilly Media, Second Edition. Wes McKinney, (2012)Python for Data Analysis, O'Reilly Media.

Web References:

1. https://www.w3schools.com
2. https://www.tutorialspoint.com
3. https://www.javatpoint.com
4. https://www.geeksforgeeks.org
5. https://www.guru99.com

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Course Title : E-Learning (MDC: THEORY)
Course Code : UG-COM-MDC3
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : *This course is for students interested in exploring ICT tools in education and focused in understanding Educational Pedagogies and Assessment.*

Course Objectives:

- To understand the basic concept of ICT (Information Communications Technology) in education.
- To understand the basic concept of Instructional Design principles.
- To develop E-content in various application areas related to ICT and Education.

Course Learning Outcomes:

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

CLO1: Explain the working of an E-learning module.

CLO2: Develop E-Content using the Instructional Design Process and upload on LMS.

CLO3: Evaluate and apply appropriate E-Learning Strategy to a given topic.

CLO4: Differentiate between Summative and Formative assessment.

Module I: Introduction and Course Development [15 HRS]

Scope and form of E-learning, Role of an E-learning project Phases in E-learning project. Instructional Design: The process of Designing Instruction.
Developing Materials (Story Boarding, Content Integration, and SCORM Compliance). Working with L.M.S. (Learning Management System)- Installation and use of the administrator, teacher and student interface; Course Definition, Registration and upload, tracking of results.

Module II: E-learning Strategies & Assessment Design [15 HRS]
E-Learning Strategies: Simulation, Drill, Interactive Learning, Problem Solving, Tutorials.

Assessment: Online formative and summative assessment. Rubrics for Assessment- Analytic and Holistic Rubrics, Security and Authentication.

Course Title **:** E-Learning (MDC: PRACTICAL)
Course Code **:** UG-COM-MDC3

Semester : -
Credits : 01
Marks : 25
Duration : 30

List of Experiments:

1. Construct a Mind Map (Free Mind/Mindomo) *(1)*
2. Create a Storyboard (PPT/Movie Maker/PowToon's/Storyboardthat) *(2)*
3. Screen Recording S/W(Screencast/OBS/Filmora) *(2)*
4. Collaborative Tools (G Suite) *(1)*
5. Creating Blogs-(Blogger/Word Press) *(2)*
6. Installation, Creation & Running of an LMS-(Moodle/GoogleClassroom *(1)*
7. Uploading Resources & Activities in the LMS-(Moodle/GoogleClassroom *(2)*
8. Creating a Complete Course in the LMS *(2)*
9. Design Rubrics for Scenarios-(Hot Potatoes/Ed puzzle/Poll Everywhere) *(2)*

Mandatory Reading:

1. Shelly Cashman Gunter.(2011).Teachers Discovering Computers: Integrating Technology in the Classroom,(7th ed.).Wadsworth Publishing Co Inc.

Supplementary Reading:

1. Smith, P. L. & Ragan, T. J.(2008). Instructional design(4rth ed.). New York: John Wiley & Sons. ISBN:0471393533
2. M.D. Roblyer, Aaron H. Doering(2018). Integrating Educational Technology into Teaching: Student Value Edition (8th ed.). Publisher: Pearson ISBN-10: 013289680X, ISBN-13:978- 0132896801.
3. Dick, W., Carey, L., & Carey, J. O.(2014). The systematic design of instruction (8th ed.). Boston

Web References:

1.https://www.udemy.com/course/instructional-design-for-elearning/

2.https://nptel.ac.in/courses/127101013/

3.https://nptel.ac.in/courses/121105010/

4. https://www.plesyoutube.com/watchv=0flnAoX9QEw

5.https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/121106012/lec13.pdf

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Course Title : Introduction to R Programming (MDC: THEORY)
Course Code : UG-COM-MDC4
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : *This course is for students interested in performing statistical analysis and Data Visualisation.*

Course Objectives:

- To make the student understand the fundamentals of R language.
- To implement algorithms using R.
- To connect R with other data sources and perform computation
- To use R for plotting charts and graphs

Course Learning Outcomes:

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

CLO1 : Develop solutions to problems and implement these solutions in R.

CLO2 : Use R with various data sources and perform computation.

CLO3 : Solve mathematical problems using R.

CLO4 : Plot charts and graphs using R.

Module I **[15 Hrs]**

Introduction to R:
R console to perform basic arithmetic operations, display strings and workspace variables, R Overview.

R Data Types:
Determining the data type of a variable, boolean, integer, numeric, character, complex and raw. Vectors, Lists, Matrices, Data Frames, Factors and Arrays

R Operators:
Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators Miscellaneous Operators (Colon, %in% and %*%)

Control Flow and Iterations:
The if, if-else, if – else if-else and switch statements, while and for loops, loops for vectors, matrices, data frames and lists. Programs to test understanding of the same.

Module II **[15 Hrs]**

Functions in R:
Writing an R function, Nested Functions, Function Scoping, Recursion, Loading an R package, Mathematical Functions, Cumulative sums and products, Calculus, Input and Output operations, Selection and Bubble sort, Linear and Binary Search.
R Data Interfaces: R and Database Connectivity , creating and dropping tables, inserting data and updating table rows, querying and querying with filters.
R and CSV files – Inputting, Reading, Writing to and Analyzing csv files.
R and Spreadsheets – Reading from, writing to and analyzing spreadsheets
R and XML files – Reading and processing XML files
Charts and Graphs : Generating Pie charts, Bar Charts and Line Graph.

Course Title : Introduction to R Programming (MDC: PRACTICAL)
Course Code : UG-COM-MDC4
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of Experiments:

1. R-Programming Basics: Installing R Studio, Using R console to perform basic arithmetic operations, display strings and workspace variables. *(1)*
2. Data types in R. *(1)*
3. Data Structures: Vectors, Lists, Matrices, Data Frames, Factors and Arrays *(3)*
4. Operators in R. *(1)*
5. Control Flow and Iterations. *(3)*
6. Functions in R. *(2)*
7. R Data Interfaces: R and Database Connectivity ,creating and dropping tables, inserting data and updating table rows, querying and querying with filters. *(2)*
8. Charts and Graphs : Generating Pie charts, Bar Charts and Line Graph. *(2)*

REFERENCES:

Mandatory Reading:
1. K. G. Srinivasa, G. M. Siddesh et al, Statistical Programming in R, Oxford University Press.

Supplementary Reading:
1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education.
2. Tilman M. Davies,The Book for R, No Starch Press.

3. Emmanuel Paradis, R Programming for Beginners.

Web References:

1. https://www.tutorialspoint.com/r/index.htm
2. https://www.javatpoint.com/r-tutorial
3. https://www.w3schools.com/r/
4. https://www.programiz.com/r
5. https://intellipaat.com/blog/tutorial/r-programming/

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Course Title: Fundamentals of Data Analysis (MDC:THEORY)
Course Code : UG-COM-MDC5
Semester : -
Marks: 50
Credits: 2
Duration: 30 Hrs

Preference : *This course is for students interested in performing statistical analysis, Data Analysis and Data Visualisation.*

Course Objectives:

- Develop skills to manipulate and analyze data.
- Create data visualizations to communicate insights.

Course Learning Outcomes:

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

CLO-1: Apply data collection methods and techniques for importing, cleaning, and structuring data in Excel.

CLO-2: Demonstrate the ability to create effective data presentations using various graphs, charts, and plots.

CLO-3: Utilize basic tools for EDA, including probability and summary statistics.

CLO-4: Create interactive dashboards and charts for effective data exploration and presentation using tableau.

SYLLABUS

Module I **[15 HRS]**

Introduction to Data Analysis: Importance of Data Analysis in Various Disciplines, Types of Data (Categorical, Numerical, Text), Data Sources and Collection Methods, Overview of Excel for Data Analysis.

Data Preprocessing and Cleaning: Data Cleaning Techniques, Handling Missing Data(Types of missing data), Techniques for handling missing data, Outlier Detection and Treatment, Data Transformation and Scaling, Importing Data into Excel, Data Cleaning in Excel, Data Transformation Techniques, Structuring Data Tables for Analysis.

Probability and Statistics

Probability:

Basic Probability Concepts (Conditional Probability, Bayes' Theorem)

Probability Distributions (Discrete: Binomial, Poisson; Continuous: Normal, Exponential)

Statistics :

Descriptive Statistics

Measures of Central Tendency (Mean, Median, Mode) Measures of Dispersion (Variance, Standard Deviation, Range, Interquartile Range, Skewness and Kurtosis),

Inferential Statistics

Sampling Techniques: Random, Stratified, Cluster
Estimation (Point and Interval Estimators, Confidence Intervals)
Hypothesis Testing (t-test, z-test, Chi-Square Test, ANOVA)
Correlation and Regression Analysis
Introduction to Statistical Modeling and Model

Module II **[15 HRS]**

Exploratory Data Analysis (EDA)

EDA Principles and Objectives, Univariate Analysis, Bivariate Analysis, Multivariate Analysis

Data Visualization

Introduction to Data Visualization: Effective Data Presentation, Graphs, Charts, and Plots, Visualization Libraries (e.g., Matplotlib, Seaborn)

Basic tools (plots, graphs and summary statistics) of Exploratory Data Analysis, Philosophy of EDA, Creating Dashboards and Interactive Charts, Introduction to Data Visualization tools such as power BI or Tableau.

Practicals: Fundamentals of Data Analysis (MDC : PRACTICAL)

Course Code : UG-COM-MDC5

Semester : -

Marks: 50

Credits: 2

Duration: 30 Hrs

List of Experiments:

1. **Data Cleaning in excel -** Import a dataset into Excel, Identify missing values and handle them, Detect outliers and decide on an appropriate treatment and Convert data types. *(1)*
2. **Data Transformation and Structuring:** Normalize numerical data, Create new variables (e.g., calculate a new column based on existing columns), Pivot data to reshape it for analysis, Merge or join datasets using Excel functions. *(1)*
3. **Descriptive Statistics:** Calculate and interpret measures of central tendency (mean, median) and dispersion (variance, standard deviation) for a dataset, Create summary statistics tables using Excel functions. *(1)*
4. **Basic Data Visualization:** Create various types of Excel charts (bar, line, pie) for given datasets, Customize chart elements (titles, labels, legends, colors) to improve clarity, Compare and contrast different chart types for effective data presentation. *(2)*
5. **Exploratory Data Analysis (EDA):** Generate histograms and box plots to visualize data distributions, Create scatter plots to explore relationships between variables, Perform multivariate analysis, such as correlation matrices or heat maps, to identify patterns. *(1)*
6. **Advanced Data Visualization:** Develop interactive Excel dashboards with slicers, pivot charts, and dynamic components. Integrate Excel with Power BI/ Tableau and create a simple Power BI/Tableau report. *(2)*
7. **Dashboard Development:** Design a data dashboard with multiple charts and slicers, Link interactive elements to update charts dynamically, Present data insights effectively through the dashboard. *(2)*
8. **Mini Project:** Students can choose a dataset of interest or relevance to their domain, Apply data preprocessing, descriptive and inferential statistics, and data visualization techniques learned in the course, Prepare a report or presentation summarizing their findings and insights. *(4)*

Suggested datasets for practice (Instructor can use other available datasets also)

1. **For data cleaning and preprocessing : NYC Airbnb Data** – Outlier detection and standardization (Inside Airbnb)
2. **www.kaggle.com**

REFERENCES:

Mandatory Reading :

1. "Tableau For Dummies" by Molly Monsey and Paul Sochan
2. Statistics for Business and Economics – Paul Newbold, William Carlson, Betty Thorne

Supplementary Reading:

1. Introductory Statistics – Sheldon M. Ross

2. Introduction to the Practice of Statistics – David S. Moore, George P. McCabe, Bruce A. Craig

WEB REFERENCES:

1. https://public.tableau.com/app/discover/viz-of-the-day
2. https://powerbi.microsoft.com/en-us/blog/
3. https://d3js.org/
4. EDA & Visualization: Towards Data Science (towardsdatascience.com)
5. Excel for Data Analysis: Microsoft Learn (learn.microsoft.com)

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Course Title : Multimedia (MDC: THEORY)
Course Code : UG-COM-MDC6
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : *This course is for students interested in exploring the dynamic world of multimedia and enhancing their creative skills in graphic design, audio, and video editing.*

Course Objectives:

- To understand the basic concept of Multimedia.
- To develop skills for designing graphical images.
- To develop skills for audio and video editing.
- To acquire skills in using audio/video editing software.

Course Learning Outcomes:

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

CLO-1: Understand the basic concepts and skills required for Multimedia

CLO-2: Demonstrate proficiency in the text, graphics, visual and audio medium via the respective tools used.

CLO-3: Classify and realize the types of Authoring tools and their functions.

CLO-4: Assemble and deliver multimedia projects

Module I: Text, Graphics and Audio [15 HRS]

Multimedia terms - Storyboard, Script and Authoring tools. Types of authoring tools, Stages of a Multimedia Project. The Multimedia team and their roles. Multimedia Software. Multimedia Hardware. Social & Ethical considerations, Digital Representations & Standards.

Text: Text in graphics, character set, fonts, layout. Character Attributes, Marker Attributes, Bundled Text Attributes, Bundled Marker Attributes.

Vector graphics and Raster Graphics: resolution, image compression, file formats, Geometrical transformations.

Color Theory: Color Basics, different Color models ,Transformations among color models.

Module II: Audio, Video and Animation **[15 HRS]**

Sound Concepts - Digitizing and processing sound, Music, Speech, Compression, file formats, MIDI and Digital Audio Human vision, Gamma correction,

Video: Analog and Digital Video, video standards, Video on PC. Introduction to graphics accelerator cards, Video Broadcast Standards - NTSC, PAL, SECAM, HDTV. Introduction to video capturing, Media & Instrument – Videodisk, DVCAM, Camcorder. Recording Formats like S-VHA Video, Component (YUV), Component Digital, Composite Digital, and Video Hardware Resolutions.

Animation: Basics of animation, Animation Principles Animation techniques-persistence of vision, animation file formats, Computer animation kinematics and Morphing, Computer Animation Languages, Key frame System, Particle systems – particle generation.

Course Title **:** Multimedia (MDC: PRACTICAL)
Course Code **:** UG-COM-MDC6
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of Experiments:

Note : Practical can be done using GIMP, Audacity, Windows Video editor, Pencil 2D, Synfig 2D or any other open-source image editing and audio video editing software

1. Design a Brochure for a given product, give details. Learn about different Image file Formats *(2)*
2. Design a poster with given information and learn about image compression *(2)*
3. Record and Edit the Sound file and Learn about Effects and Filters of sound *(3)*
4. Record your voice and learn about audio compression and audio mixing *(3)*
5. Prepare Video content for a given information with title and special effects and filters. *(3)*
6. Enhance the Quality of Video content *(2)*

REFERENCES:

Mandatory Reading:

1. Chapman, N., & Chapman, J. (2005). Digital multimedia. John Wiley & Sons, Inc.

2. Li, Z. N., Drew, M. S., & Liu, J. (2004). Fundamentals of multimedia

(pp. 253-265). Upper Saddle River (NJ): Pearson Prentice Hall.

3.Vaughan, Tay, (2009). Multimedia: Making it Work; Tata McGraw-Hill, 9th

edition.

Supplementary Reading:

1. Jeffcoate, J. (1995). Multimedia in practice. Technology and Applications. Great Britain: Prentice Hall.

Web References:

1. https://www.gimp.org/
2. https://www.audacityteam.org/
3. https://swayam.gov.in/nd2_ugc19_hs42/
4. https://www.tutorialspoint.com/multimedia
5. https://libguides.bc.edu/
6. https://www.pencil2d.org
7. https://www.synfig.org

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Course Title : Fundamentals of Human-Computer Interaction (MDC: THEORY)
Course Code : UG-COM-MDC7
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : This course is for students interested in Human-Computer Interaction, user-centered design, and evaluating user experiences.

Course objectives:

- Introduction to Human-Computer Interaction.
- User Centered Design Principles.
- Human Factors and Ergonomics.
- User Research and Evaluation.

Course Outcomes:
On completion of the course students will be able to:

CLO-1: Define Human-Computer Interaction (HCI) and articulate its significance in the design of user interfaces.

CLO-2: Apply usability principles in interface design.

CLO-3: Utilize prototyping techniques to quickly test and refine interface concepts in an iterative process.

CLO-4: Consider user needs in interface design for user comfort and efficient interactions.

Module I: Introduction to Human-Computer Interaction (HCI) and User Interface Design Principles. [15 hours]

Overview of HCI - Definition and importance of HCI, Historical context and evolution. Fundamentals of Psychology in HCI - Basics of cognitive psychology, Human perception and memory.

Principles of User Interface Design - Usability principles, Design guidelines for effective interfaces. Basics of Interaction Design - User-centered design process, Introduction to wire framing and prototyping.

Module II: Understanding Human Factors in Computing, User Research and Evaluation. [15 hours]

Ergonomics and Accessibility - Designing for physical comfort and inclusivity. Introduction to accessibility standards. Emotional Design - Recognizing the emotional aspects of user

experience, designing for positive emotional impact. Introduction to User Research Methods - Surveys, interviews, and usability testing. Basics of data collection and analysis. Usability Testing - Planning and conducting usability tests. Iterative design based on user feedback.

Course Title **:** Fundamentals of Human-Computer Interaction (MDC: PRACTICAL)
Course Code **:** UG-COM-MDC7
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of practicals:

1. Apply HCI principles to analyze everyday interfaces (e.g., websites, mobile apps, or household devices). *(1P)*
2. Create a basic wireframe and prototype for a chosen interface using an appropriate tool *(2P)*
3. Analyze the emotional design elements of an existing application and propose improvements for a positive emotional impact *(2P)*
4. Develop a usability testing plan for a chosen interface *(2P)*
5. Conduct usability testing sessions with participants, analyze results, and identify areas for improvement *(2P)*
6. Evaluate the accessibility of a website or application using an appropriate tool and propose accessibility enhancements *(2P)*
7. Apply an iterative design process to a project, incorporating feedback from peers and making incremental improvements *(2P)*
8. Conduct a cognitive walkthrough of a user interface, identifying potential usability issues from a cognitive perspective *(2P)*

REFERENCES:

Mandatory Reading:

1. Alan Dix, (2005). Human-Computer Interaction, Prentice Hall, Third Edition.

Supplementary Reading:

1. Don Norman, (2013) , The Design of Everyday Things, Basic Books Publisher.

Web References:

1. https://www.interaction-design.org/literature/topics/human-computer-interaction

2. https://www.geeksforgeeks.org/introduction-to-human-computer-interface-hci/
3. https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-hci/

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Course Title : Web Design (MDC: THEORY)
Course Code : UG-COM-MDC8
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : *This course is for students interested in developing web development skills, focusing on web fundamentals, HTML and CSS, and creating responsive designs for modern web applications.*

Course Objectives:

- Understand Web Fundamentals
- Master HTML and HTML5
- Explore CSS and CSS3
- Implement Responsive Design

Course Outcomes:
On completion of the course, students will be able to:

CLO1: Demonstrate the use of various HTML and CSS elements

CLO2: Style content to provide an effective User Interface

CLO3: Implement frameworks used in web designing.

CLO4: Design responsive websites

Module I: Web Essentials **[20 HRS]**

Clients, Servers, and Communication. The Internet-Basic Internet Protocols The World Wide Web-HTTP request message-response message-Web Clients; Web Servers, Domain and Hosting.

HTML : HTML - Introduction. The development process, basic HTML, formatting and fonts, commenting code, colour, hyperlink, lists, tables, images, simple HTML forms, web site structure, Meta tags, Character entities.
HTML5 - Introduction, New Elements, Canvas, SVG, Drag/Drop, Geolocation, Video, Audio, Input types, form elements, form attributes, semantic.

CSS : CSS - Introduction – Syntax, Id & Class, Backgrounds, Text, Fonts, Links, Lists, Tables. CSS Box Model – Border, Outline, Margin, Padding. Advanced - Grouping/Nesting, Dimension,

Display, Positioning, Floating, Align, Pseudo-class, Pseudo-element, Navigation Bar, Image Gallery, Image Opacity, Image Sprites, Media Types, Attribute Selectors.

CSS3 - Introduction, Borders, Backgrounds, Gradients, Text Effects, Fonts, 2D Transforms, 3D Transforms, Transitions, Animations, Multiple Columns.

Module II: Responsive Website **[10 HRS]**

Frameworks for Web design, overview of Bootstrap; Introduction and Syntax of Bootstrap; Bootstrap Component; Responsive Layouts with the Bootstrap Grid; Building forms with Bootstrap.

Course Title **:** Web Design (MDC: PRACTICAL)
Course Code **:** UG-COM-MDC8
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of practicals:

1) Create a HTML page with the following: *(4)*
   a) title heading paragraph emphasis strong and image elements
   b) complex HTML table
   c) simple HTML Form covering major form elements
   d) Embed Video in an HTML page

2) Using CSS do the following: *(3)*
   a) Create a Navigation bar (with dropdown) with CSS
   b) Create a CSS Grid
   c) Create a CSS3 based button
   d) Make an image rounded shape
   e) Create a CSS based sticky footer
   f) Create CSS3 Corner Ribbon
   g) Create CSS3 blurry text effect
   h) Create CSS3 speech bubble shape
   i) Create image cross fade with CSS3 transition
   j) Set style for link hover active and visited states of hyperlink

3) Creating a website using the html; CSS with Embedded Video and audio tags *(3)*

4) Mini Project using front-end development framework such as bootstrap *(5)*

REFERENCES:

Mandatory Reading:

1. Elisabeth R, Eric F, (2012). *Head First HTML and CSS* (2nd ed). Canada, O'Reilly Media, Inc.

Supplementary Reading:

1. D.T,(2018) Web Technologies, Black Book, Dream Tech
2. Ivan B (2017), HTML5 and CSS3 Made Simple (1st ed). India, BPB publication
3. DT Editorial Services (2016), ―HTML5 Black Book: Covers CSS3, Javascript, XML, XHTML, Ajax, PHP and Jquery (2nd ed). India, Dreamtech Press.
4. Handbook for Web Developer Qualification Pack.

Web References:

1.https://www.w3schools.com
2.https://www.tutorialspoint.com/html/index.htm
3.https://www.tutorialspoint.com/css/index.htm
4.https://www.udemy.com/courses/development/web-development/

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Course Title : Document Development and Data Analysis (MDC: THEORY)
Course Code : UG-COM-MDC9
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : This course is for students interested in exploring automation tools for office work and developing practical skills in spreadsheets and word processing applications.

Course Objectives:

- To explore the features of a few automation tools used in office work.
- Develop skills in implementing the features of spreadsheets, and word processing tools.

Course Learning Outcomes:

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

CLO1: Demonstrate proficiency in utilizing word processing software to create, format, and edit documents for various purposes.

CLO2: Develop skills in document design, formatting, and layout to create professional-looking documents that effectively communicate information.

CLO3: Demonstrate proficiency in utilizing various spreadsheet features such as lookup tables, Pivot tables, and other Statistical features.

CLO4: Analyze data using spreadsheets for tasks such as spreadsheet analysis, presentation creation, and database management.

SYLLABUS

Module I: Word-Processing [15 HRS]

Introduction to Word Processing Software: Overview of popular word processing software (e.g., Microsoft Word, Google Docs). Overview of the user interface and basic features; Creating new documents and opening existing ones. Basic text editing techniques (e.g., typing deleting, copying, pasting). Using spelling and grammar checking tools.
Formatting Text: Applying font styles, sizes, and colors; Adjusting paragraph alignment and line spacing; Using text formatting tools for emphasis (e.g., bold, italic, underline).
Document Formatting: Setting margins, page orientation, and paper size; Inserting headers, footers, and page numbers; Using formatting styles for consistency throughout the document.
Working with Lists and Tables: Creating bulleted and numbered lists; Inserting and formatting tables for data organization; Applying styles to lists and tables.
Document Organization and Management: Organizing content with headings, subheadings, and sections; Creating and navigating through document outlines.

Graphics and Multimedia Integration: Inserting images, shapes, and icons into documents; Formatting and positioning graphics within the document; Embedding multimedia elements (e.g., videos, audio clips).
Document Organization and Management: Implementing mail merge for personalized document creation; Finalising documents for distribution and printing.
Advanced Features and Techniques: Tracking changes and comments for collaborative editing; Using tools for document versioning and collaboration.

Module II: Spreadsheets [15 HRS]

Introduction to Spreadsheets: Overview of spreadsheet software tools and their significance; Understanding the user interface and basic features.
Data Entry and Manipulation: Inputting data into spreadsheet cells; Manipulating data using basic editing techniques (e.g., copy, paste, delete).
Formulas and Functions: Introduction to formulas for performing calculations (e.g., SUM, AVERAGE, COUNT); Understanding functions and their applications in data analysis.
Data Visualization with Charts: Creating various chart types (e.g., bar charts, line graphs, pie charts) to visually represent data; formatting and customizing charts for clarity and visual appeal.
Advanced Data Analysis Techniques: Using advanced functions (e.g., VLOOKUP, IF statements) for complex data manipulation; Utilizing logical functions for conditional data analysis.
PivotTables for Data Summarization: Creating PivotTables to summarize and analyze large datasets efficiently; Using PivotCharts for dynamic data visualization.
Data Validation and Protection: Applying data validation rules to ensure data accuracy and consistency; Protecting spreadsheet data with password protection and access controls.

Course Title **:** Document Development and Data Analysis (MDC: PRACTICAL)
Course Code **:** UG-COM-MDC9
Semester **: -**
Credits **:** 01
Marks : 25
Duration : 30

List of Practicals :

Word-processing Software (7P)

1.Basic Text Editing: Learn fundamental text manipulation techniques including typing, deleting, copying, and pasting text in a word processing document.

2.Formatting Mastery: Explore diverse formatting options such as font styles, sizes, colors, and alignment to enhance the visual appeal of documents.

3.Efficient Document Creation: Master the art of creating new documents, saving them appropriately, and managing file locations efficiently.

4.Advanced Formatting Techniques: Delve into paragraph formatting, adjusting line spacing, paragraph spacing, and indentation for professional-looking documents.

5.Table Proficiency: Acquire skills in table creation, customization, and formatting to present data effectively within documents.

6.Document Navigation and Review: Learn to navigate large documents efficiently and utilize review features like Track Changes for collaborative editing.

7.Document Finalization and Collaboration: Finalize documents by proofreading for errors, printing, and sharing collaboratively using cloud-based platforms for real-time collaboration.

Spreadsheet Software (8P)

8.Data Entry and Formatting: Acquire skills in accurately inputting and formatting data using font styles, cell alignment, and number formatting in Excel.

9.Basic Formulas and Functions: Explore essential formulas and functions like SUM, AVERAGE, and COUNT for basic calculations and analysis of datasets.

10.Data Visualization with Charts: Master the creation of various chart types such as bar charts, line graphs, and pie charts to visually represent data in Excel.

11.Advanced Functions and Logical Operations: Dive into more complex functions like VLOOKUP, IF statements, and nested functions for advanced data manipulation and analysis.

12.Data Analysis with PivotTables: Gain proficiency in creating PivotTables to summarize and analyze large datasets efficiently in Excel (2P)

14.Data Validation and Conditional Formatting: Learn to apply data validation rules and conditional formatting techniques to enhance data accuracy and visual clarity in spreadsheets.

15.Collaboration and Sharing: Discover methods for collaborating on Excel workbooks, including sharing, tracking changes, and protecting sensitive data for secure collaboration.

REFERENCES:

Mandatory Reading:

1. Dinesh Maidasani, (2008), Straight to the Point – MS Office 2003, (1st Ed.), Firewall Publications.
2. Mark Moore, (2015), Mastering Excel: Building Dashboards, (1stEd.), CreateSpace Independent Publishing Platform.

Supplementary Reading:

1. Ramesh Bangia, (2017), Learning PageMaker 7, (Ed), Khanna Book Publishing Co Pvt Ltd.
2. Michael S. Toot, (2017), Master Visually Microsoft Office 2003, (Ed), Visual Publishers.
3. Mansfield, (2017), Mastering WORD 6 for Windows, (Ed), BPB

4. Townsend, (2017), Mastering EXCEL 4 for Windows, (Ed), BPB

Web References:

1. https://www.tutorialspoint.com/computer_concepts/computer_concepts_elements_of_word_processing.htm
2. https://nios.ac.in/media/documents/sec229new/Lesson3.pdf
3. https://trumpexcel.com/hyperlinks/
4. https://www.guru99.com/excel-tutorials.html
5. https://www.edx.org/learn/excel/ibm-analyzing-data-with-excel?index=product&queryID=afa257a5ec0f496f2be49e9ecb09635d&position=4&linked_from=autocomplete&c=autocomplete

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Course Title : Technology in Teaching and Learning (MDC: THEORY)
Course Code : UG-COM-MDC10
Semester : -
Credits : 2
Marks : 50
Duration : 30

Preference : ***(This course is for students interested to learn about finance……)***

Course Objectives:

- To understand the basic concept of ICT (Information Communications Technology) in education.
- To understand the basic concept of Instructional Design principles.
- To develop E-content in various application areas related to ICT and Education.

Course Learning Outcomes:

On completion of this course the student will be able to:

CLO1: Explain the working of an E-learning module.

CLO2: Apply and Evaluate appropriate E-Learning Strategy and Pedagogy to a given topic.

CLO3: Differentiate between Summative and Formative assessment.

CLO4: Design and Develop an E-learning module and upload on LMS.

Module I: Introduction, Course Development and E-learning Strategies [15 HRS]

Scope and form of E-learning, Role of an E-learning project Phases in E-learning project. Instructional Design: The process of Designing Instruction.
Developing Materials (Storyboarding, Content Integration, and SCORM Compliance). Working with L.M.S (Learning Management System): Installation and use of the administrator, teacher and student interface; Course Definition, Registration and upload, tracking of results.
E-Learning Strategies: Simulation, Drill, Interactive Learning, Problem Solving, Tutorials.

Module II: Pedagogical Approaches & Assessment Design [15 HRS]

The Behaviorist School of learning and its implications on E-learning, The Cognitive School of Learning and its Implication on E-learning, The Constructivist School of Learning and its implications on E-learning, Blooms Taxonomy of Educational Objectives.

Assessment: Online formative and summative assessment. Rubrics for Assessment- Analytic and Holistic Rubrics, Security and Authentication.

Course Title : Technology in Teaching and Learning (MDC: PRACTICAL)
Course Code : UG-COM-MDC10
Semester : -
Credits : 01
Marks : 25
Duration : 30

List of Practicals :

1. Construct a Mind Map (Free Mind/Mindomo) *(1P)*
2. Create a Storyboard (PPT/Movie Maker/PowToon's/Storyboardthat) *(2P)*
3. Screen Recording S/W(Screencast/OBS/Filmora) *(2P)*
4. Collaborative Tools (G Suite) *(1P)*
5. Creating Blogs-(Blogger/WordPress) - *(2P)*
6. Installation, Creation & Running of an LMS-(Moodle/Google Classroom *(1P)*
7. Uploading Resources & Activities in the LMS-(Moodle/Google Classroom *(2 P)*
8.Creating a Complete Course in the LMS *(2 P)*
9. Design Rubrics for Scenarios-(Hot Potatoes/Ed puzzle/Poll Everywhere) *(2 P)*

REFERENCES:

Mandatory Reading:

1. Shelly Cashman Gunter.(2011).Teachers Discovering Computers: Integrating Technology in the Classroom,(7th ed.).Wadsworth Publishing Co Inc.

Supplementary Reading:

1. Smith, P. L. & Ragan, T. J.(2008). Instructional design(4rth ed.). New York: John Wiley & Sons. ISBN:0471393533
2. M.D. Roblyer, Aaron H. Doering(2018). Integrating Educational Technology into Teaching: Student Value Edition (8th ed.). Publisher: Pearson ISBN-10: 013289680X, ISBN-13:978- 0132896801.
3. Dick, W., Carey, L., & Carey, J. O.(2014). The systematic design of instruction (8^{th} ed.). Boston

Web References:

1.https://www.udemy.com/course/instructional-design-for-elearning/

2.https://nptel.ac.in/courses/127101013/
3.https://nptel.ac.in/courses/121105010/
4. https://www.plesyoutube.com/watchv=0flnAoX9QEw
5.https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/121106012/lec13.pdf

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