Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.

Nationally Accredited with A^{+} by NAAC IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF COMPUTER SCIENCE

SYLLABUS FOR POSTGRADUATE PROGRAMME

TEACHING PLAN

ODD SEMESTER 2024 – 2025

Vision

To provide a high-quality undergraduate education in computer science that prepares students for productive careers and life long learning.

Mission

1. To demonstrate proficiency in problem-solving techniques using the computer.
2. To demonstrate proficiency in at least two high-level programming languages and two operating systems
3. To show the ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
4. To show the ability to function effectively on teams to accomplish a common goal.
5. To sensitize the students to the social realities around them with the vision of making them responsible citizen.

Programme Educational Objectives (PEOs)

PEO	Upon completion of UG Degree Programme, the graduates will be able to:
PEO – 1	apply scientific and computational technology to solve socio ecological issues and pursue research.
PEO – 2	continue to learn and advance their career in industry both in private and public sectors.
PEO – 3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.

Programme Outcomes (POs)

PO	Upon completion of B.Sc. Degree Programme, the graduates will be able to:
PO – 1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.
PO – 2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.
PO – 3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.
PO – 4	develop innovative initiatives to sustain ecofriendly environment
PO – 5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.
PO – 6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.
PO – 7	learn independently for lifelong to execute professional, social and ethical responsibilities promoting sustainable development.

Programme Specific Outcomes (PSOs)

PSOs	Upon completion of the M.Sc. Degree Programme, the graduates will be able to:
PSO – 1	apply profound knowledge to analyze and design software and systems containing hardware and software components of varying complexity.
PSO - 2	apply mathematical model, algorithmic principles, and computer science theory in the design of real-time applications
PSO – 3	apply knowledge of computing to produce effective designs and solutions for specific problems.
PSO - 4	identify, analyze, design, optimize and implement system solutions using appropriate algorithms of varying complexity.
PSO - 5	work in multidisciplinary teams in small- and large-scale projects by utilizing modern software tools and emerging technologies to develop complex products for the societal needs.

Department : Computer Science

Class : I M. Sc Computer Science

Title of the Course : Core Course I: Analysis and Design of Algorithms

Semester : I

Course Code : SP231CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
SP231CC1	6	-	-	5	6	90	25	75	100

Objectives

1. Enable the students to learn the elementary data structures and algorithms.
2. Presents an introduction to the algorithms, their analysis and design.
3. Discuss various methods like basic traversal and search techniques, divide and conquer method, dynamic programming, backtracking.
4. Understood the various design and analysis of the algorithms.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO – 1	get knowledge about algorithms and determines their time complexity.	**PSO – 1**	**K2 (U)**
CO – 2	gain good understanding of Greedy method and its algorithm.	**PSO – 2**	**K3 (Ap)**
CO – 3	able to describe about graphs using dynamic programming technique.	**PSO – 4**	**K4 (An)**
CO – 4	demonstrate the concept of backtracking & branch and bound technique.	**PSO – 5**	**K3(Ap)**
CO – 5	explore the traversal and searching technique and apply it for trees and graphs.	**PSO – 3**	**K6(C)**

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Introduction**					
	1.	Introduction about Algorithm, Algorithm Definition	3	K1(U)	Introductory session	Overview
	2.	Algorithm Specification	2	K2(R)	Problem-solving	Simple definitions
	3.	Space complexity, Time Complexity, Asymptotic Notations	2	K2(U)	Lecture using Chalk and talk	Solve problems
	4.	Elementary Data Structures, Stacks, and Queues	3	K2(U)	PPT	Finish a procedure in many steps
	5.	Binary Tree, Binary Search Tree	3	K2(U)	Lecture using Chalk and talk	Evaluation essay
	6.	Heap sort	1	K3(Ap)	Demonstration	Concept definitions
	7.	Graph	1	K3(Ap)	Problem-solving	Problem-solving questions
II	**Traversal And Search Techniques**					
	1.	Basic Traversal and Search Techniques	3	K1(R)	Lecture using Chalk and talk	Evaluation through a short test
	2.	Techniques for Binary Trees	2	K2(U)	Demonstration	Map knowledge
	3.	Techniques for Graphs	3	K2(U)	Lecture using videos	Differentiate between various ideas
	4.	Divide and Conquer: General Method Binary Search	3	K3(Ap)	PPT	Seminar
	5.	Merge Sort	2	K3(Ap)	Demonstration	Recall steps
	6.	Quick Sort	2	K3(Ap)	Demonstration	MCQ
III	**Greedy Method**					
	1.	The Greedy Method Introduction	3	K2(U)	PPT	Short essays
	2.	General Method	3	K1(R)	Lecture using Chalk and talk	MCQ
	3.	Knapsack Problem	3	K5(E)	Demonstration	Recall steps
	4.	Minimum Cost Spanning Tree	3	K4(An)	Lecture using videos	True/False

	5.	Single Source Shortest Path	3	K3(Ap)	Demonstration	MCQ
IV	**Dynamic Programming**					
	1.	Dynamic Programming General Method	2	K2(U)	Lecture using Chalk and talk	Short Summary
	2.	Multistage Graphs	2	K3(Ap)	Lecture using videos	Concept explanations
	3.	All Pair Shortest Path	2	K3(Ap)	Demonstration	Recall Steps
	4.	Optimal Binary Search Trees	3	K4(An)	PPT	Evaluation through a short test
	5.	0/1 Knapsacks	2	K3(Ap)	Lecture using Chalk and talk	Short Summary
	6.	Traveling Salesman Problem	2	K6(C)	Problem-solving	Evaluation through a short test
	7.	Flow Shop Scheduling	2	K5(E)	Demonstration	Concept explanations
V	**Backtracking**					
	1.	Backtracking General Method	2	K1(R)	Lecture using Chalk and talk	True/False
	2.	8-Queens Problem	2	K3(Ap)	Demonstration	Evaluation through problems
	3.	Sum of Subsets	2	K3(Ap)	Problem-solving	Recall Steps
	4.	Graph Coloring	3	K4(An)	Demonstration	MCQ
	5.	Hamiltonian Cycles	3	K3(Ap)	Problem-solving	Short essays
	6.	Branch And Bound: The Method	2	K2(U)	Lecture using Chalk and talk	Seminar
	7.	Traveling Salesperson	3	K5(E)	PPT	Evaluation through a short test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/ En/SD): 1. Solve problems for Traveling Salesman.
2. Solve problems for Graph Coloring.
3. Apply the Quick Sort algorithm for a set of numbers.

Assignment: Heap Sort, Multistage Graphs

Seminar Topic: Binary Search, Branch and Bound

Sample questions

Part A

1. Which of the following data structures can be used to implement a stack?

   a) Array b) Linked List c) Both Array and Linked List d) Queue

2. What is the worst-case time complexity of Quick Sort?

   a) O(n) b) O(n log n) c) O(n^2) d) O(log n)

3. Which algorithm is used for finding the shortest path in a graph?

   a) Merge Sort b) Quick Sort c) Dijkstra's Algorithm d) Heapsort

4. Which of the following problems can be solved using the Greedy Method?

   a) 8-Queens Problem b) Knapsack Problem

   c) Merge Sort d) Traveling Salesman Problem

5. What is the time complexity of finding an element in a binary search tree?

   a) O(1) b) O(n) c) O(log n) d) O(n log n)

Part B

6. Explain the difference between space complexity and time complexity with examples.
7. Describe the process of Heapsort and explain its time complexity.
8. What is the Divide and Conquer method? Provide an example algorithm that uses this method.
9. Describe the Knapsack Problem and explain how the Greedy method can be used to solve it.
10. Explain the concept of Dynamic Programming and how it differs from Divide and Conquer.

Part C

11. Discuss the various techniques used for traversal of binary trees. Provide examples and algorithms for each method.
12. Explain Merge Sort in detail, including its algorithm, time complexity, and space complexity. Compare it with Quick Sort.
13. Describe the Dynamic Programming approach for solving the Traveling Salesman Problem.
14. Explain the 8-Queens Problem and how the Backtracking method can be used to solve it.
15. Describe the Branch and Bound technique and explain how it can be used to solve the Traveling Salesperson Problem.

Head of the Department
Mrs. J. Anto Hepzie Bai

Course Instructor
Mrs. J. Jackulin Reeja

Department : Computer Science

Class : I M.Sc Computer Science

Title of the Course : Core Course II: Object Oriented Analysis and Design & C++

Semester : I

Course Code : SP231CC2

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
SP231CC2	6	-	-	4	6	90	25	75	100

Objectives

1. Present the object model, classes and objects, object orientation, machine view and model management view.
2. Enables the students to learn the basic function, principles and concepts of object-oriented analysis and design.
3. Enable the students to understand C++ language with respect to OOAD

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO - 1	understand the concept of Object-Oriented development and modelling techniques	**PSO - 1**	**K1, K2 (R, U)**
CO - 2	gain knowledge about the various steps performed during object design	**PSO - 3**	**K2, K3 (U, Ap)**
CO - 3	abstract object-based views for generic software systems	**PSO -2**	**K3 (Ap)**
CO - 4	link OOAD with C++ language	**PSO - 4**	**K4, K5 (An, E)**
CO - 5	apply the basic concept of OOPs and familiarize to write C++ program	**PSO - 5**	**K5, K6 (E, C)**

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**The Object Model**					
	1.	The Evolution of the Object Model	4	K1(R)	Introductory session	Overview
	2.	Elements of the Object Model	4	K2(U)	PPT	Simple definitions
	3.	Applying the Object Model.	4	K2(U)	Demonstration	Examples Explanation
	4.	Classes and Objects: The Nature of an Object	3	K2(U)	Lecture using Chalk and talk	Short test
	5.	Relationship among Objects**.**	3	K2(U)	PPT	Evaluation essay
II	**Classes and Object**					
	1.	Nature of Class	3	K2(U)	Lecture using Chalk and talk	Evaluation through short test
	2.	Relationship Among classes	3	K2(U)	PPT	Seminar
	3.	The Interplay of classes and Objects.	3	K2(U)	Lecture using Chalk and talk	Short summary
	4.	Classification: The importance of Proper Classification	3	K3(Ap)	PPT	Evaluation
	5.	Identifying classes and objects	3	K3(Ap)	Demonstration	Recall definitions and their usage
	6.	Key Abstractions and Mechanism.	3	K3(Ap)	Demonstration	MCQ
III	**Introduction to C++**					
	1.	Input and output statements in C++	4	K3(Ap)	PPT	Short essays
	2.	Declarations	3	K3(Ap)	Lecture using Chalk and talk	MCQ
	3.	Control structures	3	K3(Ap)	Demonstration	Class Test
	4.	Control structures	3	K3(Ap)	Demonstration	Recall steps
	5.	Functions in C++	5	K3(Ap)	Lecture using videos	True/False
IV	**Inheritance and Overloading**					
	1.	Classes and Objects	2	K4(An)	Lecture using Chalk and talk	Short summary
	2.	Constructors and Destructors	3	K5(E)	Lecture using videos	Concept explanations

	3.	Operators overloading	2	K4(An)	Demonstration	Recall Steps
	4.	Type Conversion	2	K5(E)	PPT	Evaluation through short test
	5.	Inheritance	3	K5(E)	Lecture using Chalk and talk	Short summary
	6.	Pointers	3	K5(E)	Problem solving	Evaluation through short test
	7.	Arrays	3	K5(E)	Demonstration	Concept explanations
V	**Polymorphism and Files**					
	1.	Memory Management Operators	2	K5(E)	Lecture using Chalk and talk	True/False
	2.	Polymorphism	2	K6(C)	Demonstration	Evaluation through problems
	3.	Virtual functions	2	K6(C)	Problem solving	Recall Steps
	4.	Files	4	K6(C)	Demonstration	MCQ
	5.	Exception Handling	4	K6(C)	Problem solving	Short essays
	6.	String Handling	2	K6(C)	Lecture using Chalk and talk	Seminar
	7.	Templates	2	K6(C)	PPT	Evaluation through short test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/ En/SD): 1. Write C++ programs for Virtual Function.

2. Write C++ programs for Parameterized constructor.

3. Write C++ programs for Function overloading

Assignment: C++ program for Inheritance

Seminar Topic: Relationship among classes

Sample questions

Part A

1. The object model encompasses ____

   a) Abstraction b) Encapsulation c) Modularity d) All the above

2. Which is not a common kind of multiplicity?

   a) One-to-one b) Many-to-one c) One-to-many d) Many-to-many

3. Which of the following is not a fundamental data type in C++?

   a) int b) float c) string d) char

4. What is inheritance in C++?
   a) Wrapping of data into a single class
   b) Deriving new classes from existing classes
   c) Overloading of classes
   d) Classes with same names
5. Which type of function among the following shows polymorphism?
   a) Inline function
   b) Virtual function
   c) Undefined functions
   d) Class member functions

Part B

6. Write about the topology of second-generation languages.
7. Write short notes on Aggregation.
8. How do you wite an input and output statement in C++? Give example statements.
9. What are destructors? Write sample C++ code.
10. List any 8 string handling functions used in C++.

Part C

11. Discuss about the foundations of object model.
12. Explain about relationships among classes.
13. Describe the usage of functions with suitable C++ programs.
14. Summarize the different types of inheritance in C++.
15. Explain Polymorphism in C++ in detail.

Head of the Department
Mrs.J.Anto Hepzie Bai

Course Instructor
Mrs. Sahaya Rose Vigita.E

Department : Computer Science

Class : I M. Sc Computer Science

Title of the Course : Elective Course I: Python Programming

Semester : I

Course Code : SP231EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
SP231CC3	5	-	-	3	5	75	25	75	100

Objectives

1. Presents an introduction to python, creation of web applications, network applications and working in the clouds
2. Use functions for structuring python programs
3. Understand different data structures of python
4. Represent compound data using python lists, tuples and dictionaries

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO – 1	understand the basic concepts of python programming	PSO- 1	K1, K2 (R, U)
CO – 2	understand file operations, classes and objects	PSO- 3	K2, K3 (U, Ap)
CO – 3	acquire object oriented skills in python	PSO- 2	K3, K4 (Ap, An)
CO – 4	develop web applications using python	PSO- 4	K5(E)
CO – 5	develop client server networking applications	PSO- 5	K5, K6 (E, C)

Teaching Plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Introduction**					
	1.	Python Introduction	3	K1(R)	Introductory session	Overview
	2.	Numbers	2	K2(U)	Lecture using Chalk and talk	Simple definitions
	3.	Strings	2	K2(U)	Lecture using Chalk and talk	Example with representation
	4.	Variables	2	K2(U)	PPT	Syntax recall
	5.	Lists	2	K2(U)	Lecture using Chalk and talk	Simple programs
	6.	Tuples Dictionaries Sets	2	K2(U)	Demonstration	Concept definitions
	7.	Comparison	2	K4(An)	PPT	Problem solving questions
II	**Code Structures**					
	1.	**Code Structures:** if, elseif, and else Repeat with while Iterate with for	3	K2(U)	Lecture using Chalk and talk	Evaluation through short test
	2.	Comprehensions	2	K2(U)	Demonstration	Map knowledge
	3.	Functions	2	K2(U)	Lecture using videos	Differentiate between various ideas
	4.	Generators Decorators	2	K4(An)	PPT	Seminar
	5.	Namespaces and Scope	2	K1(R)	Demonstration	Recall steps
	6.	Handle Errors with try and except	2	K5(E)	Demonstration	MCQ
	7.	User Exceptions	2	K1(R)	Lecture using Chalk and talk	Map knowledge
III	**Modules, Packages, and Classes**					
	1.	Modules, Packages, and Programs:Standalone Programs Command Line Arguments , Modules and the import Statement	3	K1(R)	PPT	Recall steps
	2.	The Python Standard Library	2	K1(R)	Lecture using Chalk and talk	MCQ

	3.	Objects and Classes: Define a Class with class	2	K2(U)	Demonstration	Recall steps
	4.	Inheritance Override a Method Add a Method Get Help from Parent with super	3	K6(C)	Lecture using videos	Short Summary
	5.	In self Defense Get and Set Attribute Values with Properties	2	K3(A)	Demonstration	MCQ
	6.	Name Mangling for Privacy	1	K2(U)	PPT	Concept explanations
	7.	Method Types Duck Typing Special Methods	1	K1(R)	PPT	Assignment
	8.	Composition	1	K6(C)	Demonstration	Quiz
IV	**Datatypes and Web**					
	1.	Data Types: Text Strings Binary Data	2	K2(U)	Lecture using Chalk and talk	Short summary
	2.	Storing and Retrieving Data:File Input /Output	2	K1(R)	Lecture using videos	Concept explanations
	3.	Structured Text Files	2	K3(A)	Demonstration	Recall Steps
	4.	Structured Binary Files	1	K2(U)	Lecture using Chalk and talk	Concept explanations
	5.	Relational Databases	2	K1(R)	PPT	Evaluation through short test
	6.	No SQL Data Stores	1	K6(C)	Lecture using Chalk and talk	Short summary
	7.	Web: Web Clients Web Servers	2	K1(R)	PPT	Evaluation through short test
	8.	Web Services and Automation	2	K6(C)	Demonstration	Concept explanations
V	**Systems and Networks**					
	1.	Systems: Files Directories	2	K2(U)	Lecture using Chalk and talk	True/False
	2.	Programs and Processes Calendars and Clocks	2	K2(U)	Demonstration	Evaluation through problems
	3.	Networks: Patterns	2	K2(U)	PPT	Recall Steps
	4.	Internet Services	2	K4(An)	Demonstration	MCQ
	5.	The Publish Subscribe Model TCP/IP	2	K3(A)	PPT	Short essays

		Sockets Zero MQ				
	6.	Concurrency: Queues Processes Threads Green Threads and gevent Twisted Redis	3	K5(E)	Lecture using Chalk and talk	Seminar
	7.	Web Services and APIs Remote Processing Big Fat Data and Map Reduce	2	K1(R)	PPT	Concept explanations
	8.	Working in the Clouds	2	K2(U)	Lecture using videos	Recall

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/ En/SD): 1. Develop programs using Object Oriented Concepts.

2. Creating interactive web pages using forms.

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Nil

Activities related to Cross Cutting Issues: Nil

Assignment:

1. Different data types in Python and a comparison with C and C++ data types
2. Compare two Files line by line in Python.

Seminar Topic: Generators, Concurrency Control

Sample questions (minimum one question from each unit)

Part A

1. ___ is the maximum length of a Python identifier.

   a) 32 b)16 c)128 d) No fixed length

2. Which of the following is used for exception handling in Python?

   a) try b) except c) finally d) All the above

3. As what datatype are the *args stored, when passed into a function?

   a) List b) Tuple c) Dictionary d) None

4. Which of the following keywords is not reversed keyword in python?

   a) Class b) goto c) and d) None

5. Python supports the creation of anonymous functions at run time using a construct called ____.

a) lambda b)pi c) anonymous d) None

Part B

6. Write the features of Python.
7. Explain why Python is considered as an Interpreted Language.
8. Write notes on Name Mangling for Privacy.
9. Write a Python program to display Fibonacci sequence for n terms.
10. What do you understand about Redis?

Part C

11. Explain about tuples, lists and dictionaries in Python with example.
12. Explain in detail about Exception Handling.
13. Elaborate Inheritance concepts with examples.
14. Describe Web Services and automation.
15. Write in detail about TCP/IP model.

Head of the Department **Course Instructor**

Mrs. J. Anto Hepzie Bai Dr.V.S.Harilakshmi

Department : Computer Science

Class : I M.Sc. Computer Science

Title of the Course : Elective Course II: Internet of Things

Semester : I

Course Code : SP231EC5

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
SP231EC5	5	-	-	3	5	75	25	75	100

Objectives

1. About Internet of Things where various communicating entities are controlled and managed for decision making in the application domain.
2. Enable students to learn the Architecture of IoT and IoT Technologies
3. Developing IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO - 1	understand about IoT, its architecture and its applications	**PSO - 1**	**K1, K2 (R, U)**
CO - 2	understand basic electronics used in IoT & its role	**PSO - 2**	**K2, K3 (U, Ap)**
CO - 3	develop applications with C using Arduino IDE	**PSO - 3**	**K4 (An)**
CO - 4	analyze about sensors and actuators	**PSO - 4**	**K5, K6 (E, C)**
CO - 5	design IoT in real time applications using today's internet & wireless technologies	**PSO - 5**	**K6 (C)**

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Introduction to IoT**					
	1.	Introduction to IoT: Evolution of IoT	2	K2(U)	Lecture, Discussion	Quiz, Concept Mapping
	2.	Definition & Characteristics of IoT	2	K1(R)	Lecture using Chalk, PPT	Recall steps, Concept definitions
	3.	Architecture of IoT	2	K4(An)	Lecture using Chalk and talk, Demonstration, PPT	Questioning, Discussions
	4.	Technologies for IoT	2	K5(E)	Presentation, Debate	Case Analysis, Presentation
	5.	Developing IoT Applications	3	K3(Ap)	Lecture, Problem-solving exercises	Critical Thinking Tasks
	6	Applications of IoT	2	K3(Ap)	Case Studies, Group Discussions	MCQ
	7	Industrial IoT – Security in IoT	2	K4(An)	Lecture, Group Activities	Simulation, Case Studies
II	**Basic Electronics for IoT**					
	1	Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage	3	K2(U)	Lecture with illustrations	Check knowledge by asking questions.
	2	Binary Calculations – Logic Chips	3	K4(An)	Lecture cum Demonstration, PPT	Evaluation through short test
	3	Microcontrollers – Multipurpose Computers	3	K3(Ap)	Case study Method	Assignment
	4	Electronic Signals	2	K5(E)	Lecture, Problem-solving exercises	Class Test
	5	A/D and D/A Conversion	2	K6(C)	Group Discussion, PPT	Evaluation through online Quiz, Home work
	6	Pulse Width Modulation	2	K3(Ap)	Using Computational Techniques for solving Problem	Open Book Test

III	**Programming Fundamentals with C using Arduino IDE**					
	1	Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE	3	K2(U)	Lecture using Chalk and talk, Group Discussion	MCQ, True/False, , Concept explanations
	2	Basic Syntax – Data Types/ Variables/ Constant	2	K4(An)	Demonstrate with Examples	Concept Mapping
	3	Operators – Conditional Statements and Loops	3	K5(E)	Lecture, Group Discussions	Ask to write a program using conditional statements
	4	Using Arduino C Library Functions for Serial	2	K3(Ap)	Participating in Seminar	Presentation by seminar
	5	delay and other invoking Functions	3	K3(Ap)	Simulation	Model creation
	6	Strings and Mathematics Library Functions.	2	K6(C)	MS-Word Presentation	Recall
IV	**Sensors and Actuators**					
	1	Sensors and Actuators: Analog and Digital Sensors	3	K2(U)	Lecture using PPT, Group Discussion,	Formative Assessment
	2	Interfacing temperature sensor, ultrasound sensor	3	K6(C)	Lecture using Chalk and talk, Demonstration, PPT	Class test
	3	Infrared (IR) sensor with Arduino	3	K4(An)	Lecture using Chalk and talk	Discussions
	4	Interfacing LED	3	K2(U)	Lecture, Case Studies	Group discussions
	5	**Buzzer with Arduino**	3	K6(C)	Program Demonstration, PPT	Problem-solving questions, home work
V	**Sending Sensor Data Over Internet**					
	1	Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module	4	K4(An)	Group Discussion	Assignments
	2	Programming NODEMCU using Arduino IDE	3	K4(An)	Project Based	Map knowledge, questioning

	3	Using WiFi and NODEMCU	4	K3(Ap)	Simulation	Suggest idea/concept with examples.
	4	Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (Thing Speak).	4	K6(C)	Lecture Demonstration, PPT with examples	Problem-solving questions

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em/ En/SD): Asking students to develop an application using Arduino IDE.

Assignment: Microcontrollers and Multipurpose Computers, Infrared (IR) sensor with Arduino

Seminar Topic: Arduino C Library Functions for Serial, Analog and Digital Sensors

Sample questions

Part A

1. Which of the following is NOT a characteristic of IoT?

a) Connectivity b) Scalability c) Decentralization d) Intelligence

2. Ohm's Law is defined by which of the following equations?

a) V = I/R b) I = V/R c) R = I/V d) P = IV

3. Which of the following statements about the `for` loop in C is true?

a) It can only be used to increment values. b) It can initialize multiple variables.

c) It does not allow nested loops. d) It can only iterate a fixed number of times.

4. Which of the following sensors can measure distance?

a) Temperature sensor b) Infrared (IR) sensor

c) Ultrasound sensor d) Humidity sensor

5. What is the primary function of the ESP8266 NODEMCU in IoT applications?

a) Measuring temperature b) Providing power to sensors

c) Enabling WiFi connectivity d) Storing large amounts of data

Part B

6. Discuss the architecture of IoT in detail.
7. Explain the concepts of Analog-to-Digital (A/D) and Digital-to-Analog (D/A) conversion
8. Describe the process of installing and setting up the Arduino IDE
9. List any two sensors (one analog and one digital) that are commonly used in IoT applications and explain.

10. Explain how to set up the ESP8266 NODEMCU WiFi module and program it using the Arduino IDE

Part C

11. Explain the evolution of the Internet of Things (IoT)
12. Discuss in detail the role of micro controllers in IoT applications.
13. Elaborate Conditional Statements and Arduino C Library Functions for Serial, delay.
14. Describe that how to process and utilize the sensor data in an IoT application.
15. Describe the process of setting up a project that uses the ESP8266 NODEMCU WiFi module to send data from a temperature sensor to the ThingSpeak cloud platform

Head of the Department
Ms. J. Anto Hepzie Bai

Course Instructor
Dr. F. Fanax Femy

Department : Computer Science

Class : II M. Sc Computer Science

Title of the Course : Core Course V: Digital Image Processing

Semester : III

Course Code : SP233CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
SP233CC1	6	-	-	-	5	6	90	25	75	100

Objectives

1. To learn basic image processing techniques for solving real problems.
2. To learn image compression and Segmentation procedures.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO – 1	understand the fundamentals of Digital Image Processing	**PSO – 1**	**K2 (U)**
CO – 2	understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement	**PSO – 2**	**K2(U)**
CO – 3	apply, design and implement and get solutions for digital image processing problems	**PSO – 4**	**K3(Ap), K4(An)**
CO – 4	apply the concepts of filtering and segmentation for digital image retrieval	**PSO – 5**	**K3(Ap), K5(E)**
CO – 5	explore the concepts of Multi-resolution process and recognize the objects in an efficient manner	**PSO – 3**	**K5(E), K6(C)**

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Introduction**					
	1.	What is Digital image processing – the origin of DIP Examples of fields that use DIP	3	K2(U)	Lecture, Discussion	Concept Map, Short Essay
	2.	Fundamentals steps in DIP – Components of an image processing system	3	K3(Ap)	Hands-On Activity	Report Presentation
	3	Digital Image Fundamentals: Elements of Visual perception	3	K4(An)	Interactive Discussion, Case Analysis	Quiz
	3.	Light and the electromagnetic spectrum – Image sensing and acquisition	3	K3(Ap)	Lecture and demonstration	Explain their observations
	4.	Image sampling and Quantization	2	K2(U)	Lecture with PPT Interactive Sessions	Quiz, Diagram Analysis
	5.	Some Basic relationship between Pixels	2	K4(An)	Interactive Demonstration	Practical Assignment
	6.	Linear and Nonlinear operations.	2	K3(Ap)	Lecture and Demonstration	Asking Oral questions
II	**Image Enhancement**					
	1.	Image Enhancement in the spatial domain: Background	2	K1(R)	Lecture, Discussions	Quiz
	2.	some basic Gray level Transformations – Histogram Processing	3	K3(Ap)	Project-Based Learning	Presentation
	3.	Histogram Equalization	3	K3(Ap)	Interactive Software Demonstration	Critical Review
	4.	Enhancement using Arithmetic / Logic operations: Image	3	K3(Ap)	Real-World Application: Discuss	Peer Review

		Subtraction - Image Averaging				
	5.	Basics of spatial filtering	3	K4(An)	Lecture with PPT	Assignment
	6.	Smoothing spatial filters: Smoothing Linear Filters – Sharpening spatial filters	2	K3(Ap)	Project-Based Learning	Ask the students to apply filtering effect and presentation
	7	Combining spatial enhancement methods.	2	K5(E)	Comparative Analysis of skill-based course	Seminar
III	**Image Restoration**					
	1.	A model of the Image Degradation / Restoration Process	2	K4(An)	Critical Thinking Exercises	Conceptual Diagram
	2.	Noise models – Restoration is the process of noise only	3	K3(Ap)	Hands-On Simulation	Performance Evaluation
	3.	Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion.	3	K4(An)	Lecture and Demonstration with PPT	Quiz
	4.	Invariant Degradations – Estimating the degradation function	2	K5(E)	Case-Based Learning	Peer Evaluation
	5.	Inverse filtering – Minimum mean square Error Filtering	3	K3(Ap)	Practical Exercise	Problem-solving Assessment
	6.	Constrained least squares filtering	2	K4(An)	Algorithmic Explanation	Problem-solving Assessment
	7.	Geometric mean filter – Geometric Transformations.	3	K3(Ap)	Project-Based Learning	Ask to write a program for filtering
IV	**Image Compression**					
	1.	Image Compression Fundamentals–Coding Redundancy - Interpixel Redundancy	2	K2(U)	Lecture and Visual Aids (diagram)	Conceptual Quiz
	2.	Image compression models: The source encoder and decoder	2	K2(U)	Computational Thinking	Written Assignment

	3.	Channel Encoder and Decoder	3	K4(An)	PPT	Seminar
	4.	Elements of Information Theory - Measuring Information - The Information Channel	3	K2(U)	Lecture with PPT Interactive Sessions	Short test
	5.	Fundamental Coding Theorems – Error Free compression – Visible length Coding - LZW Coding	3	K5(E)	Lecture using videos	Comparative Analysis between various ideas
	6.	Lossy compression- Lossy Predictive Coding	2	K3(Ap)	Problem solving	Evaluation through short test
	7.	Image compression standards	3	K4(An)	Demonstration	Recall steps
V	**Image Segmentation**					
	1.	Segmentation - Detection and Discontinuities	2	K2(U)	Develop Practical Programs	True/False Questions
	2.	Point detection Line Detection - Edge Detection	2	K4(An)	Case Studies, Group Discussions	Analysis of Case Studies, Conceptual Questions
	3.	Edge Linking and Boundary deduction – Local Processing- Global Processing	2	K3(Ap)	Lecture with PPT	Seminar
	4.	Region-Based segmentation – Basic Formulation	3	K3(Ap)	You tube videos	MCQ
	5.	Region Growing, Splitting and Merging	3	K4(An)	Problem-solving Sessions, Debates, Scenario Analysis	Performance Evaluation Exercise, Test
	6.	Color fundamentals- color models- RGB color model	3	K6(C)	Demonstration with examples.	Concept definitions
	7.	CMY and CMYK color models.	3	K6(C)	Lecture using PPT	MCQ

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em/ En/SD): 1. Employability: Image sampling and Quantization

2. Skill Development: Implementing Histogram Equalization to Enhance Image Contrast using MATLAB.

Assignment: Basics of Spatial Filtering, Image Compression Models,

Seminar Topic: Spatial Enhancement Methods, Channel Encoder and Decoder

Sample questions

Part A

1. What is the primary objective of Digital Image Processing?

a) To create new images

b) To improve the quality of an image or extract useful information

c) To store images efficiently

d) To compress images without any loss

2. Which technique is used to improve the contrast of an image in the spatial domain?

a) Fourier Transform b) Histogram Equalization

c) Edge Detection d) Noise Reduction

3. Which filter is specifically designed to minimize the mean square error between the restored and the original image?

a) Median Filter b) Gaussian Filter

c) Minimum Mean Square Error (MMSE) Filter d) Sobel Filter

4. Which of the following is a lossless image compression technique?

a) JPEG b) LZW Coding c) MPEG d) JPEG 2000

5. Which method is commonly used for detecting edges in an image?

a) Region Growing b) K-means Clustering

c) Canny Edge Detection d) Principal Component Analysis (PCA)

Part B

6. Explain the fundamental steps involved in a digital image processing system.

7. Describe the process of histogram equalization. How does it improve the contrast of an image? Illustrate with an example

8. Discuss the different types of noise that can affect digital images.

9. What are the differences between lossless and lossy image compression techniques.

10. Explain the concept of edge detection in image segmentation

Part C

11. Discuss the components of an image processing system in detail. Explain how each component contributes to the overall functioning of the system.

12. Explain in detail the various techniques used for image enhancement in the spatial domain.
13. Describe the image degradation/restoration process model.
14. Elaborate on the fundamentals of image compression.
15. Discuss color fundamentals and color models

Head of the Department
Mrs. J. Anto Hepzie Bai

Course Instructor
Dr. F. Fanax Femy

Department : Computer Science

Class : II M. Sc Computer Science

Title of the Course : Core Course VI: Cloud Computing

Semester : III

Course Code : SP233CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
SP233CC2	6	-	-	-	5	6	90	25	75	100

Objectives

1. Gain knowledge on cloud computing, cloud services, architectures and applications.
2. Enable the students to learn the basics of cloud computing with real time usage.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO – 1	understand the concepts of cloud and its architecture	**PSO – 1**	**K1 (R), K2 (U)**
CO – 2	use and analyse the architecture and services of cloud	**PSO – 2**	**K3 (Ap)**
CO – 3	manage schedules, events and projects	**PSO – 3**	**K4 (An)**
CO – 4	collaborate cloud for Event & Project Management	**PSO – 4**	**K5 (E)**
CO – 5	apply and create the cloud simulator tools and virtual machines	**PSO – 5**	**K6 (C)**

Teaching Plan

Total Contact hours: 90 (Including lectures, assignments, and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment / Evaluation
I	**Introduction**					
	1	Introduction to Cloud Computing	3	K1 (U)	Introductory session	Overview
	2	Working of Cloud Computing	3	K2 (U)	Lecture using Chalk and talk	Simple definitions

	3	Companies in the Cloud	2	K2 (U)	PPT	Class discussion
	4	Essential characteristics, Architectural Influences, Technological Influences, and Operational Influences	4	K3 (U)	Lecture using Chalk and talk	Solve problems
	5	Cloud Computing Security challenges: Security Policy Implementation, Policy Types, and CSIRT	6	K3 (Ap)	Demonstration	Concept definitions and problem-solving questions
II	**Cloud Architecture**					
	1	Layers in Cloud Architecture	3	K2 (U)	Lecture using Chalk and talk	Short test
	2	SaaS: Features and Benefits	3	K3 (U)	PPT	True/False
	3	PaaS: Features and Benefits	3	K3 (U)	Lecture using videos	Seminar
	4	IaaS: Features and Benefits	3	K3 (U)	Demonstration	MCQ
	5	Cloud Deployment Models: Public, Private, Community, Hybrid	6	K3 (Ap)	Lecture using Chalk and talk	Problem-solving
III	**Cloud Computing for Everyone**					
	1	Cloud Computing for the Family	3	K2 (U)	PPT	Short essays
	2	Centralizing Email Communications	3	K3 (U)	Demonstration	Concept explanations

	3	Cloud Computing for the Community	3	K3 (U)	Lecture using Chalk and talk	Short Summary
	4	Collaborating on Schedules and Group Projects	3	K4 (An)	Lecture using videos	Evaluation through a short test
	5	Cloud Computing for Corporations: Managing Schedules, Projects, Contact Lists	6	K4 (An)	Demonstration	Short test
IV	**Using Cloud Services**					
	1	Collaborating on Calendars, Schedules, and Task Management	3	K2 (U)	Lecture using Chalk and talk	Short essays
	2	Exploring Online Scheduling and Planning	3	K3 (U)	Demonstration	MCQ
	3	Collaborating on Event Management	3	K3 (U)	PPT	Concept explanations
	4	Collaborating on Contact Management	3	K4 (An)	Problem-solving	Evaluation through a short test
	5	Collaborating on Project Management	6	K5 (E)	Demonstration	Problem-solving questions
V	**Cloud Simulators**					
	1	Introduction to CloudSim Simulator	3	K2 (U)	Lecture using Chalk and talk	True/False
	2	CloudSim Architecture: User code, CloudSim, GridSim, SimJava	4	K3 (Ap)	Demonstration	Problem-solving
	3	Working Platform for CloudSim	4	K3 (Ap)	Problem-solving	Recall Steps
	4	Introduction to GreenCloud	3	K4 (An)	Demonstration	MCQ

	5	Basics of VMware and Advantages of VMware Virtualization	6	K5 (E)	PPT	Evaluation through a short test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/En/SD):

1. Implementing cloud solutions for a community project.
2. Applying cloud services for managing personal and professional schedules.
3. Creating and managing virtual machines using VMware.

Assignments: Companies in Cloud, CloudSim Architecture, SaaS Benefits

Seminar Topic: Cloud Deployment Models, Cloud Security Challenges

Sample Questions

Part A

1. Which of the following is an essential characteristic of cloud computing?

   a) Scalability b) Fixed Cost c) Local Storage d) Manual Configuration

2. Which cloud computing model offers software applications over the internet?

   a) IaaS b) PaaS c) SaaS d) DaaS

3. What type of cloud is designed for exclusive use by a single organization?

   a) Public Cloud b) Private Cloud c) Community Cloud d) Hybrid Cloud

4. Which of the following is a benefit of using Platform as a Service (PaaS)?

   a) Complete control over hardware b) Reduced coding time

   c) Physical security management d) Unlimited data storage

5. Which cloud simulator provides an environment for modeling and simulating cloud computing infrastructures?

   a) VMWare b) Hyper-V c) GreenCloud d) CloudSim

Part B

6. Explain the working of cloud computing and its essential characteristics.
7. Describe the different layers in cloud architecture and their respective functions.
8. Discuss the security challenges in cloud computing and the role of the Computer Security Incident Response Team (CSIRT).
9. What are the benefits and features of Software as a Service (SaaS)?
10. Describe how cloud computing can be used for managing projects and schedules in a corporation.

Part C

11. Discuss the different cloud deployment models (Public, Private, Community, Hybrid) and their pros and cons.
12. Explain the concept of IaaS in detail, including its features, benefits, and typical use cases. How does it compare to other cloud service models like SaaS and PaaS?
13. Describe the use of cloud services for collaboration, including task management, event management, and contact management.
14. Explain the architecture of CloudSim, its components, and how it is used to simulate cloud computing environments.
15. Describe VMware virtualization, its advantages, and how it can be used to create and manage virtual machines.

Head of the Department
Mrs. J. Anto Hepzie Bai

Course Instructor
Mrs. J. Jackulin Reeja

Department : Computer Science

Class : II M. Sc Computer Science

Title of the Course : Elective Course V: Introduction to Research Methodology in Computer Science

Semester : III

Course Code : SP233CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
SP233EC1	4	-	-	3	4	60	25	75	100

Objectives

1. To ensure the reliability and validity of experiments.
2. To make use of computer aids to analyze the data, prepare reports and presentations.

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	CL
CO – 1	perform exploratory data analysis	PSO – 1	K1, K2 (R, U)
CO – 2	select and apply different research approaches and methodologies	PSO – 2	K2, K3 (U , Ap)
CO – 3	construct and document an appropriate research design	PSO – 4	K3, K4 (Ap, An)
CO – 4	validate the reliability	PSO – 5	K5, K6 (E, C)
CO – 5	apply the appropriate computer tools in each stage of research	PSO – 3	K6 (C)

Teaching plan
Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Postgraduate Research: Introduction- The Concept of Research	2	K1(U)	Introductory session	Word Cloud
	2.	Research Types – Research Attributes	2	K2(R)	Concept Explanations	Simple definitions
	3.	Qualities of Research-Research Cycle	2	K2(U)	Lecture using Chalk and talk	Diagnostic test
	4.	Types of Research Applicable in Information Systems and Cybersecurity Research	2	K2(U)	Interactive PPT	Quiz using slido
	5.	Descriptive Research-Exploratory Research	2	K2(U)	Computational Thinking	Evaluation essay
	6.	Applied Research	1	K3(A)	Demonstration	Concept definitions
	7.	Experimental Research-Theoretical Research	1	K2(U), K3(A)	Logical Thinking	Problem solving questions
II						
	1.	Computer Science (CS), Information Systems (IS) and Cybersecurity (CY) Research: Introduction	2	K1(R)	Lecture using Chalk and talk	Evaluation through short test
	2.	CS Research - IS Research	1	K2(U)	Simulation	List out the research areas
	3.	Cybersecurity (CY) Research	1	K2(U)	Lecture using videos	Prepare a list of cybersecurity challenges
	4.	The Intersection of CS, IS and CY Research	2	K3(A)	Comparative Analysis	Seminar
	5.	Designing the Research Proposal	2	K3(A)	Inquiry Based Teaching	Prepare a research proposal
	6.	Research Proposal Visualization	2	K2(U)	Logical Analysis	MCQ
	7.	Writing a Convincing Research Proposal	2	K1(R)	Project Based	Write a research proposal

III						
	1.	Mind Mapping to Visualize the Research Design: Introduction	1	K2(U)	PPT	Short essays
	2.	Strategy Approach-Design Project Versus Research Project	3	K1(R)	Comparative Study	MCQ Using Slido
	3.	Developing the Flow of Ideas - Mind Mapping Applied to Research Design	3	K5(E)	Flipped Classroom	Recall the mind mapping strategies
	4.	The Concept of Mind Mapping - Mind Map Use Cases and Benefits	3	K4(An)	Lecture using videos	Slip test
	5.	Application of Mind Mapping to Setting Out the Research Tasks.	2	K3(A)	Blended Learning	MCQ Using Nearpod
IV						
	1.	Foundational Research Writing: Foundational Research Tools and Techniques	2	K2(U)	Context Based	Short summary
	2.	Writing the Annotated Bibliography	2	K3(A)	Demonstration	Prepare a Bibliography for Research Methodology
	3.	Reading and Writing with Purpose	2	K3(A)	Computational Learning	Practice to write a proposal
	4.	Critical Thinking and Analysis - Background Discussion	2	K4(An)	PPT	Evaluation through short test
	5.	Practice-Oriented Background and Review of Trends - Theoretical Background- Conceptual Background	2	K3(A)	Demonstration	Short summary
	6.	Literature Review and Analytical Framework- Structuring and Organizing the Literature Review	2	K6(A)	Analytical Study	Evaluation through short test
V						
	1.	Design and Methodology:	1	K1(R)	Context Based	True/False

		Introduction- Research Design				
	2.	Types of Research Design- Requirements Engineering	2	K3(A)	Lecture	Evaluation through exercises
	3.	Research Methodology - Quantitative and Qualitative methodology	2	K3(A)	Analytical Study	Collect and analyze data
	4.	Overview of Data Collection Techniques and Processes	1	K4(An)	Lecture method	MCQ
	5.	Types of Data Collection - Data Organization, Selection and Processing	2	K3(A)	Problem solving	Short essays
	6.	Data Presentation and Data Visualization	2	K2(U)	Gamification	Seminar
	7.	Data Analysis	2	K5(E)	PPT	Evaluation through short test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/ En/SD):1. Collect data from a school, process it and present the contents.

2. Write a research proposal for Recommendation System.

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Professional Ethics

Activities related to Cross Cutting Issues: Nil

Assignment:

1. Requirements Engineering
2. Research Cycle

Seminar Topic:

1. Mind map: Use cases and Benefits
2. The Intersection of CS, IS and CY Research

Sample questions (minimum one question from each unit)

Part A

1. What does the research cycle NOT typically include?

a) Problem identification b) Hypothesis formulation

c) Data encryption d) Data collection

2. Name the research type that involves controlled experiments to test hypotheses.

3. Which is a benefit of using mind maps?

a) Increases confusion b) Enhances brainstorming

c) Limits idea generation d) Reduces productivity

4. Correlational research design type examines relationships between variables. Say True or False.

5. What is the primary goal of data presentation and data visualization?

a) Obscure findings b) Lengthen the research report

c) Confuse the audience d) Effective presentation of data using visual aids

Part B

6. Explain the concept of research and discuss its significance.
7. What are the essential components of a strong research proposal?
8. Compare quantitative and qualitative methodologies. Discuss scenarios where each methodology would be most appropriate in information systems research.
9. Describe the different data collection techniques and their relevance in research.
10. Explain the steps involved in data analysis and the role it plays in interpreting research data.

Part C

11. Outline the research cycle and explain each step with specific emphasis on how it applies to a research project in cybersecurity.
12. Describe the process of conducting a literature review and constructing an analytical framework.
13. Explain the concept of mind mapping and its application to research design.
14. What are the foundational research tools and techniques necessary for effective research writing? Discuss their importance in the context of writing an annotated bibliography.
15. Discuss the importance of data presentation and data visualization in research. How can effective data visualization enhance the understanding of research findings?

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