HOLY CROSS COLLEGE (AUTONOMOUS)
Affiliated to Bharathidasan University
Nationally Accredited (4th cycle) with A++ Grade (CGPA 3.75/4) by NAAC
College with Potential for Excellence
Tiruchirappalli-620002

PG DEPARTMENT OF COMPUTER APPLICATIONS
Programme: M.C.A

PO. No	Programme Outcomes *Upon completion of the M.C.A. Degree Programme, the graduate will be able to*
PO-1	Exhibit a profound mastery of fundamental concepts, theories, methodologies, and tools in their field, equipping them to skillfully analyze and evaluate issues that pertain to their area of expertise.
PO-2	Conduct original and independent research to create findings and solutions to address the societal problems.
PO-3	Apply employability skills to confidently navigate in the job market and excel in competitive examinations in diverse professional settings.
PO-4	Demonstrate a strong commitment to ethical and moral values, actively engage in activities that promote social responsibility, decision making as inspired leaders to contribute positively for the betterment of society both locally and globally
PO-5	Embrace a commitment to lifelong learning and professional development, possessing the skills to adapt to the evolving trends, engage in self-directed learning and continuously enhance their expertise.
PO-6	Promote information literacy, critical, analytical, logical, computational, ICT, entrepreneurial, managerial skills, research aptitude and become professionals/entrepreneur in various domains to serve the needs of the industry and society
PO-7	Apply the mathematical techniques, software development strategies, tools and organize information system and services to draw solution in complex and multidisciplinary scenario.

PSO .No.	Programme Specific Outcomes *Upon completion of these courses the student would*
PSO-1	Recognize the necessity for lifelong learning of emerging technologies, tools, adapt critical and analytical thinking and provide innovative ideas and solutions to societal and industrial problems in various domains.
PSO-2	Apply the software engineering strategies, practices and skills gained to analyze, design, construct effective software products to deliver quality products catering to the needs of the industry and society in a global scenario.
PSO-3	Exhibit employability skills to navigate in the job market, adapt to challenges and excel in diverse professional settings, apply the managerial skills to work and make decisions effectively, promote entrepreneurial skills to initiate startups and acquire academic excellence with an aptitude for higher studies and research.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI – 620 002
SCHOOL OF MATHEMATICAL COMPUTATION SCIENCES
PG DEPARTMENT OF COMPUTER APPLICATIONS
PG COURSE PATTERN
MCA

(For Candidates admitted in the academic year 2023 - 2024)

Semester	Course	Title of the Course	Code	Hrs/ Wk	Credits	Marks
I	Core Course 1	Computer Organization and Architecture	P23CA1CCT01	4	4	100
	Core Course 2	Advanced Java Programming	P23CA1CCT02	5	4	100
	Core Course 3	Data Structures	P23CA1CCT03	4	4	100
	Core Course 4	Computer Networks and Network Security	P23CA1CCT04	4	4	100
	Core Course 5	Fundamentals of Accounting and Financial Management	P23CA1CCT05	4	4	100
	Core Course 6	Advanced Java Programming- Practical I	P23CA1CCP06	4	2	100
	Core Course 7	Server Side Scripting Tools – Practical II	P23CA1CCP07	4	2	100
		Value Education		1	-	-
		Internship/Field Work/Field Project (30 Hours)	P23EX1INT01	-	2 (EC)	100
		TOTAL		**30**	**24+2**	**700+100**
II	Core Course 8	Operating Systems	P23CA2CCT08	4	4	100
	Core Course 9	Database Systems	P23CA2CCT09	5	4	100
	Core Course 10	Resource Management Techniques	P23CA2CCT10	4	4	100
	Core Course 11	Organizational Dynamics	P23CA2CCT11	4	4	100
	Core Course 12	Operating Systems – Practical III	P23CA2CCP12	4	2	100
	Core Course 13	Database Systems – Practical IV	P23CA2CCP13	4	2	100
	Elective Course 1	Cloud Computing/ Fog Computing / High Performance Computing	P23CA2ECT01/ P23CA2ECT02/ P23CA2ECT03	4	4	100
		Value Education		1	-	-
		Internship/Field Work/Field Project (30 Hours)	P23EX2INT02	-	2 (EC)	100
		Online Course	P23EX2ONC01	-	2 (EC)	100
		TOTAL		**30**	**24+4**	**700+200**

Semester	Course	Title of the Course	Code	Hr/Wk	Credits	Marks
III	Core Course 14	Full Stack Web Application Development	P23CA3CCT14	5	4	100
	Core Course 15	Principles of Compiler Design	P23CA3CCT15	4	4	100
	Core Course 16	Software Engineering	P23CA3CCT16	5	4	100
	Core Course 17	Mobile Application Development	P23CA3CCT17	4	4	100
	Elective Course 2	Artificial Intelligence and Machine Learning/ Fuzzy Logic/ Artificial Neural Networks	P23CA3ECT05/ P23CA3ECT06/ P23CA3ECT07	4	4	100
	Core Course 18	Full Stack Web Application Development – Practical V	P23CA3CCP18	4	2	100
	Core Course 19	Mobile Application Development – Practical VI	P23CA3CCP19	4	2	100
		Self Study Paper – Professional Ethics	P23CA3SST01	-	2(EC)	100
		Mini Project	P23CA3DIS01	–	4(EC)	100
		Internship/Field Work/Field Project (30 Hours)	P23EX3INT03	-	2 (EC)	100
		Online Course	P23EX3ONC02	-	2 (EC)	100
		TOTAL		**30**	**24+10**	**700+400**
IV	Core Course 20	Machine Learning with Python – Practical VII	P23CA4CCP20	4	3	100
	Core Course 21	Entrepreneurship and Business Management	P23CA4CCT21	3	3	100
	Elective Course 3	Internet of Things/ Big Data Analytics / Data Science and Applications	P23CA4ECT09/ P23CA4ECT10/ P23CA4ECT11	4	3	100
	Elective Course 4	Internet of Things - Practical VIII / Data Analytics - Practical IX / Data Science using R - Practical X	P23CA4ECP12/ P23CA4ECP13/ P23CA4ECP14	4	3	100
		Project	P23CA4DIS02	15	6	100
		Internship/Field Work/Field Project (30 Hours)	P23EX4INT04	-	2 (EC)	100
		TOTAL		**30**	**18+2**	**500+100**
		GRAND TOTAL		**120**	**90+18**	**3400**

(**MANDATORY COURSE** for Non-Major Candidates admitted in the academic year 2023 - 2024)

Semester	Course	Title of the Course	Code	Credits	Marks
I	Mandatory Course 1	Object - Oriented Programming with C++	P23CA1MCT01	5	100
I	Mandatory Course 2	C++ Programming– Practical I	P23CA1MCP02	5	100
II	Mandatory Course 3	Computer Graphics	P23CA2MCT03	5	100
II	Mandatory Course 4	Computer Graphics - Practical II	P23CA2MCP04	5	100
TOTAL				20	400

Semester	Course	Title of the Course	Code	Credits	Marks
III	Mandatory Course 5	Web Technologies	P23CA3MCT05	5	100
III	Mandatory Course 6	Web Technologies- Practical III	P23CA3MCP06	5	100

LIST OF NME COURSES OFFERED BY THE DEPARTMENT

Semester	Course	Title of the Course	Code	Hr/ Wk	Credits	Marks
II	SEC1(NME1)	Web Page Development - Lab	P23CA2SEP01	5	2	100
III	SEC2(NME2)	Advanced Excel - Lab	P23CA3SEP02	3	2	100

ELECTIVEPAPERS OFFERED TO OTHER DEPARTMENT

Semester	Course	Title of the Course	Code	Hr/Wk	Credits	Marks
II	Elective Course 4	Cyber Security	P23CA2ECT04	4	3	100
III	Elective Course 5	Blockchain Technology	P23CA3ECT08	3	3	100

(For the candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS),TIRUCHIRAPALLI - 620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – I

Course Title	Core Course I - Computer Organization and Architecture
Total Hours	60
Hours/Week	4 Hrs / Wk
Code	P23CA1CCT01
Course Type	Theory
Credits	4
Marks	100

General Objective:

To learn the structure and behavior of the various modules of the computer and to understand the way in which the hardware components are connected together to form computer system.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the various kinds of Number Systems and their conversions.
CO-2	Describe the Sequential Circuits and Combinational Circuits.
CO-3	Present the concepts of instruction cycle, instruction code and I/O interrupts.
CO-4	Compare different types of addressing modes and explain the concepts of vector processing.
CO-5	Analyze the purpose of Register transfer, micro operations and memory management.

UNIT I **12 Hrs**

NUMBER SYSTEM: Decimal, Binary, Octal, Hexadecimal – Conversion to one another – Gray Code – BCD – EBCDIC – ASCII – Binary Addition – Binary Subtraction – Binary Multiplication – Binary Division – 1's Complement – 2's Complement – Fixed Point Representation – Floating Point Representation.

DIGITAL LOGIC CIRCUITS: Logic Gates – Boolean Laws –Demorgan's Law– K-Map Simplification – Sum of Product – Product of Sum Methods.

Extra Reading(Key words): Designing the Logic circuits using K-Maps.

UNIT II **12 Hrs**

COMBINATIONAL CIRCUITS: Half Adder – Full Adder – Flip Flops – JK Flip Flop – RS Flip Flop –D Flip Flop – T Flip Flop – Master-Slave Flip Flop.

DIGITAL COMPONENTS: Decoders – Encoders – Multiplexers – De Multiplexers – Registers – Shift Registers – Binary Counter.

Extra Reading(Key words): Comparison of combinational and sequential circuits.

UNIT III **12 Hrs**

BASIC COMPUTER ORGANIZATION AND DESIGN: Instruction Codes – Computer Register – Computer Instructions – Timing and Control – Instruction Cycle – Memory Reference Instructions – I/O interrupt – Complete Computer Description.

Extra Reading(Key words): INTEL 8085 & 8086 Instructions.

UNIT IV **12 Hrs**

CPU: General Register Organization – Stack Organization – Instruction Format– RISC – Addressing Modes – Data Transfer and Manipulation.

PIPELINE AND VECTOR PROCESSING: Parallel Processing – Pipelining– Arithmetic Pipeline
– Instruction Pipeline – RISC Pipeline – Vector Processing.

Extra Reading(Key words): Compare and process the real time data with Stack, Pipeline and vector processing.

UNIT V **12 Hrs**

REGISTER TRANSFER AND MICRO OPERATIONS: Register Transfer Language – Register Transfer– Bus and Memory Transfers – Arithmetic Micro-operations – Logic Micro-operations – Shift Micro-operations.

MEMORY ORGANIZATION: Memory Hierarchy – Main Memory – Auxiliary Memory – Associate Memory – Cache Memory – Virtual Memory.

Extra Reading(Key words): Study on other types of Memory.

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminar.

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recall and relate the various number systems.	PSO 1	R, U
CO-2	Explain the Sequential Circuits and Combinational Circuits.	PSO 2	A
CO-3	Illustrate the concepts of instruction cycle, instruction code and I/O interrupts.	PSO 2	U
CO-4	Differentiate different types of addressing modes.	PSO 3	Ap
CO-5	Summarize on memory organization.	PSO 4	An
CO-6	Acquire the knowledge of working principles of computer systems	PSO 2	Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT:

1. Albert Paul Malvino, Leach Donald. P, **"Digital Principles and Applications"**, 2000, Fourth Edition Tata McGraw Hill Publishing Company Ltd., New Delhi.
   UNITI Chapters 4 (4.1– 4.8)
   UNITII Chapters 11(11.1,11.3)

2. Morris Mano. M, **"Computer System Architecture"**, 2005, Third Edition, Prentice – Hall of India Private Ltd., New Delhi.
   UNITI Chapters 3(3.3 – 3.4)**,** Chapters 1(1.2 – 1.4)
   UNITII Chapters 1(1.5,1.6)**,** Chapters 2(2.2 – 2.3)
   UNITIII Chapter 5(5.1–5.8)
   UNITIV Chapter 8 (8.2 – 8.6)**,** Chapter 9 (9.1 –9.6)
   UNITV Chapter 4(4.1– 4.6)**,** Chapter12(12.1 –12.6)
3. Floyd and Jain **"Digital Fundamentals"**,2006, Eighth Edition, Pearson Education
   UNITII Chapter 9(9.2 –9.5)

SUGGESTED READINGS:

1. Anokh Singh, Chanbra. A.K., **"Fundamentals of Digital Electronics"**, 2003, S. Chand Company, New Delhi.
2. Bartee Thomas C., **"Digital Computer Fundamentals"**, 2000, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, **"ComputerOrganization"**,2002,Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Dezso Sima, Terence Fountain, Peter Kacsuk, **"Advanced Computer Architecture"**, 2005, Pearson Education, New Delhi.
5. Tanenbaum Andrew S. **"Structured Computer Organization"**, 2002, Prentice Hall of India Private Ltd., New Delhi.

(For the Candidates admitted fromthe academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A -First Year - Semester – I

Course Title	**Core Course II – Advanced Java Programming**
Total Hours	**60**
Hours/Week	**5 Hrs/Wk**
Code	**P23CA1CCT02**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

To impart sound knowledge in object -oriented programming with developing programming skills in Java.

To understand various components of J2EE like JSP, Servlets, EJB, JDBC and effectively use in Web applications.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the Concepts of Object -Oriented Programming and remember the working process of Class and the concept of Inheritance.
CO-2	Applying the concepts of Packages to organize classes and interfaces. Applying the concepts of String handling functions and Exception Handling.
CO-3	Discuss and apply the concepts of Applets. Differentiate and Implement JDBC Driver types and JDBC Objects to access database.
CO-4	Understand and classify the various tiers in J2EE. Analyze and Distinguish CGI and Java Servlet technology in distributed applications.
CO-5	Design and Implement JSP and EJB technology for creation of ERP software.

UNIT I **12 Hrs**

INTRODUCING CLASSES: Class Fundamentals – Declaring Objects – Assigning Object Reference Variables – Introducing Methods – Constructors – The this Keyword – Garbage Collection – The finalize() Method.

A CLOSER LOOK AT METHODS AND CLASSES: Overloading Methods – Using Objects as Parameters – A Closer Look at argument Passing – Returning Objects – Recursion – Introducing Access Control – Understanding static – Introducing final – Introducing Nested and Inner Classes.

INHERITANCE: Inheritance Basics – Using super – Creating Multilevel Hierarchy – Method Overriding – Dynamic Method Dispatch – Using Abstract Classes – Using final with Inheritance.

Extra Reading (Key terms): comparing different kinds of Inheritance.

UNIT II **12 Hrs**

PACKAGES AND INTERFACES: Packages – Access Protection – Importing Packages – Interfaces.

EXCEPTION HANDLING: Exception – Handling Fundamentals – Exception Types – Uncaught Exceptions – Using try and catch – Multiple catch Clauses – Nested try Statements – throw – throws – finally – Java's Built – in Exceptions.

STRING HANDLING: The String Constructors – String Length – Special String Operations – Character Extraction – String Comparison – Searching Strings – Modifying a String – Data Conversion using valueOf( ) – Changing the Case of Characters Within a String – String Buffer.

***Extra Reading (Key terms): Apply*ing all the string functions in programs.**

UNIT III **12 Hrs**

I/O, APPLETS, OTHER TOPICS: I/O Basics – Reading Console Input – Writing Console Output – The Print Writer Class –Reading and Writing Files – Applet Fundamentals.

JDBC OBJECTS: The concept of JDBC – JDBC Driver Types – JDBC packages – A brief overview of the JDBC process – Database Connection – Associating the JDBC / ODBC Bridge with the Databases – Statement objects – Result set.

Extra Reading (Keyword): Threading and Multi-Threading, Java Persistance API.

UNIT IV **12 Hrs**

J2EE MULTI – TIRE ARCHITECTURE: J2EE Multi-Tier Architecture – Client Tier Implementation – Web Tier Implementation – Enterprise JavaBeans Tier Implementation – Enterprise Information Systems tier Architecture.**JAVA SERVLETS:** Java Servlets and Common Gateway Interface programming – Benefits of using a Java servlet – A simple Java servlet – Anatomy of a Java servlet – Deployment Descriptor – Reading data from a client – Sending data to a client – Reading HTTP request header – Writing the HTTP response header.

Extra Reading (Keyword): AjaX–Asynchronous JavaScript and XML.

UNIT V **12 Hrs**

JAVA SERVER PAGES: Java Server Pages – Java Server pages Tags – Tomcat – Request String – User Sessions – Cookies – Session Objects.

ENTERPRISE JAVA BEANS: Enterprise Java Beans – Session Java Bean – Entity Java Bean – Message Driven Bean – The JAR File.

Extra Reading (Keyword): JSTL core and Formatting tag, server – Glassfish, Websphere.

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the Apply the concepts of Class, data encapsulation, inheritance, and polymorphism to large scale software.	PSO 1	R, U, Ap
CO-2	Apply the concepts of String handling and Exception handling.	PSO 2	U
CO-3	Investigate the concepts of Graphical User Interfaces. Identify various driver and Objects used in JDBC connection with database.	PSO 3	R
CO-4	Recall and relate the various technologies with multitier in J2EE architecture.	PSO 4	R
CO-5	Design and implement Java servlet program using HTTP protocol.	PSO 4	C, Ap
CO-6	Apply JSP tags and create Web application software for real time problems	PSO 5	Ap
CO-7	Design and construct business software using various types of beans in EJB.	PSO 3 PSO 5	C, Ap
CO-8	Develop advanced java programs for creating web applications and web sites	PSO 3	Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT:

1. Herbert Schildt, Java 2: "**The Complete Reference",** 2011 Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

   UNIT I **:** CHAPTERS 6, 7, 8
   UNIT II **:** CHAPTERS 9, 10, 17
   UNIT III (First Half) **:** CHAPTERS 13

2. Jim Keogh, **"The Complete Reference J2EE"**, 2014, Tata McGraw – Hill Publishing Company Limited, New Delhi.

   UNIT III (Second Half)**:** CHAPTER 6
   UNIT IV **:** CHAPTERS 2, 10
   UNIT V **:** CHAPTERS 11, 12

SUGGESTED READINGS :

1. C. Muthu, "**Programming with** JAVA", Vijay Nicole Imprints Private Limited, 2nd Ed, Chennai, 2011
2. James McGovern, Rahim Adatia, Yakov Fain, Jason Gordon, Ethan Henry, Walter Hurst, Ashish Jain, Mark Little, VaidayanathanNagarajan, Harsad Oak, Lee Anne Phillips, **"J2EE BIBLE 1.4"**, 2011, Wiley Dreamtech Private India Ltd., New Delhi.
3. Dreamtech Software Team,**"Java Server Programming J2EE Black Book",** 2005, Dreamtech Press.
4. Denninger, Stefan, Peters, Ingo, Castaneda, Rob, **"Enterprise JavaBeans 3.1"**, 2010, Apress Publishers.
5. Joel Murach and Michael Urban, **"Murach's Java Servlets and JSP"**, 2014, Mike Murach & Associates.

(For the Candidates admitted fromthe academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – I

Course Title	**Core Course III– Data Structures**
Total Hours	**60**
Hours/Week	**4 Hrs/Wk**
Code	**P23CA1CCT03**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

To understand the fundamental concepts of Data Structures and Algorithms.

Course Objectives:

The Learner will be able to

CO No.	Course Objectives
CO-1	Understand the basics of Data Structures and its applications.
CO-2	Apply the real time applications in Linear Data Structures.
CO-3	Analyze the different types of Trees and its basic operations.
CO-4	Analyze sorting and searching algorithms
CO-5	Explain Graph and its Applications

UNIT I **12 Hrs**

INTRODUCTION AND OVERVIEW: Introduction– Basic Terminology; Elementary Data Organization– Data Structures – Data Structure Operations.

STRING PROCESSING: Introduction– Basic Terminology – Storing Strings – Character Data Type – String Operations – Word Processing – Pattern Matching Algorithms.

ARRAYS, RECORDS AND POINTERS: Introduction – Linear Arrays – Representation of Linear Arrays in Memory – Traversing Linear Arrays – Inserting and Deleting.

Extra Reading : Compare the efficiency of various Search and Pattern Matching Algorithms.

UNIT II **12 Hrs**

LINKED LISTS: Introduction – Linked Lists – Representation of Linked Lists in Memory – Traversing a Linked List – Searching a Linked List – Memory Allocation: Garbage Collection – Insertion into a Linked List – Deletion from a Linked List – Header Linked Lists – Two – way Lists.

STACKS, QUEUES, RECURSION: Introduction – Stacks – Array Representation of Stacks – Linked Representation of Stacks – Arithmetic Expressions : Polish Notation – Quicksort, Application of Stacks – Recursion – Towers of Hanoi – Implementation of Recursive Procedures by Stacks – Queues – Linked Representation of Queues – Dequeue – Priority Queues.

Extra Reading : Apply the Linear Data Structures and develop algorithms for real time applications using Linked List, Stack, Queue.

UNIT III **12 Hrs**

TREES: Introduction – Binary Trees – Representing Binary Trees in Memory – Traversing Binary Trees – Traversal Algorithm using Stacks – Header Nodes – Threads – Binary Search Trees – Searching and Inserting in Binary Search Trees – Deleting in a Binary Search Tree – AVL Search Trees – Insertion in an AVL Search Tree – Deletion in an AVL Search Tree.

Extra Reading: Implement the Tree Structures in Real Time Applications.

UNIT IV **12 Hrs**

SORTING AND SEARCHING: Introduction Searching: Linear Search – Binary Search - Sorting: Bubble Sort – Insertion sort – Selection sort – Merging – Merge sort – Radix Sort, Searching and data modification

Extra Reading: Find the Time and Space Complexity of Algorithms.

UNIT V **12 Hrs**

GRAPHS AND THEIR APPLICATIONS: Introduction, graph theory Terminology, sequential representation of graphs, Adjacency matrix and path matrix, Warshall's algorithms; shortest path, linked representation of a Graph Operations on Graph, Traversing a Graph.

Extra Reading: Compare Minimum Spanning Tree and Maximum Spanning tree

Course Outcomes:

The Learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the fundamentals of Data Structures and basic concepts of String Processing, Linear Arrays, Records and Pointers.	PSO 1	U
CO-2	Analyze the representation of Linked Lists in memory, Stack, Queues and implement real time applications in Stack and Queues.	PSO 2	An
CO-3	Explore the structure of Trees, basic operations of Trees, analyze and illustrate the algorithms.	PSO 2	U
CO-4	Apply data structures and algorithms in real time applications.	PSO 3	Ap
CO-5	Analyze various searching and sorting algorithms	PSO 4	An
CO-6	Discuss various trees and Traversing	PSO 2	An

PRESCRIBED TEXT:

1. Seymour Lip schutz, G.A. Vijayalakshmi Pai..*Data Structures*, 2006, Tata McGraw Hill Education Private Limited, New Delhi.

UNIT I: Chapter1(1.1-1.4), Chapter 3, Chapter 4(4.1- 4.5)
UNIT II: Chapter 5, Chapter 6
UNIT III: Chapter 7(7.1-7.12)
UNIT IV: Chapter 4(4.6,4.7,4.8), Chapter 9(9.1,9.3-9.8) (Complexity of the Algorithms are not included)
UNIT V: Chapter 8(8.1-8.7)

SUGGESTED READINGS:

1. Seymour Lipschutz, **"Theory and Problems of Data Structures"**, 2000, McGraw Hill Book Company, International Editions.

2. Tanenbaum A.M and Augustein M.J., **"Data structures with Pascal"**, 2002, Prentice Hall of India Ltd, New Delhi.

3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, **"Data Structures and Algorithms"**, 2004, Addison Wiley Publishing company.

4. Robert. L. Kruse, **"Data structures and program design"**, Third Edition, 2001.

5. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta. **"Fundamentals of Data Structures in C++"**, 2009, Second Edition.

(For the Candidates admitted from the academic year 2023 Onwards)
HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – I

Course Title	**Core Course IV– Computer Networks and Network Security**
Total Hours	**60**
Hours/Week	**4 Hrs/Wk**
Code	**P23CA1CCT04**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:
To learn and understand the computer networking concepts, its implementation details and the importance of network security.

Course Objectives(CO):
The learner will be able to

CO No.	Course Objectives
CO-1	Remembers and understands the basic concept of computer hardware and software.
CO-2	Understand the types of Transmission Media and remembers the working principles of Public Switched Telephone Network and Mobile Telephone System.
CO-3	Understand the general techniques of Error control, Flow control in Data Link Protocols.
CO-4	Analyses the Routing and Congestion Control Algorithms in Network Layer; remember the underlying protocol in Transport Layer.
CO-5	Remember the various services of Transport Layer and Application Layer; analyze the various techniques in cryptography.
CO-6	Understand the fundamentals of network security and learn the encryption and digital signature techniques.

UNIT I **12 Hrs**

INTRODUCTION: Network Hardware – Network Software: Protocol Hierarchies – Design Issues for the Layers – Connection– Oriented and Connectionless Service – Service Primitives – Reference Models: The OSI Reference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models.

Extra Reading: Learn the general concepts of Networks.

UNIT II **12 Hrs**

THE PHYSICAL LAYER: Guided Transmission Media – Wireless Transmission Media – Communication Satellites – The Public Switched Telephone Network: Structure of the Telephone System – Mobile Telephone System.

Extra Reading: Working with real time examples using Mobile Networks.

UNIT III **12 Hrs**

THE DATA LINK LAYER: Data Link Layer Design issues – Error Detection and Correction – Elementary Data Link Protocols – Sliding Window Protocols.

THE NETWORK LAYER: Network Layer Design Issues – Routing Algorithms: The Optimality Principle – Shortest Path Routing – Flooding – Distance Vector Routing – Link State Routing – Hierarchical Routing – Broadcast Routing – Multicast Routing – Congestion Control Algorithms.

Extra Reading: Analyse the Routing Algorithms

UNIT IV **12 Hrs**

THE TRANSPORT LAYER: The Transport Service: Services Provided to the Upper Layers – Transport Service Primitives– Elements of Transport Protocols.

THE APPLICATION LAYER: DNS – The Domain Name System – Electronic Mail: Architecture and Services – The User Agent – Message Transfer – The World Wide Web: Architectural Overview – Performance Enhancements.

Extra Reading: Examine the Protocols and WWW.

UNIT V **12 Hrs**

NETWORK SECURITY: Cryptography: Introduction to Cryptography – Substitution Ciphers – Transposition Ciphers – Symmetric Key Algorithms: DES - The Data Encryption Standard – AES—The Advanced Encryption Standard – Public Key Algorithms: RSA – Digital Signatures: Symmetric Key Signatures – Public Key Signatures – Communication Security: Firewalls – Virtual Private Networks – Wireless Security.

Extra Reading: Implement the Security concepts in real time examples

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	To educate concepts, vocabulary and techniques currently used in the area of computer networks.	PSO 1	R, U
CO-2	To study protocols, network standards, the OSI model, cabling, networking components, and basic LAN design.	PSO 2	R
CO-3	To accumulate existing state of the art in network protocols, architectures, and applications.	PSO 2	U
CO-4	To be familiar with contemporary issues in networking technologies.	PSO 3, 4	U
CO-5	Explain the fundamentals of network security.	PSO 4	R
CO-6	Learn the encryption and digital signature techniques.	PSO 3,4	An, Ap
CO-7	Illustrate various encryption techniques with applications involved.	PSO 4,5	An, Ap
CO-8	Develop enhanced network security algorithms	PSO 1	U, Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply;An-Analyse;E-Evaluate;C-Create

PRESCRIBED TEXT:

1. Tanenbaum Andrew S., **"Computer Networks"**, 2006, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi.

UNIT I **:** Chapter 1 – 1.2, 1.3(1.3.1 – 1.3.4), 1.4 (1.4.1 – 1.4.3)
UNIT II **:** Chapter 2 – 2.2, 2.3, 2.4, 2.5(2.5.1), 2.6
UNIT III **:** Chapter 3 – 3.1 – 3.4, Chapter 5 – 5.1,5.2(5.2.1 – 5.2.8),5.3
UNIT IV **:** Chapter 6 – 6.1(6.1.1 – 6.1.2),6.2
Chapter 7 – 7.1, 7.2(7.2.1, 7.2.2, 7.2.4), 7.3(7.3.1, 7.3.5)
UNIT V **:** Chapter 8 – 8.1(8.1.1 – 8.1.3), 8.2(8.2.1 – 8.2.2), 8.3(8.3.1), 8.4(8.4.1 – 8.4.2), 8.6(8.6.2 – 8.6.4)

SUGGESTED READINGS:

1. Comer Dougles E., Droms Ralph E., **"Computer Networks and Internets"**, 2004, Prentice Hall Publications Private Ltd., New Delhi.

2. Farouzan Behrouz A., **"Data Communications and Networking"**, 2002, Tata McGraw –Hill Publications, New Delhi.

3. Peterson Larry L., **"Computer Networks: A Systems Approach"**, 2003, Morgan Kaufmann Publications, New Delhi.

4. Vijay Ahuja, **"Design and Analysis of Computer Communication Networks"**, 2000, Tata McGraw Hill Publishing Company, New Delhi.

5. William Stallings, **"Data and Computer Communications"**, 2003, Prentice Hall of India, New Delhi.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS

First Year - Semester – I

Course Title	**Core Course V Fundamentals of Accounting and Financial Management (for MCA students)**
Total Hours	**60**
Hours/Week	**4Hrs/Wk**
Code	**P23CA1CCT05**
Course Type	**Theory**
Credits	**4**
Marks	**100**

GENERAL OBJECTIVE

To enable the students, understand the basic accounting principles and final accounts and to provide an insight into financial decision making procedures and their applications in complex financial management.

COURSE OBJECTIVES (CO):
The learner will be able to

CO No.	**Course Objectives**
CO-1	Understand the accounting concepts and conventions and the accounting cycle.
CO-2	Prepare final accounts of a sole trader.
CO-3	Understand the nature and objectives of financial management and analyses the leverages.
CO-4	Evaluate the methods of capital investment decisions.
CO-5	Understand and apply the working capital management methods.

UNIT I INTRODUCTION TO ACCOUNTING 12 Hrs

Accounting: Scope – Functions – Advantages – Limitations - Branches of Accounting – Accounting Concepts and Conventions – Journal – Ledger - Trial Balance.

Extra Reading/Keywords: *Book keeping, Accounting cycle, Double entry system.*

UNIT II FINAL ACCOUNTS 12 Hrs

Final Accounts: Adjusting and Closing entries - Final accounts of sole trader (with simple adjustments).

Extra Reading/Keywords: *Trading account, Profit and Loss account and Balance Sheet*

UNIT III INTRODUCTION TO FINANCIAL MANAGEMENTAND LEVERAGES 12 Hrs

Financial Management: Nature and Scope - Objectives of Financial Management - Analysis of leverages: Operating leverage, financial leverage and Combined leverage - EBIT, EPS analysis.

Extra Reading/Keywords: *Finance, Leverage, Trading on equity*

UNIT IV CAPITAL EXPENDITURE DECISIONS 12 Hrs

Capital Budgeting: Methods of capital investment decision making – Payback period - Accounting rate of return - Discounted cash flow methods: Net Present Value and Internal Rate of Return.

Extra Reading/Keywords: *Capital Budgeting, Average Rate of Return.*

UNIT V WORKING CAPITAL MANAGEMENT **12 Hrs**

Management of Working Capital: Meaning - Significance - Types - Operating cycle - Estimation of working capital requirements.

Extra Reading/Keywords: *Gross working capital, Net working capital, operating cycle.*

THEORY 30% AND PROBLEM 70%.

Note: Texts given in the Extra Reading /Keywords must be tested only through assignment and seminar.

COURSE OUTCOMES

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recall the basic accounting concepts and conventions and the accounting cycle.	PSO – 2	U
CO-2	Apply the rules of double entry book keeping for the preparation of final accounts of a sole trader.	PSO – 2	Ap
CO-3	Recall the nature and objectives of financial management and the procedure for analyzing the leverages.	PSO – 1	Ap
CO-4	Evaluate the methods of capital investment decisions.	PSO – 3	An
CO-5	Apply working capital management methods.	PSO - 4	Ap
CO-6	Analyze the organization's performance through financial tools.	PSO – 2	Ap

PSO – Programme Specific Outcomes; CO – Course Outcome; R - Remember; U - Understand; Ap – Apply; An – Analyse; E - Evaluate; C – Create

PRESCRIBED TEXT:

1. Dalston L. Cecil &Jenitra L. Merwin, 2019, *Financial Accounting*, Trichy: Learntech Press.
2. Reddy T.S. & Murthy A., 2021, *Financial Accounting*, Margham Publishers.
3. Maheswari S.N., 2019, *Elements of Financial Management*, Sultan Chand & Sons
4. Pandey I.M, 2015, *Financial Management and Policy*, Prentice Hall, Delhi.
5. Khan M.Y. & Jain P.K..2016, *Financial Management*, Tata McGraw Hill, New Delhi.

WEB REFERENCES

1. https://icmai.in/upload/Students/Syllabus-2012/Study_Material_New/Foundation-Paper2-Revised.pdf
2. https://icmai.in/upload/Students/Syllabus-2012/Study_Material_New/Inter-Paper8.pdf
3. http://mastermindsindia.com/Financial%20Management2310.pdf
4. https://icmai.in/upload/Students/Syllabus-2012/Study_Material_New/Inter-Paper5-Revised.pdf
5. https://icmai.in/upload/Students/Syllabus2016/Inter/Paper-5New.pdf.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – I

Course Title	**Core Course VI – Advanced Java Programming- Practical I**
Total Hours	**60**
Hours/Week	**4 Hrs/Week**
Code	**P23CA1CCP06**
Course Type	**Practical**
Credits	**2**
Marks	**100**

Course Objectives(CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Apply the Concept of Object Oriented Programming in real time problems
CO-2	Implement the working process of Packages, Interfaces with the concepts of Exception handling and String handling functions.
CO-3	Applying the concepts GUI and Establishing JDBC connection in Java
CO-4	Develop a Java servlet program using HTTP protocol.
CO-5	Apply JSP tags and create Web application software for real time problems Implement business software using various types of beans in EJB for real time problems.

List of Exercise:

INTRODUCING CLASSES - METHODS AND CLASSES - INHERITANCE

1. To create a Class and Objects.
2. To define a class, define instance methods for setting and retrieving values of instance Variables and instantiate its object.
3. To define a class, describe its constructor, overload the Constructors and instantiate its object.
4. To implement inheritance and demonstrate use of method overriding.
5. To define a class, define instance methods and overload them and use them for dynamic method invocation.

PACKAGES AND INTERFACES

6. To demonstrate use of implementing interfaces.
7. To demonstrate use of extending interfaces.
8. To implement the concept of importing classes from user defined package and creating packages

EXCEPTION HANDLING:

9. To implement Wrapper classes and their methods.
10. To implement the concept of Exception Handling using predefined exception.
11. To implement the concept of Exception Handling by creating user defined exceptions.

STRING HANDLING:

12. To practice using String class and its methods.
13. To practice using String Buffer class and its methods.

I/O, APPLETS, OTHER TOPICS:

14. To display a message in the Applet.
15. Applet for configuring Applets by passing parameters.
16. Applet to demonstrate Keyboard event.
17. Applet to demonstrate Mouse events.

18. Applet program for using Graphics class -to display basic shapes and fill them; draw Different items using basic shapes; set background and foreground colors.

JAVA SERVLETS:

19. Java Servlet Program for Session Tracking using HTTP Session.
20. Design a Java Servlet Program to insert details in to the database.
21. Construct a Java Servlet Program to retrieve details from the database.

JSP

22. Implement a JSP Program for creation of bio data using all form elements in HTML.

EJP

23. Develop a Program that create session bean to generate business Process.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – I

Course Title	**Core Course VII –Server Side Scripting Tools –Practical lI**
Total Hours	**60**
Hours/Week	**4 Hrs/Wk**
Code	**P23CA1CCP07**
Course Type	**Practical**
Credits	**2**
Marks	**100**

Course Objectives (CO):
The learner will be able to

CO No.	Course Objectives
CO-1	Understand and apply the syntax of various Linux commands
CO-2	Apply the syntax of PHP statements to develop Applications
CO-3	Understand the syntax of MySQL statements and apply in PHP programs
CO-4	Apply the syntax of simple Ruby on Rails statements to develop Applications
CO-5	Understand and Apply Perl statements to implement the programs in Perl

List of Exercises

1. Write and execute the Linux commands.
2. Write a PHP program using Built-in functions.
3. Write a Simple PHP program for performing Shopping Cart.
4. Write a PHP program for calculating CIA marks of students using user defined functions.
5. Write a PHP Program to produce Student Mark Sheet by connecting to the MySQL database.
6. Write a PHP Program to produce Employee Pay Slip using the MySQL database.
7. Write a simple Ruby on Rails program using Functions and Hashes.
8. Develop a simple Ruby on Rails project using MVC.
9. Write a simple Perl program using control statements.
10. Write a Perl program using the concepts of subroutines and packages.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A -First Year - Semester – I

Course Title	**Mandatory Course I** **Object - Oriented Programming With C++**
Code	**P23CA1MCT01**
Course Type	**Theory**
Credits	**5**
Marks	**100**

General Objective:
To introduce the basic concepts of Object - Oriented Programming and apply the concepts of Object – Oriented Programming using C++.

Course Objectives:
The Learner will be able to

CO No.	Course Objectives
CO-1	Understand the features of C++ supporting object oriented programming.
CO-2	Applying the basic concepts of C++ and remember the flow of program through control statements and use user defined functions in program execution.
CO-3	Discuss and apply the concepts of Classes and Objects. Apply the concepts of Constructors, Destructors and Arrays.
CO-4	Understand and classify the various Operator overloading, String handling functions and Inheritance.
CO-5	Understand and Implement Virtual Functions, I/O operations and working files in real time applications.

UNIT I
PRINCIPLES OF OBJECT - ORIENTED PROGRAMMING: Software Crisis - Software Evolution - A Look at Procedure-Oriented Programming - Object-Oriented Programming Paradigm - Basic Concepts of OOP - Benefits of OOP - Object-Oriented Languages - Application of OOP.
OBJECT ORIENTED SYSTEMS DEVELOPMENT: Introduction - Procedure- Oriented paradigms - procedure - Oriented Development Tools - Object Oriented Paradigm - Object - Oriented Notations and Graphs - Steps in Object-Oriented Analysis - Steps in Object-Oriented Design - Implementation - Prototype Paradigm - Wrapping up.
Extra Reading: Basic I/O and Control operations in Java.

UNIT II
BEGINNING WITH C++: Application of C++ - A simple C++ program - More C++ statements – An example with Class - Structure of C++ Program.
OKEN, EXPRESSIONS AND CONTROL STRUCTURES: Tokens - Keywords - Identifiers - Basic data types - User-defined Data Types - Derived Data Types - Symbolic Constants - Type Compatibility - Declaration of Variables - Dynamic Initialization of Variables - Reference Variables- Operators in C++ - Scope Resolution Operator - Member Dereferencing Operators - Memory Management Operators - Manipulators - Typecast Operator - Expressions and Implicit Conversions - Operator Overloading - Operator Precedence - Control Structure.
FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by Reference - Inline functions - Default Arguments - Const Arguments - Function Overloading - Friend and Virtual Functions.
Extra Reading: Develop multidimensional array programs

UNIT III

CLASSES AND OBJECTS: C structures revisited - Specifying a class - Defining Member Functions - a C++ program with class - Making an Outside Function Inline - Nesting of Member Functions – Private Member Functions - Arrays within a Class - Memory Allocation for Objects - Static Data Members -Static Member Functions - Arrays of Objects - Objects as Function Arguments - Friendly Functions - Returning Objects - Const Member Functions - Pointers to Members.

CONSTRUCTORS AND DESTRUCTORS: Constructors - Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy Constructors - Constructing Two-Dimensional Arrays - Destructors.

Extra Reading: Implement the concept of Arrays and multi-dimensional arrays in real time problems.

UNIT IV

OPERATOR OVERLOADING AND TYPE CONVERSIONS: Defining Operator Overloading - Overloading Unary Operators - Overloading Binary Operators - Overloading Binary Operators using Friends - Manipulation of Strings Using Operators - Rules for Overloading Operators - Type Conversions.

INHERITANCE: Defining Derived Class - Single Inheritance - Making a Private Member Inheritable Inheritance - Multi-level Inheritance - Hierarchical Inheritance - Hybrid Inheritance - Virtual Base Classes - Abstract Classes - Constructors in Derived Class - Member Classes.

Extra Reading (Key terms): comparing different kinds of Inheritance.

UNIT V

POINTERS, VIRTUAL FUNCTIONS AND POLYMORPHISM: Pointers to objects -This pointer - Pointers to Derived Classes - Virtual Functions Pure Virtual Function.

MANAGING CONSOLE I/O OPERATIONS: C++ Streams - C++ Stream Classes - Unformatted I/O Operations - Formatted Console I/O Operations - Managing Output with Manipulators

WORKING WITH FILES: Classes for File Stream Operations - Opening and Closing a File - Detecting End-of-File - File modes - File Pointers and their Manipulations - Sequential Input and Output Operations - Random Access - Command Line Arguments.

Extra Reading: Implement the system and file concepts.

Note: Texts given in the Extra reading /Key words must be tested only through **Assignment and Seminar.**

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the features of C++ supporting object oriented programming	PSO 1, PSO 2	U
CO-2	Develop C++program for simple applications	PSO 2	An
CO-3	Analyze different data types, arrays and constructors	PSO 2	U
CO-4	Analyze different data types and arrays	PSO 5	An
CO-5	Understand how to apply the major object-oriented concepts to implement object oriented programs in C++, encapsulation, inheritance and polymorphism	PSO 1	Ap
CO-6	Understand advanced features of C++ specifically stream I/O	PSO 2, PSO 3	U
CO-7	Create files and perform file operations using C	PSO 1, PSO5	R, An

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An– Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. Balagurusamy E., **Object Oriented Programming with C++**, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

UNIT I : Chapters: 1, 17
UNIT II : Chapters: 2, 3, 4
UNIT III : Chapters: 5, 6
UNIT IV : Chapters: 7, 8
UNIT V : Chapters: 9, 10, 11

SUGGESTED READINGS:

1. Eric Nagler, **Learning C++**, 2003, Jaico Publishing House, Mumbai.
2. Herbert Schildt, **C++ The Complete Reference**,2001, Tata McGraw Hill Publishing Company Ltd, New Delhi.
3. KayshavDattatri, **C++ Effective Object-Oriented Software Construction**, 2000, Prentice Hall of India Private Ltd., New Delhi.
4. NabajyotiBarkakati, **Object Oriented Programming in C++**, 2000, Prentice-Hall of India Private Ltd., New Delhi.
5. YashavantKanetkar, **Let Us C++**, 2005, BPB Publications, New Delhi.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A -First Year - Semester – I

Course Title	**Mandatory Course II** **C++ Programming – Practical I**
Code	**P23CA1MCP02**
Course Type	**Practical**
Credits	**5**
Marks	**100**

General Objective:
Student writes application programs using C++ for solving real time problems.

Course Objectives:

CO No.	Course Objectives
CO-1	Recall the syntax of Inline functions and Control structures and solve problems using C++
CO-2	Remember the syntax of Classes and Objects, Constructors and solve problems using C++
CO-3	Create programs for arrays and strings using C++
CO-4	Develop programs for Functions, Operator overloading in C++
CO-5	Write programs for creating a file and perform I/O operation on files

EXERCISES

1. Write a C++ program using Inline function.
2. Write a C++ program using Default Arguments.
3. Write a C++ program using Function Overloading.
4. Write a C++ program using Nested Functions.
5. Write a C++ program using Constructor and Destructor.
6. Write a C++ program using Single, Two Dimensional Array.
7. Write a C++ program using Unary Operator overloading.
8. Write a C++ program using Binary Operator overloading.
9. Write a C++ program using the concept of Inheritance
    i) Single
    ii) Multilevel
    iii) Multiple
    iv) Hierarchical
    v) Hybrid
10. Write a C++ program to implement the working with File Operations.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - First Year - Semester – II

Course Title	Core Course 8 – Operating Systems
Total Hours	60
Hours/Week	4 Hrs/ Wk
Code	P23CA2CCT08
Course Type	Theory
Credits	4
Marks	100

General Objective:
To enable the students to understand and learn the fundamental concepts of Operating System.

Course Objectives (CO):
The learner will be able to

CO No.	Course Objectives
CO-1	Understand the various types of Main Frame operating system
CO-2	Understand, Apply, Analyze and Evaluate the various scheduling algorithms
CO-3	Understand, Analyze the Deadlock concepts and Memory Management techniques
CO-4	Understand, Apply the File System concepts and RAID levels
CO-5	Understand the various mechanisms related to protection and security and apply the basic concepts of OS to Linux.

UNIT I **12 Hrs**

INTRODUCTION: What is an Operating System – Mainframe Systems – Desktop Systems – Multiprocessor System – Distributed Systems – Clustered Systems – Real – Time Systems – Handheld Systems – Feature Migration – Computing Environments.

OPERATING SYSTEM STRUCTURES: System Components – Operating System Services – System Calls – System Programs – System Structure – Virtual Machines – System Design and Implementation.

Case Study: Under what circumstances would a user be better off using time sharing system, rather than a PC or single user workstation.

Extra reading /keywords: *Mobile Operating Systems.*

UNIT II **12 Hrs**

PROCESS MANAGEMENT: Processes: Process Concept– Process Scheduling – Operation on Processes – Cooperating Processes – Inter– Process Communication.

CPU SCHEDULING: Basic Concepts – Scheduling Criteria – Scheduling Algorithms – Multiple Processor Scheduling – Real Time Scheduling.

PROCESS SYNCHRONIZATION: Background – The Critical– Section Problem – Synchronization Hardware – Semaphores – Classical Problems of Synchronization

Case study: Explain the differences in the degree to which the following scheduling algorithms discriminate in favor of short processes (FCFS, RR, Multilevel feedback queues)

Extra reading /keywords: *Operating system synchronization.*

UNIT III **12 Hrs**

DEADLOCKS: System Model – Deadlock Characterization – Methods for Handling Deadlocks Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery from Deadlock.

STORAGE MANAGEMENT: Memory Management: Background – Swapping –Contiguous Memory Allocation – Paging – Segmentation – Segmentation with Paging.

Case Study: Suppose that a system is in an unsafe state. Show that it is possible for the processes to complete their execution without entering a deadlock state.

Extra reading /keywords: *Pre-paging, Inverted page table, Real time processing.*

UNIT IV **12 Hrs**

VIRTUAL MEMORY: Background –Demand Paging–Process Creation – Page Replacement: LRU, FIFO**,** optimal

MASS– STORAGE STRUCTURE: Disk Structure – Disk Scheduling – Disk Management – Swap– Space Management – RAID Structure – Disk Attachment.

PROTECTION: Goals of Protection –Domain of Protection –Access Matrix- Access Rights.

Case Study: Describe the actions taken by the operating system when a page fault occurs.

Extra reading /keywords: *Log structure files system.*

UNIT V **12 Hrs**

SECURITY: The Security Problem – User Authentication – Program Threats – System Threats – Securing Systems and Facilities – Intrusion Detection – Cryptography.

THE LINUX SYSTEM: Introduction to Bash Shell –Basic Commands – Commands to work with file – Text editor – Stream text editor (grep, sed, and awk) – Process Management – Scheduling – Memory Management – File System – Input and Output – Inter – process Communication.

Case Study: Make a list of six security concerns for a bank's computer system.

Extra reading /keywords: *Intrusion Detection and Cryptography.*

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminar.

Course Outcomes (CO):

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	List and recognize the various types of operating system.	PSO 1	R, U
CO-2	Explain, Discuss, Compare and Contrast the various scheduling algorithms	PSO 2	Ap
CO-3	Describe, Compute and choose the correct scheduling algorithm for the given problem	PSO 2	E
CO-4	Explain the Deadlock concepts and Memory Management Techniques	PSO 3	R, U
CO-5	Discuss the concepts of file systems and mass storage structure, explain the different allocation methods, compare the various levels of RAID.	PSO 4	R, Ap
CO-6	Acquire the knowledge of operating system software	PSO 1	U

PSO-Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. Abraham Silberschatz and Peter Baer Galvin, Greg Gagne **"Operating System Concepts"**, Tenth Edition, Windows XP Update, John Wiley and Sons Inc., New Delhi, 2021.
   UNIT I : Chapters:1(1.1 To 1.10), 3(3.1 To3.8)
   UNIT II : Chapters:4(4.1 To 4.5),6(6.1 to 6.6),7(7.1 To7.7)
   UNIT III : Chapters:8(8.1 To 8.7)9(9.1 To 9.6), 10(10.1 To10.4)
   UNIT IV : Chapters:11(11.1 To 11.6),12(12.1To12.4)14(14.1 To14.6)
   UNIT V : Chapters: 18(18.1 To 18.5),19(19.1 To 19.7)20(20.2 To20.9)

BOOKS FOR REFERENCE:

1. Ekta Walia, Ekta, **"Operating System Concepts"**, Khanna Book Publishing Company (P) Limited, New Delhi, 2019.
2. G Sreehitha Reddy, K Reddy Pradeep, **"Operating Systems Concepts"**, HarperCollins Publishers, New Delhi, 2019.
3. Cesar Herrera, Flor Narciso, Darrell Hajek, **"Principles of Operating Systems"**, Amazon Digital Services LLC - KDP Print US, 2021.
4. Richard Fox, **"Linux with Operating Systems Concepts"**, CRC Taylor & Francis Group, Second Edition, 2021.
5. Dudley Dawson, **"Linux Security and Administration The Essentials and Operating System, Command-Line, and Networking (2022 Guide for Beginners)"**, Dudley Dawson Publishers, 2022.

(For the candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A. First Year - Semester – II

Course Title	Core Course 9 – Database Systems
Total Hours	75
Hours/Week	5 Hrs/Wk
Code	P23CA2CCT09
Course Type	Theory
Credits	4
Marks	100

General Objective:

To enable the students to understand the fundamental concepts of database management system, to learn and apply SQL and NOSQL Queries.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the basic concepts of database system and fundamental relational Algebraic operations.
CO-2	Understand and apply SQL queries, implement the database concepts using Advanced SQL techniques, Create ER model for any database applications.
CO-3	Understand & apply the normalization techniques, learn the basic idea of Object – based database.
CO-4	Understand physical storage media and file structure, Compare the file organization techniques; understand, analyze & compare Indexing & Hashing techniques.
CO-5	Understand the concepts of Transaction and Concurrency control, classify the database system architecture, Understand and apply NOSQL queries

UNIT I **15 Hrs**

INTRODUCTION: Database system applications – Purpose of database systems – View of Data – Database Languages – Relational databases – Database design – Object – based and semi structured databases – Data storage and Querying – Transaction Management – Data Mining and Analysis – Database Architecture – Database Users and Administrators.

RELATIONAL MODEL: Structure of Relational Databases – Database Schema – Keys – Schema Diagrams - Relational Query Languages – Relational Operations – Fundamental Relational Algebra Operations – Null values – Modification of databases.

Extra reading /keywords: *The Unified Modeling Language.*

UNIT II **15 Hrs**

SQL: Overview of SQL Query Language – SQL Data Definitions – Basic Structure of SQL Queries – Additional basic and Set Operations – Aggregate Functions – Nested sub queries.

INTERMEDIATE SQL: Join Expressions - Views – Integrity Constraints - SQL Data Types and Schemas – Authorization.

DATABASE DESIGN AND THE E – R MODEL: Overview of the Design Process– The Entity – Relationship Model – Constraints – E-R Diagrams.

Extra reading /keywords: *Other Relational Query Languages.*

UNIT III **15 Hrs**

FUNCTIONAL DEPENDENCIES AND NORMAL FORMS: Introduction – Basic Definitions – Trivial and Nontrivial Dependencies – First, Second, and Third Normal Forms – Boyce/Codd Normal Form – Multi – Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

OBJECT – BASED DATABASES: Overview – Complex Data types – Structured types and Inheritance in SQL – Table Inheritance – Array and Multi set Types in SQL – Object – Identity and Reference types in SQL.

Extra reading /keywords: *Additional Normal Forms.*

UNIT IV **15 Hrs**

STORAGE AND FILE STRUCTURE: Overview of physical storage media – Magnetic disks – RAID – Tertiary Storage – Storage Access – File Organization – Organization of Records in Files – Data Dictionary Storage.

INDEXING AND HASHING: Basic Concepts – Ordered Indices – B^+ – Tree Index Files – B– tree Index Files – Multiple Key Access – Static Hashing – Dynamic Hashing – Comparison Ordered Indexing and Hashing – Bitmap Indices – Index Definition in SQL.

Extra reading /keywords: *Storage for Object – Oriented databases.*

UNIT V **15 Hrs**

TRANSACTIONS: Transaction Concept –A Simple Transaction Model – Storage Structure – Transaction Atomicity and durability - Transaction isolation – Serializability.

CONCURRENCY CONTROL: Lock-Based Protocols – Timestamp – Based Protocols –Validation – Based Protocols.

DATABASE SYSTEM ARCHITECTURES: Centralized and Client – Server Architectures – Server System Architectures – Parallel Systems – Distributed System – Network Types.

NoSQL Basics: NoSQL Storage Architecture, CRUD operations with MongoDB, Querying, Modifying and Managing NoSQL Data stores, Indexing and ordering datasets (MongoDB/CouchDB/Cassandra)

Extra reading /keywords: *Introduction to NoSQL and MongoDB and its Features*

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes:

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the basic concepts of database system and fundamental relational algebraic operations.	PSO 1	R, U
CO-2	Explain, Apply SQL queries, Create ER model for any database applications.	PSO 2	Ap
CO-3	Explain the normalization techniques, discuss the basic idea of object – based database.	PSO 2	U
CO-4	Describe the physical storage media and file structure, compare the file organization techniques; compare Indexing & Hashing techniques.	PSO 3	U, Ap
CO-5	Discuss the concepts of Transaction and Concurrency control, classify the database system architecture, Apply NoSQL queries.	PSO 4	U, Ap

PSO-Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. Korth Henry F., Abraham Silbershatz and Sudarsan, **— Database System Concepts"**, 6th Edition, McGraw Hill Higher Education, New York, 2011.

UNIT I			
	Chapter	:	1 (1.1 – 1.10,1.12)
	Chapter	:	2 (2.1 – 2.6)
UNIT II			
	Chapter	:	3 (3.1 –3.8)
	Chapter	:	4 (4.1– 4.6)
	Chapter	:	7(7.1 – 7.5)
UNIT III	Chapter	:	22(22.1- 22.6)
UNIT IV	Chapter	:	10(10.1 – 10.7)
	Chapter	:	11(11.1 – 11.10)
UNIT V	Chapter	:	14(14.1, 14.6)
	Chapter	:	15(15.1, 15.4, 15.5)
	Chapter	:	17(17.1 –17.5)

2. Date C.J., **—An Introduction to Database Systems"**, Eighth Edition, Pearson Education Private Ltd., New Delhi, 2006.

UNIT III	Chapter	:	11(11.1 – 11.3)
	Chapter	:	12(12.3, 12.5)

WEB REFERENCES:

UNIT V - NoSQL Basics

https://www.mongodb.com/

https://www.geeksforgeeks.org/

BOOKS FOR REFERENCE:

1. Friedrichsen, Lisa, et al., **"Concepts of Database Management"**, United States, Cengage Learning, 2020.
2. Vikraman, N., **"Relational Data Base Management System (R.D.B.M.S): For MCA/ BCA/ ME/ M.TECH/ B.TECH/ B.Sc/ M.Sc Students"**, Independently Published, 2020.
3. Panneerselvam R, **"Database Management Systems"**, Prentice Hall India Pvt. Ltd., 2018.
4. Starks, Joy L., et al. **"Concepts of Database Management**", United States, Cengage Learning, 2018.
5. DONOVAN, JOHN J., **"Database System Approach to Management Decision Support (Classic Reprint)**", United States, Fb&c Limited, 2018.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A -First Year - Semester – II

Course Title	**Core Course 10 - Resource Management Techniques**
Total Hours	**60**
Hours / Week	**4**
Code	**P23CA2CCT10**
Course type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

To give detailed knowledge about the basics of Liner programming, Queuing theory Inventory models, project scheduling.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO - 1	Understand the Linear Programming Problem and find the optimal solution
CO - 2	Understand transportation problem and applies the techniques to find solutions.
CO - 3	Understands assignment problem to determine optimum solution.
CO - 4	Understand Network scheduling and applies techniques to minimize the shortest path .
CO - 5	Understand queueing models to determine the solution**.**

UNIT I **12 Hrs**

LINEAR PROGRAMMING: Introduction to Operations Research-Formulations and Graphical solution to L.P. Problem– Simplex method (excluding artificial variable techniques) (**Problems Only**)

Extra Reading /Key Words: *Two Phase method*

UNIT II **12 Hrs**

TRANSPORTATION PROBLEM : Transportation problem and its solution – Initial Basic Feasible Solutions - North west corner method – Row minima method – column minima method- matrix minima method – Vogel's approximation method - Unbalanced Transportation Problem – Maximization Type Problem-– Optimum Solutions - Modi method (**Problems Only**)

Extra Reading /Key Words: *Best Candidates Method (BCM)*

UNIT III **12 Hrs**

ASSIGNMENT PROBLEM: Assignment problem and its solution by Hungarian method. Unbalanced Assignment Problem – Maximization Type Assignment Problem (**Problems Only**)

Extra Reading /Key Words: *Solving the Rectangular assignment problem and applications*

UNIT IV **12 Hrs**

PROJECT SCHEDULING BY PERT-CPM: Network Representation-Critical Path calculations – PERT calculation. (**Problems Only**)

Extra Reading /Key Words: *Applications, limitations of network techniques*

UNIT V

QUEUEING MODELS **12Hrs**

Characteristics of Queuing Models – Poisson Queues - (M / M / 1): (FIFO / ∞ /∞), (M / M / 1) : (FIFO/ N / ∞) models. (**Problems Only**)

Extra Reading /Key Words: *Little's formula Queueing theory*

Note: Tests given in the Extra Reading /Key Word: must be tested only through assignment and seminars.

NOTE:

No theory – only problems.

Course Outcomes (CO):

The Learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO 1	Understand the linear programming problem to seek solutions to problems.	**PSO - 1**	**R**
CO 2	Classify the types of assignment problem to solve problems.	**PSO - 2**	**U**
CO 3	Evaluate the technique of Hungarian on assignment problem	**PSO- 5**	**A**
CO 4	Understand the network scheduling through PERT/CPM methods.	**PSO-1**	**U**
CO 5	Understand the characteristics of Queueing models	**PSO -2**	**R**

PSO-Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. P.R.Vittal & V.Malini, Operation Research, Margham Publications, (Reprint 2014) Chennai.

UNIT I : Chapter 2, 3, 4

UNIT II : Chapter 10

UNIT III : Chapter 11

UNIT IV : Chapter 14

UNIT V : Chapter 13

BOOKS FOR REFERENCE:

1. Gupta P.K., Hira S., **"Operations Research",** S. Chand & Co. Limited, New Delhi, 2005
2. Hamady A. Taha, **"Operations Research An Introduction",** Pearson Education Publishing Limited, New Delhi, 2002.
3. MariappanP, **"Operations Research Methods & Applications"**, New Century Book House Private Limited., 2001.
4. Panneer Sevvam, **"Operations Research"**, Prentice Hall of India Private Ltd, New Delhi, 2003.
5. Sharma J.K, **"Operations Research Theory & Applications"**, Macmillan India Limited, Chennai, 2007

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - First Year - Semester – II

Course Title	Core Course 11 – Organizational Dynamics
Total Hours	60
Hours/Week	4 Hrs Wk
Code	P23CA2CCT11
Course Type	Theory
Credits	4
Marks	100

General Objective:

To enable the students to understand the basic concepts of organizational structure and its behavior.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the concept of Organization, Background and Foundation of Organizational Behavior.
CO-2	Remember, Understand the models of Man, Personality and learning, Analyse the behavior of individuals groups in organizations.
CO-3	Understand the concepts of Attitude, Motivation & Work stress, Apply Stress Management in the Personal life.
CO-4	Understand the concepts of Interpersonal behavior, group dynamics & group decision making, Analyse & Evaluate the different leadership styles and apply them in life situation.
CO-5	Understand the Organization theory, organization structures, Analyse the various organization structures, centralization & decentralization.

UNIT I **12 Hrs**

NATURE OF THE ORGANIZATIONAL BEHAVIOUR: Concept of Organization –what Managers Do?-Concept of Organization Behaviour –Challenges and Opportunities for Organization Behaviour-Applying OB Knowledge to Management Practices.

Foundations of Organizational Behaviour: Classical Approach- Neoclassical Approach-Modern Approach-Organizational Behaviour Models.

Nature of Human Behaviour: Concept of Behaviour-Individual Differences-Models of Man.

Personality: Concept of Personality-Personality Measurement.

Extra reading /keywords: *Key elements of Organizational Behavior*

UNIT II **12 Hrs**

PERCEPTION: Concept of Perception: Perceptual Process – Perceptual Selectivity – Perceptual Organization– Person Perception: Distortion in Perception -Developing Perceptual skills.

Extra reading /keywords: *Nature of human behavior in Psychiatry*

UNIT III **12 Hrs**

ATTITUDES AND VALUES: Attitudes- Attitudes Relevant to Organizational Behaviour - Attitude Change-Values. **Motivation:** Concept of Motivation-Theories of Motivation-Cultural Context of Motivation.

Motivational Applications: Designing of Reward System-Empowerment-Morale.

Extra reading /keywords: *Stress management techniques*

UNIT IV **12 Hrs**

Interpersonal Behaviour: Nature of interpersonal behavior – Transactional analysis - Group Dynamics **:** Concept of Group Dynamics –Formal Groups-Informal Group or organization-Group Behaviour-Group Decision Making.

Leadership: Concept of Leadership-Leadership Theories-Leadership Styles-Leadership Styles in Indian Organizations-Contemporary Issues in Leadership.

Extra reading /keywords: *Successful Leadership skills and techniques*

UNIT V **12 Hrs**

Organizational Change and Stress Management: Nature of Organizational Change – Planned Change -Human response to change- Change through organization development – Change Agents – Stress Management – Overcoming Stress.

Extra reading /keywords: *Process and types of Organization change and Managing changes.*

Course Outcomes(CO):

The Learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognize, Explain the concept of Organization, Background and Foundation of Organizational Behavior.	PSO 2	R, U
CO-2	Explain the models of Man, Personality and learning; analyze the behavior of individuals and groups in organizations.	PSO 1,4	U, Ap
CO-3	Discuss the concepts of Attitude, Motivation & Work stress, apply Stress Management in the Personal life.	PSO 2	U, Ap
CO-4	Describe, Analyse the concepts of Interpersonal behavior, Explain group dynamics & group decision making, compare the different leadership styles and apply them in life situation.	PSO 4	An
CO-5	Explain the Organization theory: Compare the various organization structures, Differentiate centralization & decentralization.	PSO 3	An
CO-6	Explain Organizational change and manage the stress.	PSO 3	Ap

PSO-Programme Specific Outcomes;CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. ” **Organisational Behaviour**” L.M.Prasad., Sultan Chand and Sons, New Delhi, Six Edition 2019 Reprint 2021, 2022.

UNIT I	**:**	Chapters 1,2 and 3
UNIT II	**:**	Chapters 4
UNIT III	**:**	Chapters 6,8 and 9
UNIT IV	**:**	Chapters 11,12 and 15
UNIT V	**:**	Chapters20

BOOKS FOR REFERENCE:

1. S.S. Khanka **“Organizational Behavior**”, Sultan Chand and Company, New Delhi, 2002.
2. K.Aswathappa, “**Organizational behavior**”**,** 5th Edition, Tata McGraw Hill, New Delhi.
3. Abraham B. Rami Shani and James b. Lau, “**Behavior of Organizations –An Experimental Approach**”, 2000, Richard D Irvin, Inc Publishing.
4. Schermerhorn, “**Organisational Behavior**”, 2001, Nineth edition, Wiley John and sons.
5. Stephen P. Robbins, “**Organizational Behavior**”, 2002, 10th Edition, Prentice Hall Publishing.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A -First Year - Semester – II

Course Title	**Elective 1- Cloud Computing**
Total Hours	**60**
Hours/Week	**4 Hrs / Wk**
Code	**P23CA2ECT01**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

To impart the Basic Concepts of Cloud Computing and understand the Technologies with a wide knowledge of the Virtualization concepts, Industries using Cloud Platforms and the major cloud applications.

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Remember the deployment and service models.
CO-2	Understand the various cloud enabling technologies and security fundamentals.
CO-3	Analyze virtualization mechanisms and services.
CO-4	Explain the various platforms of cloud in industry.
CO-5	Evaluate pricing models for cloud- based services in various applications

UNIT I **12 Hrs**

UNDERSTANDING CLOUD COMPUTING: Origins and Influences - Basic Concepts and Terminology - Goals and Benefits - Risks and Challenges.

FUNDAMENTAL CONCEPTS AND MODELS: Roles and Boundaries - Cloud Characteristics - Cloud Delivery Models - Cloud Deployment Models.

Extra Reading / Keyword: *Real time applications.*

UNIT II **12 Hrs**

CLOUD-ENABLING TECHNOLOGY: Broadband Networks and Internet Architecture **–** Data Center Technology – Virtualization Technology-Web Technology – Multitenant Technology – Service Technology.

FUNDAMENTAL CLOUD SECURITY: Basic Terms and concepts –threat agents – cloud Security Threats – Additional Considerations.

Extra Reading / Keyword: *Additional Technologies.*

UNIT III **12 Hrs**

VIRTUAL MACHINES PROVISIONING AND MIGRATION SERVICES: Introduction and Inspiration –Background and related work – Virtual Machines Provisioning and Manageability – Virtual Machine Migration Services – Provisioning in the Cloud Context.

Extra Reading / Keyword: *Other service Mechanisms.*

UNIT IV **12 Hrs**

AMAZON WEB SERVICES: Compute Services: Amazon Machine Images – EC2 instances – EC2 environment – Storage Services: S3 Key concepts. **GOOGLE APP ENGINE:** Architecture and Core Concepts – Application Life Cycle. **MICROSOFT AZURE:** Azure Core Concepts – SQL Azure – Windows Azure platform appliance – Observations.

Extra Reading / Keyword: *Applications of Architectures.*

UNIT V **12 Hrs**

SCIENTIFIC APPLICATIONS: Healthcare – Biology – Geosciences. **BUSINESS AND CONSUMER APPLICATIONS:** CRM and ERP – Productivity – Social Networking – Media Applications – Multiplayer Online Gaming.

ENERGY EFFICIENCY IN CLOUDS: Energy-Efficient and Green Cloud Computing Architecture.

Extra Reading / Keyword: *Implementation of services.*

Course Outcomes (CO) :

The learner

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the fundamental concepts in cloud.	PSO 1	R, U
CO-2	Analyze the cloud enabling technologies.	PSO 2	A
CO-3	Know and explain the Virtualization mechanisms.	PSO 2	U
CO-4	Comprehend the Cloud Platforms available in Industry.	PSO 3	Ap
CO-5	know and distinguish the various applications and advanced topics of Cloud.	PSO 4	An

PSO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing : Concepts, Technology and Architecture", Prentice Hall, U.S.A., 2013.

UNIT I **:** Chapters 3 & 4
UNIT II **:** Chapters 5 & 6

2. RajkumarBuyya, James Broberg, AndrzejGoscinski, "Cloud Computing : Principles and Paradigms", John Wiley & Sons, U.S.A. , 2013.

UNIT III **:** Chapter 5 (5.1to 5.4 , 5.6)

3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Elsevier Inc., 2013.

UNIT IV **:** Chapter 9
UNIT V **:** Chapters 10 & 11

BOOKS FOR REFERENCE:

1. Shailendra Singh, **"Cloud Computing"**, Oxford Higher Education, 2018
2. Sandeep Bowmik, **"Cloud Computing"**, Cambridge Publications, 2019.
3. Dr. Anand Nayar, **"Handbook of Cloud Computing"**, BPB Publications, 2022.
4. David Fisher, **"Cloud Computing: Principles, Design and Applications"**, States Academic Press Publications, 2022.
5. Mehul Mahrishi Kamal Kant Hiran, Ruchi Doshi, Dr. Fagbola Temitayo, **"Cloud Computing"**, BPB Publishers, 2019.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - First Year - Semester – II

Course Title	**Elective 1- Fog Computing**
Total Hours	**60**
Hours/Week	**4**
Code	**P23CA2ECT02**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objectives:
To impart the Basic Concepts of Cloud Computing and understand the Technologies and Architectures of Cloud Computing.

Course Objectives(CO):
The learner will be able to

CO No.	Course Objectives
CO-1	remember the fundamental concepts of Fog.
CO-2	understand the architecture and components of Fog.
CO-3	analyze the protocols of Fog.
CO-4	understand the data management and Fog security principles.
CO-5	apply the case studies related to Fog Computing.

UNIT I **12 Hrs**

INTRODUCTION TO FOG COMPUTING: Fog Computing-Definition-Characteristics- Application Scenarios - Issues -Fog Computing and Internet of Things–Fog Computing Components - Fog Computing and Cloud Computing- Simple Case Studies (STLS and Wind Farm) -High-Level and Software Architecture.

Extra Reading / Keyword: *Distinguishing Fog with Cloud Computing.*

UNIT II **12 Hrs**

Fog Computing Fundamentals: Introduction – Background and Motivation of Fog Computing – Fog Computing Basics – Fog Computing Services.

IoT Resource Estimation Challenges and Modeling in Fog: Fog Resource estimation and its challenges.

Extra Reading / Keyword: *Designing Framework.*

UNIT III **12 Hrs**

Tackling IoT Ultra Large Scale Systems: Fog Computing in Support of Hierarchical Emergent Behaviors: Introduction – Fog Computing – Hierarchical Emergent Behaviors, a Fresh Approach for ULSS - Two Autonomous Vehicles Primitives CaseStudy.

The Present and Future of Privacy-Preserving Computation in Fog Computing: Introduction – Block Chain – Multi-Party Computation – Multi-Party Computation and Block Chain.

Extra Reading / Keyword: *Protocol usage.*

UNIT IV **12 Hrs**

Self-aware Fog Computing in Private and Secure Sphere: Cloud, Fog and Mist Computing Networks- Self-aware Data Processing - **Case study:** Health monitoring – Patient Safety monitoring and training support – Smart house.

Urban IoT Edge Analytics: Design challenges – Edge-assisted Architecture – Information Acquisition and Compression – Content-aware wireless networking – Information availability.

Extra Reading / Keyword: *Implementation of Security principles.*

UNIT V **12 Hrs**

Control-as-a-Service in Cyber-Physical Energy Systems over Fog Computing: Power Grid and Energy Management - Energy Management Methodologies - Cyber-Physical Energy Systems - Internet-of-Things and Fog Computing - Control-as-a-Service - Residential Cyber-Physical Energy System.

Leveraging Fog Computing for Healthcare IoT: Introduction – Healthcare Services in the Fog Layer – Data management – Event Management – Resource Efficiency – Device management – Personalization – Privacy and Security – System Architecture of Healthcare IoT.

Extra Reading / Keyword: *Implementation of real time applications as services.*

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes:

The Learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discuss the fundamental concepts in Fog.	PSO 1	R, U
CO-2	Analyze the architectures available in Fog.	PSO 2	R,U
CO-3	Know and explain the Protocols related to Fog.	PSO 2	U
CO-4	Comprehend the Data Management and Security Principles.	PSO 3	Ap
CO-5	Examine the case studies of Fog.	PSO 4	U
CO-6	Acquire the knowledge of fog computing and use of IoT in fog computing	PSO 1	R, U

PSO-Programme Specific Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

For UNITI

1. Amir VahidDastjerdi and RajkumarBuyya,**—Fog Computing: Helping the Internet of Things Realize its Potential**‖, University ofMelbourne.
2. FlavioBonomi,RodolfoMilito,PreethiNatarajanandJiangZhu,**—FogComputing:APlatf orm for Internet of Things and Analytics**‖, Big Data and Internet of Things: A Roadmap for Smart Environments, Studies in Computational Intelligence 546, DOI: 10.1007/978-3-319-05029-4_7, © Springer International Publishing Switzerland2014.
3. FlavioBonomi, Rodolfo Milito, Jiang Zhu, SateeshAddepalli,**—Fog Computing and Its Role in the Internet of Things**‖,MCC'12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978-1- 4503-1519-7/12/08...$15.00.
4. Shanhe Yi, Cheng Li, Qun Li,**—A Survey of Fog Computing: Concepts, Applications and Issues**‖,Mobidata'15, ACM 978-1-4503-3524-9/15/06, DOI:10.1145/2757384.2757397, June 21, 2015, Hangzhou,China..

For UNITS II, III, IV, V

5. Amir M. Rahmani ,PasiLiljeberg, Preden, Axel Jantsch, **—Fog ComputingintheInternet of Things - Intelligence at the Edge**‖, Springer International Publishing,2018.

BOOKS FOR REFERENCE:

1. Ivan Stojmenovic, Sheng Wen, **"The Fog Computing Paradigm: Scenarios andSecurity Issues",** Proceedings, Federated Conference on ComputerScience and Information Systems, pp. 1–8, 2014.
2. Hazar, Yanru Zhang, Nguyen H. Tran, DusitNiyato, and Zhu Han, **"Multi – Dimensional payment Plan in Fog Computing withMoral",**IEEE,2016.
3. FarhoudHosseinpour,JuhaPlosila,HannuTenhunen,**"An Approach for Smart management of Big Data in the Fog Computing Context",**IEEE 8th InternationalConference on Cloud Computing Technology andScience,2016.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - First Year - Semester – II

Course Title	**Elective 1 - High Performance Computing**
Total Hours	**60**
Hours/Week	**4**
Code	**P23CA2ECT03**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

To enable the students to understand and learn the general concepts of cluster, grid and cloud computing.

Course Objective (CO):
The learner will be able to

CO No.	Course Objectives
CO-1	Understand, Study various computing technology architecture
CO-2	Understand the emerging trends in computing technology
CO-3	Understand, deploy the computing technology
CO-4	Understand, Apply Non-IP and IP protocols
Co-5	Understand the communications

UNIT I **12 Hrs**

CLUSTER COMPUTING AND ITS ARCHITECTURE: Ease of Computing - Scalable Parallel Computer Architecture - Towards Low Cost Parallel Computing & Motivation - Windows opportunity- A Cluster Computer and Its Architecture - Cluster Classification - Commodity Components for Clusters-Network Services/Communication SW- Cluster Middleware and Single Systems Image – Resource management & Scheduling (RMS).

Extra reading /keywords: *Applications of cluster computing*

UNIT II **12 Hrs**

CLUSTER SETUP AND ADMINISTRATION: Introduction - Setting up the cluster - Security - System Monitoring - System Tuning.

Extra reading /keywords*:* *Architecture of cluster setup*

UNIT III **12 Hrs**

INTRODUCTION TO GRID AND ITS EVOLUTION: Beginning of the Grid - Building blocks of Grid - Grid Application and Grid Middleware - Evolution of the Grid: First, Second & Third Generation.

Extra reading /keywords: *Study the difference of grid generation*

UNIT IV **12 Hrs**

INTRODUCTION TO CLOUD COMPUTING: Defining Clouds - Cloud Providers - Consuming Cloud Services - Cloud Models – Iaas, Paas, SaaS – Inside the cloud - Administering cloud services - Technical interface - Cloud resources.

Extra reading /keywords: *Other cloud resources*

UNIT V **12 Hrs**

NATURE OF CLOUD: Tradition Data Center - Cost of Cloud Data Center - Scaling computer systems - Cloud work load – Managing data on clouds - Public, private and hybrid clouds.

Extra reading /keywords: *Applications of Cloud Data center*

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminar.

Course Outcomes(CO):

The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the cluster computing and resource management scheduling.	PSO 1	R, U
CO-2	Evaluate the Cluster Settup.	PSO 2	Ap
CO-3	Understand the first, second and third generation of grid computing.	PSO 3	U
CO-4	Classify the cloud service providers and models.	PSO 4	A
CO-5	Evaluate the cost of cloud data center.	PSO 5	E

PSO-Programme Specific Outcomes;CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT:

1. Rajkumar Buyya, **"High Performance Cluster Computing"**, Volume 1, Architecture and Systems, Pearson Education.

   UNIT I: Chapter 1,2

   UNIT II: Chapter 3.1-3.7,4.1-4.5

2. Berman, Fox and Hey, **"Grid Computing – Making the Global Infrastructure a Reality"**, Wiley India.

   UNIT III: Chapter 3.3-4.2

   UNIT IV: Chapter 4.1-4.8

3. Hurwitz, Bllor, Kaufman, Halper, **"Cloud Computing for Dummies"**, Wiley India.

   UNIT V: Chapter 3.2-3.9.

BOOKS FOR REFERENCE:

1. Ronald Krutz, **"Cloud Security"**, Wiley Publications, New Delhi, 2016.
2. Christoph Niethammer – Michael M. Resch, **"Tools for High Performance Computing"**, 2017.
3. Anthony Velte, Toby Velte, Robert Elsenpeter, **"Cloud Computing, A Practical Approach"**, Tata McGrawHill,2019.
4. Ch Satyanarayana, Debasis Samanta, Xiao-Zhi Gao, Rajiv Kumar Kapoor, **"High performance Computing and networking"**, 2021.
5. Charles Severance Kevin Dowd, **"High Performance Computing"**, O' Reilly Publications, 2021.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.

DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – II

Course Title	**Core Course 12– Operating Systems– Practical III**
Total Hours	**60**
Hours/Week	**4 Hrs/Wk**
Code	**P23CA2CCP12**
Course Type	**Practical**
Credits	**2**
Marks	**100**

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	provide introduction to Unix operating systems and its file systems
CO-2	To gain an understanding of important aspects related to shell and the process
CO-3	To develop the ability to formulate regular expressions and use them for pattern matching
CO-4	To provide the compressive introduction to shell programming, services and utilities
CO-5	Demonstrate the changing of file permission and ownership

LIST OF EXERCISES

1. Develop a program to perform CPU scheduling algorithm.
2. Develop a program to perform Producer - consumer problem using Semaphores.
3. Develop a program to perform Dining- philosopher problem.
4. Develop a program to perform Memory Management Techniques (Paging).
5. Develop a program to perform Contiguous Memory Allocation.
6. Develop a program to perform Page Replacement Algorithms.
7. Develop a program to perform File allocation Strategies.
8. Develop a program to Perform Dead Lock Prevention.
9. Develop a program to perform Dead Lock Avoidance.
10. Develop a program to perform Disk Scheduling Algorithm.

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – II

Course Title	**Core Course 13 - Database Systems - Practical IV**
Total Hours	**60**
Hours/Week	**4 Hrs/Wk**
Code	**P23CA2CCP13**
Course Type	**Practical**
Credits	**2**
Marks	**100**

Course Objectives (CO):

The learner will be able to

CO No.	Course Objectives
CO-1	Understand the basic concepts of database system and fundamental relational Algebraic operations.
CO-2	Understand and apply SQL queries, implement the database concepts using Advanced SQL techniques, Create ER model for any database applications.
CO-3	Understand & apply the normalization techniques, learn the basic idea of Object – based database.
CO-4	Understand physical storage media and file structure, Compare the file organization techniques; understand, analyze & compare Indexing & Hashing techniques.
CO-5	Understand the concepts of Transaction and Concurrency control, classify the database system architecture, Understand and apply NOSQL queries

SQL

1. Table Creation and Manipulation
2. Table Manipulation Using Built-In-Functions
3. Table Manipulation Using Operators

PL/SQL PROGRAMS

1. Cursor
2. To Join Two Tables
3. To Split A Table Into Two
4. To Update A Table
5. Creation and Retrivel of Information Without Using Cursors

STORED PROGRAMS

1. Program Using Functions
2. Programs Using Procedures
3. Programs Using triggers

FORMS AND REPORTS

1. Creation of Forms
2. Creation of Reports

NOSQL (MONGO DB)

1. CRUD Operations
2. Manipulation Using Operators

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI - 620002

DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – II

Course Title	Mandatory Course 3 Computer Graphics
Code	P23CA2MCT03
Course Type	Theory
Credits	5
Marks	100

General Objective:

To introduce students with fundamental concepts and theory of Computer Graphics

Course Objectives (CO)

The learner will be able to

CO No.	Course Objectives
CO-1	Demonstrate the working principle of various video display devices such as CRT, LCD and LED systems and categorize the input and output devices used in graphics systems.
CO-2	Examine the specification of basic geometric structures such as points, Lines, Circles and Curves.
CO-3	Apply the various attributes that control the appearance of the displayed primitives.
CO-4	Apply two dimensional transformations and clipping techniques in 2D scenes.
CO-5	Recognize the three dimensional display methods and compare parallel and perspective projections.

UNIT I

Overview of Graphics Systems: Video display devices: Refresh cathode-ray tubes – Raster-scan displays – Random Scan Displays – Colour CRT Monitors – Direct-View Storage Tubes – Flat-Panel Displays – Three-Dimensional Viewing Devices – Stereoscopic and virtual reality systems – Raster Scan Systems: Video Controller – Raster-Scan Display Processor – Random Scan Systems – Graphics Monitors and Workstations – Input Devices: Keyboards - Mouse – Trackball and Space Ball – Joysticks – Data Glove – Digitizers – Image Scanners – Touch Panels – Light Pens – Voice Systems – Hard Copy Devices.

Extra reading /keywords: *CRT, LCD, LED*

UNIT II

Output Primitives: Points and Lines DDA Line-Brsenhame Line–Midpoint circle drawing algorithms-Loading the Frame Buffer – Line Function – Circle –Properties of Circles – Curve functions – Fill-Area Functions – Character Generation.

Extra reading /keywords: *Ellipse Algorithm, Spline Curves*

UNIT III

Attributes of Output Primitives: Line Attributes: Line Type – Line Width – Pen and Brush Options – Line Color – Curve Attributes – Color and Grayscale Levels: Color Tables – Grayscale – Area-Fill Attributes: Fill Styles – Pattern Fill – Soft Fill – Character Attributes: Text Attributes – Marker Attributes – Bundled Attributes: Bundled Line Attributes – Bundled Area – Fill Attributes – Bundled Text Attributes – Bundled Marker Attributes – Inquiry Functions.-Line clipping-polygon clipping algorithms

Extra reading /keywords: *Color Table, Fill Styles*

UNIT IV

Two - Dimensional Geometric Transformations: Basic Transformations: Translation – Rotation – Scaling – Matrix Representations and Homogenous Coordinates – Composite Transformations: Translations – Rotations – Scaling. Other Transformations: Reflection – Shear – Transformations between Coordinate systems – Affine Transformations – Transformation functions – Raster Methods for transformations.

Extra reading /keywords: *Shear, Window, View port*

UNIT V

Three Dimensional Concepts: Three – Dimensional Display Methods: Parallel Projection – Perspective Projection – Depth Cueing – Visible Line and Surface – Identification – Surface Rendering – Exploded and Cutaway views – Three – dimensional and stereoscopic views – Three – dimensional Graphics packages.

Extra reading /keywords: *Depth Cue, Convergence*

Course Outcomes(CO):
The learners

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Develop a facility with the relevant mathematics of computer graphics	PSO 1, PSO 2	U
CO-2	Able to write basic graphics application programs including animation	PSO 2	An
CO-3	Able to design programs to display graphic images to given specifications	PSO 2	U
CO-4	Draw orthographic projections of lines, Planes and solids	PSO 5	An
CO-5	Obtain development of surfaces	PSO 1	Ap
CO-6	Prepare isometric and perspective views of simple solids	PSO 2, PSO 3	U

PRESCRIBED TEXT BOOK:

1. Donald Hearn & M. Pauline Backer "Computer Graphics", 2015, Prentice Hall of India, New Delhi

UNIT 1 : Chapter 2
UNIT II : Chapter 3
UNIT III : Chapter 4
UNIT IV: Chapter 5
UNIT V : Chapter 9

BOOKS FOR REFERENCE:

1.T. Graceshalini A. P. Godse, Dr. D. A. Godse," Computer Graphics & Multimedia", 2020, Technical Publications.
2. Ronald E. Barr, Davor Juricic, Thomas J. Krueger," Engineering & Computer Graphics Workbook Using SOLIDWORKS" ,2017, Beginner Publishers
3. David Rogers , J. Alan Adams ,MATHEMATICAL ELEMENTS FOR COMPUTER GRAPHICS", 2017,
4. Mahesh Goyani, "Computer Graphics", 2020, TechKnowledge
5. Rajiv choprs,"Computer Graphics: with an Iintroduction to Multimedia", 2015, S Chand Publishing

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI -620002.

PG DEPARTMENT OF COMPUTER APPLICATIONS

M.C.A - First Year - Semester – II

Course Title	Mandatory Course 4 : Computer Graphics - Practical II
Code	P23CA2MCP04
Course Type	Practical
Credits	5
Marks	100

To implement the following algorithm using C Programming:

1. DDA LINE DRAWING ALGORITHM
2. BRESENHAM'S LINE DRAWING ALGORITHM
3. MIDPOINT CIRCLE ALGORITHM
4. LINE CLIPPING ALGORITHM
5. POLYGON CLIPPING ALGORITHM
6. MIDPOINT CIRCLE ALGORITHM
7. SHAPES USING ANIMATION
8. BOUNCING BALL ANIMATION

(For the Candidates admitted from the academic year 2023 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI - 620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year - Semester – II

Course Title	**Elective 4 : Cyber Security**
Total Hours	**60**
Hours/Week	**4 Hrs/Wk**
Code	**P23CA2ECT04**
Course Type	**Theory**
Credits	**3**
Marks	**100**

GENERAL OBJECTIVE:
To gain in-depth knowledge in the field of Computer forensics- Cyber Crime & Cyber Laws

COURSE OBJECTIVES:
The Learners will be able to

CO NO.	COURSE OBJECTIVES
CO-1	Understand the basics of Cyber Security.
CO-2	Identify the domain of cyber security policy.
CO-3	Analyze cyber security frameworks and securitypolicy.
CO-4	Apply security principles and develop control system.
CO-5	Apply cyber security protection methods in real time applications.

UNIT I **12 Hrs**

INTRODUCTION TO CYBERCRIME: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cyber crimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes

CYBER OFFENSES: Introduction, How Criminals Plan the Attacks, Social Engineering Cyber stalking, Cyber cafe and Cybercrime, Botnets, the Fuel for Cybercrime, Attack Vector, Cloud Computing

UNIT II **12 Hrs**

CYBERCRIME: MOBILE AND WIRELESS DEVICES: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Device Registry, Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

UNIT III **12 Hrs**

TOOLS AND METHODS USED IN CYBERCRIME: Introduction, Proxy Servers and Anonymizers, Phishing, Identity Theft (ID Theft), Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks

UNIT IV **12 Hrs**

CYBER CRIMES AND CYBER SECURITY: THE LEGAL PERSPECTIVES: Introduction, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyberlaws - The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students with respect to Indian Scenario

UNIT V **12 Hrs**

COMPUTER FORENSICS: Understanding Computer Forensics · Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail · Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics. Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics · Special Tools and Techniques, Forensics Auditing · Ant forensics

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

COURSE OUTCOMES

The learners will be able to:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognize the various attacks and cyber-crimes and the importance of cyber security and cyber forensics	PSO 1	R, U
CO-2	Understand and identify the various concepts and techniques in cryptography and cybercrime	PSO 2	U
CO-3	Analyze and categorize the attacks and cybercrimes and to explore the advantages of cyber forensics	PSO 4	An
CO-4	Demonstrate suitable security mechanisms to avoid attacks and to methods to enhance protection in information security and cyber security	PSO 3 PSO 5	Ap
CO-5	Assess the protection methods or techniques that are suitable to solve the security breaches and cyber attacks	PSO 4	E

PSO – Programme Specific Outcome; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

PRESCRIBED TEXT

1. Godbole Nina, Belapure Sunit. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Wiley: April 2011 India Publications Released

2. Gregory C. Rasner**, "**Cyber Security and Third-Party Risk: Third Party Threat Hunting", 1st Edition

SUGGESTED REFERENCES:

1. Nelson Bill, Phillips Amelia, Steuart Christopher, **"Guide to Computer Forensics and Investigations"**, Cengage Learning, 2013.
2. T. Britz Marjie., **"Computer Forensics and Cyber Crime: An Introduction"**. Pearson, 2013.
3. Wu Chwan-Hwa (John), Irwin J. David, **"Introduction to Computer Networks and Cyber Ssecurity"**, CRC Press, 2013
4. Diogenes Yuri , Ozkaya Erdal, **"Cybersecurity – Attack and Defense Strategies: Infrastructuresecurity with Red Team and Blue Team tactics Paperback"**, 2018
5. Lavender, Linda K, **"Principles of Cyber Security"**, United States, Good Heart Willcox Company, 2018.

(For the Candidates admitted from the academic year 2023 -24 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 620002

PG DEPARTMENT OF COMPUTER APPLICATIONS

Course Title	**Non – Major Elective 1 Web Page Development - Lab**
Total Hours	**60**
Hours/Week	**5 Hrs/Wk**
Code	**P23CA2NMP01**
Course Type	**Practical**
Credits	**3**
Marks	**100**

General Objective:

To make the students hands-on experience using open-source technologies such as HTML5, CSS to implement static and dynamic interactive web pages.

Course Objectives:

The Learner will be able to

CO. No.	**Course Objectives**
CO-1	Remembers and understands to develop basic skills in analyzing the usability of a website
CO-2	Understand a HTML5 tags to create a personal website
CO-3	Remembers and understands to develop a web page in various styles using CSS
CO-4	Understands to implement and manage a webpage using external CSS to import classes for various HTML5tags

1. Acquaintance with elements, Tags and basic structure of HTML files.
2. Practicing basic and advanced text formatting.
3. Working with Background, Text and Font properties.
4. Practicing use of multimedia components (Image, Video & Sound) in HTML document.
5. Designing of webpage-Working with List.
6. Designing of webpage-Working with Tables.
7. Practicing Hyper linking of Web pages.
8. Designing of webpage-Working with Frames.
9. Designing of webpage-Working with Forms and Controls.
10. Acquaintance with creating style sheet, CSS properties and styling.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	**Core Course 14 – Full Stack Web Application Development**
Total Hours	**75**
Hours/Week	**5 Hrs/Wk**
Code	**P23CA3CCT14**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:
To learn and understand an overview of the fundamental components and frameworks used in Full-Stack Web Development and best practices to build dynamic and scalable web applications.

Course Objectives(CO):
The learner will be able to

CO No.	Course Objectives
CO-1	Understand the basic components of the web development framework; Develop proficiency in JavaScript fundamentals
CO-2	Understand how to work with Node packages and utilize the Node Package Manager (NPM); Develop and deploy a simple Node.js web application for server-side development
CO-3	Introduces and understand the MongoDB, and equip them with the skills to build and manage databases for web applications.
CO-4	Understand and develop knowledge and skill to utilize Express in Node.js for server-side development and Angular for building dynamic and interactive web applications.
CO-5	Understand React, a key component of the MERN stack to build user-centric and scalable web applications.

UNIT I **15 Hrs**

BASICS OF FULL STACK: Understanding the Basic Web Development Framework: User – Browser – Webserver – Backend Services. MVC Architecture: Understanding the different stacks – The role of Express – Angular – Node – Mongo DB – React.

JAVASCRIPT PRIMER: Variables and Data types – Operators – Looping – Creating Functions – Java Script Arrays and Objects – Events – JavaScript Form Validation - AJAX: GET and POST.

Extra Reading /Key words: *Develop a comprehensive understanding of JavaScript objects and strings to manipulate and manage data.*

UNIT II **15 Hrs**

NODE JS: Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers – Callbacks – Handling Data I/O – Implementing HTTP services in Node.js.

Extra Reading /Key words: *Create RESTful APIs, and handle HTTP requests and responses using Node.js.*

UNIT III **15 Hrs**

MONGO DB: Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications.

Extra Reading /Key words: *Handling Cookies in Node JS.*

UNIT IV **15 Hrs**

EXPRESS AND ANGULAR: Implementing Express in Node.js – Configuring routes – Using Request and Response objects Angular – Typescript – Angular Components – Expressions – Data binding – Built-in directives.

Extra Reading /Key words: *Develop skills in utilizing advanced features of Angular, such as built-in directives, services to optimize web application development.*

UNIT V **15 Hrs**

REACT: MERN STACK – Basic React applications – React Components – React State – Express REST APIs – Modularization and Web pack – Routing with React Router – Server-side rendering.

Extra Reading /Key words: *Learn to integrate Express REST APIs with React applications*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain features of Web Development Framework, the MVC Architecture and Develop basic programming skills using JavaScript	PSO 1	R, U
CO-2	Explain and apply Node packages using Node.js for event driven programming applications	PSO 2	R, U, Ap
CO-3	Develop skills in building simple applications using MongoDB and Node.js, integrating backend and database functionalities	PSO 2, PSO 3	U, Ap, An
CO-4	Implement Express framework, Angular with TypeScript in Node.js to build robust and scalable server-side web applications	PSO 3	U, Ap, An
CO-5	Understand and implement client-side techniques in React to end–to–end web applications	PSO 4	U, Ap, An

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, **"Node.js, MongoDB and Angular Web Development"**, Addison-Wesley Publications, Second Edition, 2018.

   Unit I: Chapter 1 and Chapter 2
   Unit II: Chapter 3, Chapter 4, Chapter 5 and Chapter 7
   Unit III: Chapter 11, Chapter 12 and Chapter 13
   Unit IV: Chapter 18, Chapter 20, From Chapter 22 to Chapter 25

2. Vasan Subramanian, **"Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node"**, Second Edition, A press Publications, 2019.

   Unit V: Chapter 1, From Chapter 3 – Chapter 5, Chapter 7, 8 and Chapter 11

BOOKS FOR REFERENCE:

1. Simon Holmes, **"Getting MEAN with Mongo, Express, Angular, and Node"**, Manning Publications, 2016
2. Chris Northwood, **"The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer"**, A press Publications, 1st Edition, 2018
3. Kirupa Chinnathambi, **"Learning React: A Hands-On Guide to Building Web Applications Using React and Redux"**, Addison-Wesley Professional, 2nd Edition, 2018
4. Jeff Dickey, **"Write Modern Web Apps with the MEAN Stack: Mongo, Express, AngularJS, and Node.js"**, Peachpit Press, 2015.
5. Amos Q. Haviv, Adrian Mejia, **"Web Application Development with MEAN"**, Kindle, 2017

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Core Course 15 – Principles of Compiler Design
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3CCT15
Course Type	Theory
Credits	4
Marks	100

General Objective:
To introduce the various phases of a compiler and to acquire the knowledge in developing and designing a compiler.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the phases of compiler and apply Syntax Directed Translator;
CO-2	Recognize and apply the tokens to compute NFA, DFA and NFA from DFA;
CO-3	Apply Context free grammars to construct different types of parsers;
CO-4	Understand and distinguish different types of syntax tree and storage organization;
CO-5	Apply lexical, syntax analysis to optimize the target code.

UNIT I **12 Hrs**
INTRODUCTION: Language Processors – The Structure of a Compiler – Applications of Compiler Technology.
ASIMPLESYNTAX– DIRECTED TRANSLATOR: Introduction– Syntax Definition –Syntax – Directed Translation – Parsing – A Translator for Simple Expressions.
Extra Reading /Key words: *OpenCL, OpenXL.*

UNIT II **12 Hrs**
LEXICAL ANALYSIS: Lexical Analysis – The Role of the Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – From Regular Expression to Automata – Optimization of DFA – Based Pattern Matchers.
Extra Reading /Key words: *Hashing Scheme , Mitopia.*

UNIT III **12 Hrs**
SYNTAX ANALYSIS: Introduction – Context–Free Grammars – Writing a Grammar – Top – Down Parsing – Bottom – Up Parsing.
INTRODUCTION TO LR PARSING: Simple LR – Using Ambiguous Grammars.
Extra Reading /Key words: *Earley Algorithm, Intersection Parsing.*

UNIT IV **12 Hrs**

SYNTAX – DIRECTED TRANSLATION: Syntax Directed Definitions – Evaluation Orders for SDD'S – Application of Syntax – Directed Translation.

INTERMEDIATE – CODE GENERATION: Variants of Syntax Trees – Three – Address Code.

RUN – TIME ENVIRONMENTS: Storage Organization – Stack Allocation of Space.

Extra Reading /Key words: *Runtime Analysis Tools, Runtime Structures.*

UNIT V **12 Hrs**

CODE GENERATION: Issues in the Design of a Code Generator – The Target Language – Addresses in the Target Code – Basic Blocks and Flow Graphs – Optimization of Basic Blocks – A Simple Code Generator – Peephole Optimization.

MACHINE – INDEPENDENT OPTIMIZTIONS: The Principal Sources of Optimization – Introduction to Data – Flow Analysis.

Extra Reading /Key words: *Lazy Code Motion, Scalar compiler optimization.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the concepts of compiler and discuss the lexical analysis	PSO 1	U
CO-2	Describe the functionality of Lexical and Syntax analysis	PSO 1	U
CO-3	Illustrate the concepts of parser and its types	PSO 2	Ap
CO-4	Define the storage organization and List the intermediate codes.	PSO 4	U
CO-5	Summarize the working features of Code Generation.	PSO 4	U
CO-6	Acquire the knowledge of compiler develop a new compiler software	PSO 4	U, Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, Monica S. Lam **"Compilers Principles, Techniques, and Tools"**, 2022, Pearson Education.

UNIT I	**:**	Chapter 1: (1.1, 1.2, and 1.5), Chapter 2: (2.1 –2.5)
UNIT II	**:**	Chapter 2: (2.6), Chapter 3: (3.1– 3.4, 3.6,3.7,3.9)
UNIT III	**:**	Chapter 4: (4.1– 4.6,4.8)
UNIT IV	**:**	Chapter 5: (5.1 – 5.3), Chapter 6 :(6.1, 6.2), Chapter 7:(7.1,7.2)
UNIT V	**:**	Chapter 8: (8.1 – 8.7), Chapter 9 :(9.1,9.2)

BOOKS FOR REFERENCE:

1. Kenneth C. Louden and Kenneth Louden, **"Compiler Construction: Principles and Practice",** 2018, First ecition, Cengage Learning Publisher.
2. A.A.Puntambekar, **"Compiler Design"**, 2010,Technical Publications.
3. Reinhard Withelm, HelmutSeidl, **"Compiler Design Virtual Machines"**,2010, SpringerVenlag Berlin Heidelberg.
4. Anand Sharma, **"Theory of Automata and Formal Languages"**, 2015, Laxmi Publications.
5. K. Cooper, L. Torczon, **"**Engineering a Compiler**"**, 2012, Morgan Kaufman Publishers.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Core Course 16 – Software Engineering
Total Hours	75
Hours/Week	5 Hrs/Wk
Code	P23CA3CCT16
Course Type	Theory
Credits	4
Marks	100

General Objective:
To enable the students to understand the software engineering methodologies for the development of quality, cost effective and feasible software.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Understand Software, the nature of software, software process and various models
CO-2	Recognize the requirements, analyze and apply the various requirement models
CO-3	Know the design concepts, analyze and apply the concepts to design architectural, component level & User interface models, apply the Golden rules
CO-4	Realize the quality concepts, Software Quality Assurance tasks, types of Testing
CO-5	Analyze the Product, process & project metrics, Create a viable Software Plan with the Strategies for Software Project Improvement

UNIT I **15 Hrs**

SOFTWARE AND SOFTWARE ENGINEERING: The nature of software – The Software Process–The Software Engineering Practice.

PROCESS MODELS: A Generic Process Model – Defining a Framework Activity–Identifying a Task Set – Process Assessment and Improvement – Prescriptive Process Models: Product and Process.

AGILITY: Agility –Agility and the Cost of Change – Agile Process – SCRUM.

Extra Reading/Keywords: *Legacy software*

UNIT II **15 Hrs**

UNDERSTANDING REQUIREMENTS: Requirement Engineering –Establishing the Ground work– Eliciting the Requirements – Developing Use cases– Building the requirement model – Negotiating Requirements – Validating Requirements.

REQUIREMENT MODELING: SCENARIOS, INFORMATION & ANALYSIS CLASSES: Requirement Analysis – Scenario Based Modeling – Class Based Modeling – Functional Modeling – Behavioral Modeling

Extra Reading/Keywords: *Building the analysis model.*

UNIT III **15 Hrs**

DESIGN CONCEPTS: Design within the Context of Software Engineering – The Design process – The Design Concepts – The Design model

ARCHITECTURAL DESIGN: Software Architecture – Agility and Architecture – Architectural Styles – Architectural Considerations –Architectural Decisions – Architectural Design – Assessing Alternative Architectural Designs.

COMPONENT LEVEL DESIGN: What is a Component? **–** Defining class-based components – Conducting Component Level design – Specialized Component Level Design – Component Refactoring.

USER EXPERIENCE DESIGN: User Experience Design Elements - The Golden Rules –User Interface Analysis and Design – User Experience Design – User Interface Design.

Extra Reading / Keywords: *Class–Based Modeling.*

UNIT IV **15 Hrs**

QUALITY CONCEPTS: Quality – Software Quality – Achieving Software Quality.

SOFTWARE QUALITY ASSURANCE: Elements of Software Quality Assurance –SQA Processes and Product Characteristics – SQA Tasks, Goals and Metrics – Formal Approaches to SQA - Statistical Software Quality Assurance (six sigma) – Software Reliability - ISO 9000 Quality standards.

SOFTWARE TESTING – COMPONENT LEVEL: A Strategic approach to Software Testing – Planning and Record Keeping – Test Case Design - White Box Testing–Black box Testing - Object Oriented Testing.

SOFTWARE TESTING – INTEGRATION LEVEL: Software Testing Fundamentals – Integration Testing – Validation Testing– Testing Patterns.

Extra Reading/Keywords: Software *reviews, Formal technical reviews.*

UNIT V **15 Hrs**

SOFTWARE METRICS AND ANALYTICS: Software Measurement – Software Analytics – Product Metrics – Metrics for Testing – Metrics for Maintenance – Process and Project Metrics.

CREATING A VIABLE SOFTWARE PLAN : The Project Planning Process – Software Scope and Feasibility – Resources – Project Scheduling – Defining a Project Task Set – Defining Task Network - Scheduling.

SOFTWARE PROCESS IMPROVEMENT: SPI – SPI Process – CMMI – SPI Frameworks – SPI Return on Investment – SPI Trends.

Extra Reading/ Keywords: *The "New" software engineering process, the software engineering responsibilities.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Remember the basics of software and understand the nature of software, software process and software engineering practice, explain and compare the various models	PSO1	R,U
CO-2	Understand the requirements, analyze and design the various requirement models	PSO2	R,U
CO-3	Explain the design concepts, analyze and apply the concepts to design architectural, component level & User interface models, list the golden rules	PSO3	U, An, Ap
CO-4	Explain the quality concepts, Software Quality Assurance tasks, apply the strategies of testing	PSO4	Ap
CO-5	Apply the process-project metrics, estimation modeling & Analyse the viability of the Software.	PSO5	An, Ap

PSO-Programme Specific Outcomes; CO - Course Outcomes; R-Remember,U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Roger S. Pressman & Bruce R. Maxim, **"Software Engineering: A Practitioner's Approach",** Ninth Edition, McGraw– Hill Education India Pvt. Ltd., 2023.

UNIT I **:** Chapters 1.1, 1.3, 1.4, 2.1–2.6, 3.1–3.3
UNIT II **:** Chapters 7, 8
UNIT III **:** Chapters 9, 10, 11, 12.1 – 12.3, 12.5, 12.6
UNIT IV **:** Chapters 15.1, 15.2, 15.4, 17.2 – 17.8, 20.1, 20.2, 20.5, 20.6
UNIT V **:** Chapters 23.1, 23.6, 25.2 – 25.4, 25.7 –25.10, 28

BOOKS FOR REFERENCE:

1. Ian Sommarvilla, **"Software Engineering"**, Eighth Edition, Pearson Education Publishing Ltd., New Delhi, 2009.
2. Rajib Mall, **"Fundamentals of Software Engineering"**, Fifth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2018.
3. Roger S. Pressman, **"Software Engineering: A Practitioner's Approach"**, Eighth Edition, Tata McGraw–Hill International Edition, 2017.
4. K.K. Aggarwal, Yogesh Singh, **"Software Engineering"**, Third Edition, New Age International Publishers, 2019
5. Mark Richards, Neal Ford, **"Fundamentals of Software Architecture: An Engineering Approach"**, O'Reilly Publications, 2014

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Core Course 17 - Mobile Application Development
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3CCT17
Course Type	Theory
Credits	4
Marks	100

General Objective:
To give Basic Knowledge on mobile application development using Android OS.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the need of Flutter and Learn Basic Concepts
CO-2	Learn to create a mobile app with Layouts
CO-3	Learn to create a mobile app with Forms and Animations
CO-4	Learn and use the routing widgets in mobile apps;
CO-5	Learn to develop a mobile app with HTTP, Database and JSON.

UNIT I **12 Hrs**

MEET FLUTTER: Why does Flutter use Dart? – on Dart- Who uses Flutter? – Who Should be using Flutter? – Other Mobile Development options- The immediate benefits of Flutter – Future Benefits of Flutter – Introduction to Flutter- Flutter Rendering-.

INTRODUCTION TO DART: Hello Dart – Common Programming Concepts of Dart- Control Flow-Functions – Object Oriented Programming

Extra Reading /Key words: *Mac Os, Ios*

UNIT II **12 Hrs**

BREAKING INTO FLUTTER: Counter app- Widgets – Build Context- Enhancing counter app with widgets – Favour composition – Layout in Flutter – element Tree

FLUTTER USER INTERACTION, STYLES AND ANIMATIONS: Setting up and configuring a Flutter app –Structural widgets more configuration – styling themes in Flutter- Common layout and UI widgets

Extra Reading /Key words: *Table Layout, Gird Layout*

UNIT III **12 Hrs**

USER INTERACTION: FORMS AND GESTURES: User interaction and gestures – Flutter forms – form field widgets – Form UI and Working with Focus nodes – Managing Form state with form methods

PUSHING PIXELS: FLUTTER ANIMATIONS AND USING THE CANVAS: Introducing Flutter animations – Custom painter and the canvas- Staggered animations – Tween sequence – built –in animations – Reusable custom color transition widgets

Extra Reading /Key words: *Embedded app, Inner Layouts*

UNIT IV **12 Hrs**

STATE MANAGEMENT AND ASYCHRONOUS DART: Routing in Flutter- Declarative Routing and named routes – Routing on the fly – routing animation

FLUTTER STATE MANAGEMENT: Deepdrive into stateful widgets – inheritance widget – Blocs

Extra Reading /Key words: *MAP View, SQlite*

UNIT V **12 Hrs**

WORKING WITH DATA: HTTP, FIRESTORE AND JSON : HTTP and Flutter – JSON serialization – Working with Firebase in Flutter – Dependency Injection

USING FIREBASE WITH FLUTTER: Introduction Firebase – Setting up Firebase – using Firestore

Extra Reading /Key words: *Json Objects, Review Apps*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the Flutter APP environment and its components.	PSO 1	R, U
CO-2	Understand the widgets of Dart in Flutter	PSO 2,PSO 3	U
CO-3	Apply the suitable widget to develop a mobile app with Routing widgets.	PSO 4	U,AP
CO-4	Analyze the widgets and apply the suitable widget to develop a mobile app with HTTP, Firebase.	PSO 2,PSO 3	U,AP,AN
CO-5	Evaluate and justify the widgets for developing the mobile app with JSON.	PSO 2, PSO 3	U,AP,AN

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. Eric Windmill, **"Flutter in Action"**, Manning Publications co, NewYork, 2020.

   UNIT I : Chapters – 1,2
   UNIT II : Chapters -3,4
   UNIT III : Chapters -5,6
   UNIT IV : Chapters – 7,8
   UNIT V : Chapter 10

2. Rap Payne, **" Beginning App Development with Flutter"**, APress Publication, 2019.

   UNIT V : Chapter 12

BOOKS FOR REFERENCE:

1. Napoli, M. L. (n.d.). **"Beginning Flutter: A Hands On Guide to App Development",** John Wiley & Sons.2019.
2. Zammetti, F, **"Practical flutter: Improve your Mobile Development with Google's Latest Open-Source SDK".** Apress., 2019.
3. Al-Shahmeh, M. M**.," Flutter Apps Development 2E: Build Cross-Platform Flutter Apps with Trust"**. Independently Published, 2023.
4. Martins, F, **" Flutter and Dart The complete guide: Create Cross-Platform Mobile Apps with Google's Latest Open-Source SDK Through Flutter And Dart"**, 2021.
5. Bailey, T., & Biessek, A, **" Flutter for beginners: An introductory guide to building cross-platform mobile applications with Flutter 2.5 and Dart"**, Packt Publishing Ltd, 2021.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A-Second Year-Semester– III

Course Title	Elective 2- Artificial Intelligence and Machine Learning
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3ECT05
Course Type	Theory
Credits	4
Marks	100

General Objective:
To introduce the basic principles, techniques, and applications of Artificial Intelligence and provide fundamentals of software programming environments.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Learn the Knowledge Representations & Reasoning with (AI) and its foundations
CO-2	Apply basic principles of AI in solutions with the requirements for problem solving and inferences
CO-3	Understand the rules for logical and statistical reasoning perceptions with theorems
CO-4	Interconnect the Human and Machine Learning Concepts with the Tools
CO-5	Demonstrate Machine Learning models with the types of data and the processing

UNIT I **12 Hrs**
INTRODUCTION: Artificial Intelligence and Problem solving: Definition - AI problems- Underlying Assumption - AI Technique-
PROBLEMS, PROBLEM SPACES AND SEARCH: Defining the problem as state space search- Production systems.
HEURISTIC SEARCH TECHNIQUES: Generate and Test – Constraint Satisfaction-Means-End Analysis
Extra Reading /Key words: *Impact of AI in Daily Life*

UNIT II **12 Hrs**
KNOWLEDGE REPRESENTATION ISSUES: Representations and mappings -Approaches to Knowledge representations.
USING PREDICATE LOGIC: Representing simple facts in logic- Representing Instance and ISA relationships - Computable functions and predicates – Resolution.
Extra Reading /Key words: *General and Narrow AI*

UNIT III **12 Hrs**
REPRESENTING KNOWLEDGE USING RULES: Procedural Vs Declarative knowledge – Logic programming- Backward vs Forward Reasoning.
STATISTICAL REASONING: Probability and Baye's Theorem- Bayesian Networks - Dempster-Shafer Theory.
Extra Reading /Key words: *Machine Perception and Swarm behavior*

UNIT IV **12 Hrs**

INTRODUCTION TO MACHINE LEARNING:

Introduction – Human Learning – Types of Human Learning – Machine Learning – Problems Not To Be Solved Using Machine Learning – Applications of Machine Learning – State – Of – The - Art Languages /Tools in Machine Learning – Issues in Machine Learning

Extra Reading /Key words: *Types of Learning, Reinforcement, PAC learning*

UNIT V **12 Hrs**

PREPARING TO MODEL: Introduction – Machine Learning Activities – Basic types of Data in Machine Learning – Exploring Structure of Data – Data quality and Remediations – Data Preprocessing.

Extra Reading /Key words: *Linear and Non-Linear, Kernel Functions.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO. No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Learn the Knowledge Representations & Reasoning with (AI) and its foundations	PSO1,PSO2	U
CO-2	Apply basic principles of AI in solutions with the requirements for problem solving and inferences	PSO2	An
CO-3	Understand the rules for logical and statistical reasoning perceptions with theorems	PSO2	U
CO-4	Interconnect the Human and Machine Learning Concepts with the Tools	PSO5	An
CO-5	Demonstrate Machine Learning models with the types of data and the processing	PSO1	Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. Elaine Rich,Kevin Knight, Shivashankar B Nair **"Artificial Intelligence",** Tata McGraw Hill, 3rd Edition, New Delhi, India, 2017.
   - **UNIT I** **:** Chapter 1(1.1,1.2,1.3),Chapter 2(2.1,2.2) Chapter 3(3.1,3.5,3.6)
   - **UNIT II** **:** Chapter 4(4.1,4.2), Chapter 5(5.1,5.2,5.3,5.4)
   - **UNIT III** **:** Chapter 6(6.1,6.2,6.3),Chapter 8(8.1,8.3,8.4)
2. Saikat Dutt Subramanian Chandramouli, **"Machine Learning"**, Pearson Publishing, 2021.
   - **UNIT IV** **:** Chapter 1
   - **UNIT V** **:** Chapter 2

BOOKS FOR REFERENCE:

1. Sridhar Seshadri, **"A First Course in Artificial Intelligence and Agent Technology"**, 1stEdition, LAP LAMBERT Academic Publishing, India, 2017.
2. Utpal Chakraborty, **"Artificial Intelligence for All: Transforming Every Aspect of our Life"**, 2020.
3. Russell and Norvig, **"Artificial Intelligence: A Modern Approach"**, 4th Edition, 2022.
4. Ian H. Written, Eibe Frank, Mark A. Hall and Christopher J. Pal, **"Data Mining: Practical Machine Learning Tools and Techniques"**, 2016.
5. Oliver Theobald, **"Machine learning foe Absolute Beginners",** 3rd Edition, 2021.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	MAJOR ELECTIVE 2 - Fuzzy Logic
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3ECT06
Course Type	Theory
Credits	4
Marks	100

General Objective:
To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	To provide a strong foundation of fundamental concepts in Fuzzy Sets;
CO-2	To provide a basic exposition to the goals and functions of Fuzzy Sets;
CO-3	To enable the student to apply these techniques in applications which involve Arithmetic Operations in Fuzzy Sets;
CO-4	Applythese techniques in rule based Fuzzy Systems
CO-5	To analyse clustering techniques with fuzzy classifications

UNIT I **12 Hrs**

INTRODUCTION: Classical Sets and Fuzzy Sets – Background - Uncertainty and Imprecision - Statistics and Random Processes - Uncertainty in Information - Fuzzy Sets and Membership - Chance versus Ambiguity. **CLASSICAL SETS:** Operations on Classical Sets - Properties of Classical (Crisp) Sets - Mapping of Classical Sets to Functions - Fuzzy Sets.

UNIT II **12 Hrs**

MEMBERSHIP FUNCTIONS: Features of the Membership Function - Standard Forms and Boundaries, Fuzzification - Membership Value Assignments – Intuition – Inference - Rank Ordering - Angular Fuzzy Sets - Neural Networks - Genetic Algorithms - Inductive Reasoning. **FUZZY:** To Crisp Conversions: Lambda - Cuts for Fuzzy Sets – Lambda - Cuts for Fuzzy Relations - Defuzzification Methods. Extension Principle - Crisp Functions -Mapping and Relations - Functions of fuzzy.

UNIT III **12 Hrs**

FUZZY ARITHMETIC: Fuzzy Numbers - Interval Analysis in Arithmetic - Approximate Methods of Extension - Vertex method - DSW Algorithm - Restricted DSW Algorithm - Comparisons. Fuzzy Vectors. **CLASSICAL LOGIC AND FUZZY LOGIC:** Classical Predicate Logic – Tautologies – Contradictions – Equivalence - Exclusive OR and Exclusive NOR.

UNIT IV **12 Hrs**

FUZZY RULE BASED SYSTEMS: Natural Language - Linguistic Hedges - Rule-Based Systems - Canonical Rule Forms - Decomposition of Compound Rules - Likelihood and Truth Qualification - Aggregation of Fuzzy Rule -, Graphical Techniques of Inference - Fuzzy Decision Making.

UNIT V **12 Hrs**

FUZZY CLASSIFICATION: Classification by Equivalence Relations - Crisp Relations - Fuzzy Relations. **CLUSTER ANALYSIS:** Cluster Validity - c-Means Clustering - Hard c-Means (HCM), Fuzzy c-Means (FCM). **CLASSIFICATION METRIC:** Hardening the Fuzzy c-Partition - Similarity Relations from Clustering.

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	To have the knowledge on concepts of fuzzy sets;	PSO 1	R, U
CO-2	To have the knowledge on concepts of fuzzy functions. To gain Knowledge of fuzzyarithmetics;	PSO 2	U, A
CO-3	To use the fuzzyrules in decision making;	PSO 3	U
CO-4	To evaluate similarity relationship through fuzzy classification and clustering.	PSO 3	A, Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Timothy J. Ross , **"Fuzzy Logic with Engineering Applications"** , II Edition, Tata McGraw- Hill Publications.

BOOKS FOR REFERENCE:

1. Guanrong Chen &Trung Tat Pham "**Introduction to Fuzzy Systems"**, Chapman & Hall, CRC, 2006.
2. Driankov D., Hellendoorn H., Reinfrank M, **"An Introduction to Fuzzy Control",** Narosa Publications,1993.
3. Robert Babuska, "**Fuzzy Modeling for Control"**, International Series in Intelligent Technologies,Kluwer Academic Publications,1998.
4. Ronald R Yager and Dimitar P Filev, **"Essentials of Fuzzy Modelling & Control".,** John Wiley &Sons, Inc,2002.
5. J.-S.R.Jang, C.-T.Sun, E.Mizutani, "**Neuro-Fuzzy and Soft Computing**", Prentice Hall,1997.
6. B.Kosko, Fuzzy Engineering, Prentice Hall,1997.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A-Second Year-Semester– III

Course Title	Elective 2 - Artificial Neural Networks
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3ECT07
Course Type	Theory
Credits	4
Marks	100

General Objective:
To study the theoretical foundations of Artificial Intelligence and an indication of the ways that current techniques that can be used in concurring Applications.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the AN Techniques and typical problem spaces and search programs;
CO-2	State the standard search methods and knowledge representation issues;
CO-3	Determine the varietyof methods for encoding knowledge in the AN Systems;
CO-4	Comprehend the symbolic and statistical reasoning techniques and theorems;
CO-5	Analyze the frameworks like Weak and Strong Slot-and-Filler Structures.

UNIT I **12 Hrs**

BASIC LEARNING ALGORITHMS: Biological Neuron – Artificial Neural Model – Types of Activation Functions – Architecture– Feed Forward and Feedback – Learning Process – Error Correction Learning – Memory Based Learning – Hebbian Learning – Competitive Learning – Boltzman Learning –Supervised and Unsupervised Learning – Learning Tasks – Pattern Space– Weight Space –Pattern Association – Pattern Recognition – Function Approximation – Control – Filtering –Beam forming – Memory – Adaptation – Statistical Learning Theory – Single Layer Perceptron – Perceptron Learning Algorithm– Perceptron Convergence Theorem – Least Mean Square Learning Algorithm – Multilayer Perceptron – Back Propagation Algorithm – XOR problem – Limitations of Back Propagation Algorithm.

UNIT II **12 Hrs**

RADIAL BASIS FUNCTION NETWORKS AND SUPPORT VECTOR MACHINES: Cover's Theorem on the Separability of Patterns – Exact Interpolator – Regularization Theory – Generalized Radial Basis Function Networks – Learning in Radial Basis Function Networks – Applications
– XOR Problem – Image Classification.

SUPPORT VECTOR MACHINES: Optimal Hyperplane for Linearly Separable Patterns and Nonseparable Patterns – Support Vector Machine for Pattern Recognition – XOR Problem – – insensitive Loss Function –Support Vector Machines for Nonlinear Regression.

UNIT III **12 Hrs**

COMMITTEE MACHINES: Ensemble Averaging – Boosting – Associative Gaussian Mixture Model – Hierarchical Mixture of Experts Model (HME) – Model Selection using a Standard Decision Tree –A priori and Posteriori Probabilities – Maximum Likelihood Estimation – Learning Strategies for the HME Model – EM Algorithm – Applications of EM Algorithm to HME Model.

NEURODYNAMICS SYSTEMS: Dynamical Systems – Attractors and Stability – Non–linear Dynamical Systems – Lyapunov Stability– Neurodynamical Systems – The Cohen–Grossberg Theorem.

UNIT IV **12 Hrs**

ATTRACTOR NEURAL NETWORKS: Associative Learning – Attractor Neural Network Associative Memory – Linear Associative Memory– Hopfield Network – Content Addressable Memory – Strange Attractors and Chaos – Error Performance of Hopfield Networks – Applications of Hopfield Networks –Simulated Annealing– Boltzmann Machine – Bidirectional Associative Memory – BAM Stability Analysis – Error Correction in BAMs – Memory Annihilation of Structured Maps in BAMS – Continuous BAMs– Adaptive BAMs – Applications.

ADAPTIVE RESONANCE THEORY: Noise – Saturation Dilemma – Solving Noise – Saturation Dilemma – Recurrent On–center – Off– surround Networks – Building Blocks of Adaptive Resonance – Substrate of Resonance Structural Details of Resonance Model – Adaptive Resonance Theory – Applications.

UNIT V **12 Hrs**

SELF ORGANISING MAPS: Self–organizing Map – Maximal Eigenvector Filtering – Sanger's Rule – Generalized Learning Law– Competitive Learning – Vector Quantization – Mexican Hat Networks –Self–organizing Feature Maps – Applications PULSED NEURON MODELS – Spiking Neuron Model – Integrate–and–Fire Neurons– Conductance Based Models – Computing with Spiking Neurons.

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the levels of model and Problems and production system characteristics	PSO 1	R, U
CO-2	Identify the Heuristics search techniques and issues in Representing the Knowledge	PSO 2	U, A
CO-3	Express the facts, Functions with Reasoning in programming, matching controls	PSO 3	U
CO-4	Integrate the Implementation issues in Symbolic/ Statistic reasoning theorems	PSO 3	A, Ap
CO-5	Explore the varietyof Slot & filler structures includes semantic nets, scripts	PSO 4	An

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. Satish Kumar, **"Neural Networks, A Classroom Approach"**, Second Edition, Tata McGraw -Hill, 2017.

2. Simon Haykin, **"Neural Networks, A Comprehensive Foundation",** 2nd Edition, Addison WesleyLongman,2001.

BOOKS FOR REFERENCE:

1. MartinT. Hagan, Howard B. Demuth and Mark Beale, **"Neural Network Design",** Thomson Learning,2003.
2. James A. Freeman and David M. Skapura, **"Neural Networks Algorithms, Applications and Programming Techniques"**, Pearson Education,2003.
3. Bunkure, J. K. (2020), **"Mixture of Expert Models. Statistical Analysis Method"**, Germany: GRIN Verlag.
4. Attractor **"Networks: Fundamentals and Applications in Computational Neuroscience"** (2023). (n.p.): One Billion Knowledgeable.
5. Kohonen, T. (2012), **"Self-Organizing Maps"**, Germany: Springer Berlin Heidelberg.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Core Course 18 – Full Stack Web Application Development – Practical V
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3CCP18
Course Type	Practical
Credits	2
Marks	100

General Objective:
To provide hands-on experience and practical skills in Full Stack Web Application Development, covering essential topics, technologies, and frameworks like Node.js, Express, Angular, MongoDB, and React.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Understand and develop the client side Web Application using JavaScript
CO-2	Understand and develop Web Application using NodeJS
CO-3	Understand and implement MongoDB database connection and Performing CRUD Operations
CO-4	Understand and implement Express backend with Angular frontend to create a complete full-stack Web Application.
CO-5	Implement Basic React Applications using Express REST APIs with React

List of Exercises:
Implement the following concepts:

1. Demonstrate JavaScript functions, loops, and arrays to manipulate data and create interactive web components.
2. Demonstrate a basic Node.js application to handle HTTP requests and responses.
3. Implement event handling using Events, Listeners, and Emitters in a Node.js application.
4. Establish a connection between a Node.js application and MongoDB, and perform database CRUD operations.
5. Develop Angular components; manage data using TypeScript, and implement data binding.
7. Integrate Express backend with Angular frontend to create a complete full-stack web application.
7. Create simple React components, manage state, and implement basic React functionalities.
8. Fetch data from an Express API, display it using React components, and handle user interactions.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Develop basic programming skills using JavaScript	PSO 1	R, U
CO-2	Understand and apply Node packages using Node.js for eventdriven programming applications	PSO 2	R, U, Ap
CO-3	Develop skills in building simple applications using MongoDB and Node.js, integrating backend and database functionalities	PSO 2, PSO 3	U, Ap, An
CO-4	Implement Express framework, Angular with TypeScript in Node.js to build robust and scalable server-side web applications	PSO 3	U, Ap, An
CO-5	Implement client-side techniques in React toend–to–end web applications	PSO 4	U, Ap, An

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Core Course 19 – Mobile Application Development – Practical VI
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA3CCP19
Course Type	Practical
Credits	2
Marks	100

General Objective:
To give Basic Knowledge on mobile application development using Flutter

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the need of Flutter and Learn Basic Concepts
CO-2	Learn to create a mobile app with Layouts
CO-3	Learn to create a mobile app with Forms and Animations
CO-4	Learn and use the routing widgets in mobile apps;
CO-5	Learn to develop a mobile app with HTTP, Database and JSON.

List of Exercises:

1. Flutter Introduction and getting started with Flutter.
2. Create a Hello World Application in Flutter.
3. Write an application as ask the user for a number and determine whether the number is prime or not in Dart.
4. Write a program in Dart that find the area of a circle using function.
5. Write a Dart program to create a class Laptop with properties [id, name, ram] and create 3 objects of it and print all details.
6. Create a simple Calculator application in Flutter.
7. Create a simple Navigation App.
8. Create forms in Flutter, Implementing Text input, drop-down lists, and more form elements in forms, Applying validation in form.
9. Build an application for adding firebase to Flutter application.
10. Code for Applying Flutter with JSON.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Remember and understand the the Flutter APP environment and itscomponents.	PSO 1	R, U
CO-2	Understand layouts, widgets in Dart.	PSO 2,PSO 3	U,AP
CO-3	Apply the tools of Dart to develop a mobile app	PSO 4	U,AP,AN
CO-4	Analyze and apply proper widgets to develop a mobile app using HTTP, Firebase.	PSO 2,PSO 3	U,AP,AN
CO-5	Evaluate and justify the widgets for developing the mobile app with JSON.	PSO 2, PSO 3	AP,AN, E

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Self Study Paper - Professional Ethics
Code	P23CA3SST01
Course Type	Theory
Credits	2(EC)
Marks	100

General Objective:
To understand the concepts of computer ethics in work environment.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Examine situations and to internalize the need for applying ethical principles, values to tackle with various situations;
CO-2	Develop a responsible attitude towards the use of computer as well as the technology;
CO-3	Envision the societal impact on the products/ projects they develop in their career;
CO-4	Understanding the code of ethics and standards of computer professionals;
CO-5	Analyze the professional responsibility and empowering access to information in the work place.

UNIT I
COMPUTER ETHICS INTRODCUTION AND COMPUTER HACKING : A general Introduction – Computer ethics: an overview – Identifying an ethical issue – Ethics and law – Ethical theories – Professional Code of conduct – An ethical dilemma – A framework for ethical decision making – Computer hacking – Introduction – definition of hacking – Destructive programs – hacker ethics – Professional constraints – BCS code of conduct – To hack or not to hack? – Ethical positions on hacking.
Extra Reading /Key words: *hacking, ethics.*

UNIT II
ASPECTS OF COMPUTER CRIME AND INTELLECTUAL PROPERTY RIGHTS: Aspects
of computer crime – Introduction – What is computer crime – computer security measures – Professional duties and obligations – Intellectual Property Rights – The nature of Intellectual property – Intellectual Property – Patents, Trademarks, Trade Secrets, Software Issues, Copyright – The extent and nature of software piracy – Ethical and professional issues – free software and open source code.
Extra Reading /Key words: *Security, Copyright.*

UNIT III
REGULATING INTERNET CONTENT, TECHNOLOGY AND SAFETY: Introduction – In defense of freedom expression – censorship – laws upholding free speech – Free speech and the Internet – Ethical and professional issues – Internet technologies and privacy – Safety and risk – assessment of safetyand risk – risk benefit analysis – reducing risk.
Extra Reading /Key words: *censorship, privacy.*

UNIT IV

COMPUTER TECHNOLOGIES ACCESSIBILITY ISSUES : Introduction – Principle of equal access – Obstacles to access for individuals – professional responsibility – Empowering computers in the workplace – Introduction – computers and employment – computers and the quality of work – computerized monitoring in the work place – telecommuting – social, legal and professional issues – Use of Software, Computers and Internet – based Tools – Liability for Software errors – Documentation Authentication and Control – Software engineering code of ethics and practices – IEEE – CS – ACM Joint taskforce.

Extra Reading /Key words: *Technological issues, professional responsibility.*

UNIT V

SOFTWARE DEVELOPMENT AND SOCIAL NETWORKING : Software Development – strategies for engineering quality standards – Quality management standards – Social Networking – Company owned social network web site – the use of social networks in the hiring process – Social Networking ethical issues – Cyber bullying – cyber stalking – Online virtual world – Crime in virtual world – digital rights management – Online defamation – Piracy–Fraud.

Extra Reading /Key words: *Cyber crime, Cyber stalking.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Examine situations and to internalize the need for applying ethical principles, values to tackle with various situations;	PSO 1	R, U
CO-2	Develop a responsible attitude towards the use ofcomputer as well as the technology;	PSO 2	R,U
CO-3	Envision the societal impact on the products/ projects they develop in their career;	PSO 2	U
CO-4	Understanding the code of ethics and standards of computer professionals;	PSO 3	Ap
CO-5	Analyze the professional responsibility and empowering access to information in the work place;	PSO 4	U
CO-6	Become ethicallyresponsible IT professional.	PSO 5	Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. Caroline Whitback, **"Ethics in Engineering Practice and Research"**, Cambridge UniversityPress,2011.
2. George Reynolds, **"Ethics in Information Technology"**, Cengage Learning,2011.

BOOKS FOR REFERENCE:

1. John Weckert and Douglas Adeney, **"Computer and Information Ethics"**, Greenwood Press, 1997.
2. Penny Duquenoy, Simon Jones and Barry G Blundell, **"Ethical, Legal and Professional Issues in Computing"**, Middlesex University Press,2008.
3. Richard Spinello, **"Case Studies in Information and Computer Ethics"**, Prentice Hall,1997.
4. Sara Baase, **"A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet"**, 3rd Edition, Prentice Hall,2008.
5. http://www.infosectoday.com/Articles/Intro_Computer_Ethics.html

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	**Mandatory Course 5 – Web Technologies**
Code	**P23CA3MCT05**
Course Type	**Theory**
Credits	**5**
Marks	**100**

General Objective:

To understand the basic concepts of Internet and scripting tags to develop web page skills using HTML and JavaScript.

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Describes the fundamental concepts of Internet and Internet Technologies ;
CO-2	Recalls and applies the HTML scripting tags;
CO-3	Understand and implement the Java Scripts in HTML;
CO-4	Recognize the different Java Scripts functions and their usage;
CO-5	Design and develop Web Pages for real-world problems.

UNIT I
INTRODUCTION TO THE INTERNET: Computers in Business – Networking – Internet – E-Mail – Resource Sharing – Gopher – World Wide Web – Usenet – Telnet – Bulletin Board Service – Wide Area Information Service – Internet Technologies – Modem – Internet Addressing – Physical Connections – Telephone Lines – Internet Browsers – Internet Explorer – Netscape Navigator.
Extra Reading /Key words: *Advanced Internet Concepts*

UNIT II
INTRODUCTION TO HTML : History of HTML – HTML Documents – Anchor Tag – Hyper Links – Head and Body Sections – Header Section – Title – Prologue – Links – Colorful Web Page – Comment Lines.
Extra Reading /Key words: *HTML object model*

UNIT III
DESIGNING THE BODY SECTION: Heading Printing – Aligning the Headings – Horizontal Rule – Paragraph – Tab Settings – Ordered and Unordered Lists – Lists – Unordered Lists – Ordered Lists – Nested Lists – Table Handling –Tables – Table Creation in HTML – Width of the table and cells.
Extra Reading /Key words: *HTML document object model*

UNIT IV
JAVASCRIPT: JavaScript in Web Page – The advantage of JavaScript – Writing JavaScript into HTML – Basic programming Techniques – Data types and Literal – Type Casting – JavaScript Arrays – Operators and Expressions.
Extra Reading /Key words: *JavaScript object model*

UNIT V

FUNCTIONS: User defined functions – Placing text in a browser – Dialog Boxes – Form object's methods – Built-in objects – User defined Objects.

Extra Reading /Key words: *JavaScript document object model*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand and discuss the fundamental concepts of Internet and Internet Technologies	PSO 1	R, U
CO-2	Understand and apply the knowledge of HTML tags	PSO 3,4	U, Ap
CO-3	Familiarize and apply the knowledge of Java Script codes	PSO 3,4	U, Ap
CO-4	Apply the different Java Script user defined functions and their usage	PSO 3,4	U, Ap
CO-5	Analyze and develop Web Pages for real-world problems	PSO 4,5	An, Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. C. Xavier, "**World Wide Web Design with HTML**", Tata McGraw Hill Company Limited, New Delhi, 2017.
2. Ivan Bayross, "**HTML, DHTML, JavaScript, Perl, CGI**", BPB, Third Revised Edition, 2006.

BOOKS FOR REFERENCE:

1. Julie C. Meloni, **"Sams Teach Yourself: Covering HTML5, CSS3, and jQuery"**, 7th Edition,2012.
2. Thomas A. Powell, **"The Completer reference HTML, Tata McHill",** Second Edition, 2000.
3. John Pollock, **"JavaScript a Beginners Guide",** Fifth Edition, Tata McGraw Hill, 2019.
4. Laura Lemay,Rafe Colburn, Jennifer Kyrnin, **"Mastering HTML, CSS &Javascript Web Publishing"**, BPB Publications, 2016
5. Satish Jain, **"Web Designing and Development: Training Guide",** 2015

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Mandatory Course 6 – Web Technologies - Practical III
Code	P23CA3MCP06
Course Type	Practical
Credits	5
Marks	100

General Objective:
To learn and develop webpage by use of HTML5 & CSS, JavaScript and jQuery scripting languages.

Course Objectives(CO):
The learners will be able to

CO NO.	Course Objectives
CO-1	Understand the basic concepts of HTML5 Tags
CO-2	Perform basic operations using HTML5 with CSS
CO-3	Learn how to use JavaScript for effective website creation
CO-4	Learn how to use jQuery for effective website creation
CO-5	Applythe Scripting tags and create website

List of Exercises:

HTML5 & CSS

1. Develop a HTML document and perform the basic alignments on the headers and format the document using suitable tags.
2. Develop a home page for your company with suitable name, logo, pictures, background design and color text with links.
3. Design a web page of your meals menu for a week using table tag with its attributes.
4. Develop a simple application by using frame controls.

JAVA SCRIPT

1. Develop a script to generate Random Numbers within 1 to 10 and display the numbers in a Table.
2. Develop a script to create an Arithmetic Calculator using Function.
3. Develop a script to check the given String is Palindrome or not.

J QUERY

1. Develop a program to displaythe Week Days.
2. Develop a program to generate Date and Time in different format.
3. Develop a program to Validate Age and Numeric Value.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand various tags in HTML	PSO 1	U
CO-2	Remember and apply HTML tags to design webpages.	PSO 3,4	R, Ap
CO-3	Understand and apply the knowledge of Java Script codes	PSO 3,4	U, Ap
CO-4	Apply the different Java Script user defined functions and their usage	PSO 3,4	Ap
CO-5	Analyze and develop Web Pages for real-world problems	PSO 4,5	An, Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	SEC 2 (NME 2) – Advanced Excel
Total Hours	45
Hours/Week	3 Hrs/Wk
Code	P23CA3SEP02
Course Type	Practical
Credits	2
Marks	100

General Objective:
To be able to apply appropriately the python programming knowledge gainedand develop computer Based solutions for a given problem

Course Objectives(CO):
The learner will be able to

CO No.	Course Objectives
CO-1	To Understand the different types of analytics techniques
CO-2	Use advanced sorting for descriptive analysis
CO-3	Use advanced conditional formatting for descriptive analysis
CO-4	Work with advanced analytic functions
CO-5	Gain an understanding of the Excel Analysis

List of Exercises

1. Excel Introduction
(An overview of the screen, navigation and basic spreadsheet concepts • Various selection techniques • Shortcut Keys)
2. Table Preparation Using Mean Median Count
3. Text Functions (Upper, Lower, Proper, Left, Mid, Right, Trim, Len, Exact Concatenate, Find, Substitute)
4. Date and Time Functions (Today, Now, Day, Month, Year, Date, Date if, Date Add,EO Month, Weekday)
5. Data Analysis Using Charts and Graphs
6. Tree map & Waterfall
7. Sorting and Filtering
8. Logical Functions
9. Data Validation
10. Lookup Functions
11. Hyper / Data Linking
12. Advanced Formulas and Functions
13. Advanced Data Analysis using PivotTables and Pivot Charts

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the different types of arithmetic functions.	PSO 1	R, U
CO-2	Understand the different types of text, date and time functions.	PSO 3,4	U, Ap
CO-3	Apply sorting and filtering to the set of data.	PSO 3,4	U, Ap
CO-4	Analyze various types of data with the help of charts.	PSO 3,4	Ap,An
CO-5	Evaluate different types of data using PivotTables and Pivot Charts	PSO 4,5	Ap, E

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)

HOLYCROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI-620002.
PG DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A - Second Year – Semester – III

Course Title	Elective 5 – Blockchain Technology
Total Hours	45
Hours/Week	3 Hrs/Wk
Code	P23CA3ECT08
Course Type	Theory
Credits	3
Marks	100

General Objective:
To impart knowledge in block chain techniques and able to present the concepts clearly and structured. To get familiarity with future currencies and to create own crypto token

Course Objectives(CO):
The learners will be able to

CO No.	Course Objectives
CO-1	Decompose a blockchain system's fundamental components, how they fit together and examine a decentralization using blockchain.
CO-2	Understand how Crypto currency works, from when a transaction is created to when it is considered part of the blockchain.
CO-3	Explain the components of Ethereum and programming languages for Ethereum
CO-4	Learn the basics Hyperledger and Web3.
CO-5	Provide the details of alternative blockchain and blockchain projects in different perspective.

UNIT I **9 Hrs**

BLOCKCHAIN: Introduction, growth, distributed systems-history of blockchain and bitcoin-types of blockchain-consensus CAP theorem and blockchain.

Extra Reading /Key words: *Crypto Mining, Ada Crypto*

UNIT II **9 Hrs**

DECENTRALIZATION: Decentralization using blockchain- methods of decentralization, blockchain and full ecosystem decentralization- smart contracts-decentralized organisations-platforms for decentralization. Blockchain: Architecture- Versions, Variants, Use cases-Life use cases of blockchain, Blockchain vs shared Database.

Extra Reading /Key words: *Forks, Genesis Block.*

UNIT III **9 Hrs**

INTRODUCTION TO CRYPTOCURRENCIES- TYPES- APPLICATIONS BITCOINS: Introducing Bitcoin- Bitcoin digital keys and addresses- Transactions- Blockchain mining. Alternative Coins. Limitations of Bitcoin.

Extra Reading /Key words: *Casper, DDos Attacks.*

UNIT IV **9 Hrs**

Concept of Double Spending- Hashing- Proof of work. Bitcoin Network and payments- Bitcoin network- Wallets- Bitcoin payments, Innovation in Bitcoin, Bitcoin Clients and APIs.

Extra Reading /Key words: *EEA, EVM*

UNIT V **9 Hrs**

INTRODUCTION TO BLOCKCHAIN PLATFORMS: Ethereum, Hyperledger, IOTA, EOS, Multichain- Bigchain, etc. Advantages and Disadvantages-Ethereum vs Bitcoin, Design a new blockchain- Potential for disruption- Design a distributed application-Blockchain applications.

Extra Reading /Key words: *Gossip Protocol, Hyperledger.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the technology components of Blockchain and how it works behind – the scenes	PSO 1	R,U,Ap
CO-2	Be aware of different approaches to developing decentralized applications	PSO 2	U,R
CO-3	Understand the Bitcoin and its limitations by comparing with other alternative coins.	PSO 3	U
CO-4	Establish deep understanding of the Ethereum model, its consensus model and code execution.	PSO 4	R
CO-5	Understand the architectural components of a Hyperledger and its development framework	PSO 5	C, Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Imran Bashir, **"Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained"**, Second Edition, Packt Publishing, 2018.

BOOKS FOR REFERENCE:

1. Rajdeep Chakraborty, Anupam Ghosh, Valentina Emilia Balas, Ahmed A. Elngar, **"Blockchain Principles and Applications in IoT"**, 2023, 1st Edition, Chapman & Hall.
2. Sonali Vyas, Vinod Kumar Shukla, Shaurya Gupta, Ajay Prasad, **"Blockchain Technology Exploring Opportunities, Challenges, and Applications"**, 2022, 1st Edition, CRC Press.
3. Arshdeep Bahga, Vijay Madisetti, **"Blockchain Applications: A Hands On Approach"**, 2017..
4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, **"Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction"**, Princeton University Press, 2016.
5. Alex Leverington,, **"Ethereum Programming",** Packt Publishing, 2017.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Core Course 20 – Machine Learning with Python – Practical VII
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4CCP20
Course Type	Practical
Credits	3
Marks	100

General Objective:
To provide hands-on experience and essential practical skills and techniques in Machine Learning and Data Science using Python, enabling them to effectively manipulate data, develop predictive models, and create insightful visualizations for real-world applications.

Course Objectives:
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the fundamentals of data manipulation and analysis using the Pandas library, enabling learners to efficiently import and export data for effective analysis.
CO-2	Implement various machine learning models, including regression and classification techniques, to address real-world data-driven problems.
CO-3	Simulate clustering methods such as K-Means, allowing learners to group similar data points and recognize underlying patterns within datasets.
CO-4	Understand the processes involved in importing, exporting, and managing data with tools like Pandas and MySQL to ensure data integrity and accessibility.
CO-5	Create simple and effective visualizations using libraries like Matplotlib and Seaborn, enhancing the learners' ability to interpret and communicate data insights clearly.

List of Exercises:
Implement the following concepts:

1. Import and export data using Pandas library functions.
2. Demonstrate various data pre-processing techniques for a given dataset.
3. Demonstrate various Data Visualization Techniques.
4. Implement Simple and Multiple Linear Regression Models.
5. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.
6. Implement Naïve Bayes Classification.
7. Build KNN Classification model for a given dataset.
8. Implement Random forest ensemble method on a given dataset.
9. Implement K-Means clustering Algorithm.
10. Develop CRUD Operations using MySQL.
11. Create simple prediction models to analyze data using Python's machine learning libraries.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Develop efficiently import and export data using the Pandas library, enabling effective data manipulation and analysis.	PSO 1	U, AP
CO-2	Create and use different machine learning models, such as regression and classification, to solve problems with data.	PSO 2	R, U, Ap
CO-3	Implement clustering methods like K-Means, enabling them to group similar data points and understand patterns.	PSO 2, PSO 3	U, Ap, An
CO-4	Import, export, and manage data effectively using tools like Pandas and MySQL.	PSO 3	U, Ap, An
CO-5	Create simple and clear visualizations using libraries like Matplotlib and Seaborn, making it easier to interpret data.	PSO 4	U, Ap, An

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Core Course 21 – Entrepreneurship and Business Management
Total Hours	45
Hours/Week	3 Hrs/Wk
Code	P23CA4CCT21
Course Type	Theory
Credits	3
Marks	100

General Objective:
To enable the students to acquire the knowledge about the managerial skill to start a business, financial assistance by the government and the management of small business.

Course Objectives:
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the need of an entrepreneur and types of entrepreneur.
CO-2	Recognize entrepreneurship and strategies for developing women entrepreneurs.
CO-3	Know the motivational cycle of entrepreneurship and its competencies
CO-4	Understand the formulation of Business Plan and Project Appraisal.
CO-5	Analyze the role of IPR and MSME in entrepreneurship

UNIT I **9 Hrs**

ENTREPRENEUR: Introduction – Evolution of the Concept of Entrepreneur- Characteristics of Successful Entrepreneurs- The Charms of Becoming an Entrepreneur- The Entrepreneurial Decision Process- Functions of Entrepreneur – Need for an Entrepreneur – Types of Entrepreneurs - Distinction between an Entrepreneur and a manager – Intrapreneur – Social Entrepreneur.
Extra Reading /Key Words*:* *Barriers to entrepreneurship.*

UNIT II **9 Hrs**

ENTREPRENEURSHIP: Concept of Entrepreneurship – Growth of Entrepreneurship in India – Role of Entrepreneurship in Economic Development
WOMEN ENTREPRENEURSHIP: Concept of Women Entrepreneur – Functions of Women Entrepreneurs – Growth of Women Entrepreneurship in India – Problems of Women Entrepreneurs – Developing Women Entrepreneurship- Limitations of Women Entrepreneurship.
Extra Reading /Key Words*:* *Creativity and Innovation in entrepreneurship.*

UNIT III **9 Hrs**

ENTREPRENEURIAL MOTIVATION: Meaning of Entrepreneurial Motivation – Motivation Cycle or Process – Theories of Entrepreneurial Motivation – Entrepreneurial Motivating Factors – Changes in Entrepreneurial Motivation – Achievement Motivation - Entrepreneurial Motivational Behaviour.
ENTREPRENEURIAL COMPETENCIES: Meaning of Entrepreneurial Competency – Major Entrepreneurial Competencies – Developing Entrepreneurial Competencies.
Extra Reading /Key Words*:* *Matching entrepreneur with the project.*

UNIT IV **9 Hrs**

FORMULATION OF BUSINESS PLAN: Meaning of Business plan – Contents of Business plan – Significance of Business plan – Formulation of Business plan – Planning Commission's Guidelines for Formulating Project Report 310- Network Analysis -Common Errors in Business Plan Formulation.

PROJECT APPRAISAL: Concept of Project Appraisal – Methods of Project Appraisal – Environmental Clearance for SMEs.

Extra Reading /Key Words*: Product Launching.*

UNIT V **9 Hrs**

INTELLECTUAL PROPERTY RIGHTS (IPR) AND MICRO, SMALL AND MEDIUM ENTERPRISES (MSMES): IPR and MSMEs – Patents – Copyrights – Trademarks – Geographical Indications – Industrial Designs – Trade Secrets – Integrated Circuits – Protection of New Plant Variety – Why IPR for MSMEs? - Efforts to Help MSMEs to Exploit the Benefits of IPR – Need for Future Actions.

Extra Reading /Key Words*: Problems of Women Entrepreneurs.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recalls the purpose of an entrepreneur types of entrepreneurs	PSO1,7	R
CO-2	Analyzes the strategies for developing women entrepreneurs	PSO7	An
CO-3	Describe the entrepreneurial motivation cycle and its competencies	PSO7	Ap
CO-4	Describe the steps involved in developing the Business Plan and preparing the Project Appraisal	PSO7	U
CO-5	Applies for Intellectual Property Rights in Patents, Copyrights and Trademark as well as explore the benefits for MSMEs	PSO7	Ap
CO-6	Recalls the purpose of an entrepreneur types of entrepreneurs	PSO1,7	R

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Dr. S.S. Khanka , **"ENTREPRENEURIAL DEVELOPMENT"**, S. Chand Publishing (A division of S Chand And Company Limited house), 2020.

UNIT I : Chapter 1
UNIT II : Chapters 2, 3
UNIT III : Chapters 10, 11
UNIT IV : Chapters 15, 16
UNIT V : Chapter 31

BOOKS FOR REFERENCE:

1. Gupta. C. B & Srinivasan, **"Entrepreneurial Development"**, Sultan Chand, New Delhi, 2015.
2. R. K. Singal, S.K. Kataria & Sons, **"Entrepreneurship Development & Management"**, S.K. Kataria & Sons, Reprint 2015.
3. Raju Rai, **"Entrepreneurship"**, Oxford Higher Education, Second Edition, 2017
4. Desai. Vasant, **"Entrepreneurial Development"**, Himalaya pub, Mumbai, 2019
5. CA Dr. Abha Mathur, **"Entrepreneurship Development"**, Taxmann Publications, New Delhi, 2020

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Elective Course 4 – Internet of Things
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4ECT09
Course Type	Theory
Credits	3
Marks	100

General Objective:
To understand building blocks of Internet of Things, architectures, Protocols, design and develop IoT Devices.

Course Objectives:
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the fundamentals of Internet of Things;
CO-2	Realize the Internet of Things Ecosystem using Wireless Technologies;
CO-3	Analyze various protocols for Internet of Things;
CO-4	Explore the design methodology of M2M Communication in Internet of Things;
CO-5	Design a portable Internet of Things using Raspberry Pi and Arduino.

UNIT I **12 Hrs**

INTRODUCTION TO IOT: Introduction–Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems. IoT Levels and Templates -Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.
Extra Reading/Keywords: *Body area network, skin area network.*

UNIT II **12 Hrs**

REALIZATION OF IOT ECOSYSTEM USING WIRELESS TECHNOLOGIES: Introduction- Architecture for IoT Using Mobile Devices- Mobile Technologies for Supporting IoT Ecosystem- Mobile Use Cases for IoT – Low Power Wide Area Networking Topologies – Sigfox- Weightless – Nwave- Ingenu- Lora.
Extra Reading/Keywords: *Application software-Android, Xamarin.*

UNIT III **12 Hrs**

INFRASTRUCTURE AND SERVICE DISCOVERY PROTOCOLS FOR THE IOT ECOSYSTEM: Introduction- Layered Architecture for IoT – Protocol Architecture of IoT – Infrastructure Protocols-Device or Service

Discovery for IoT – Protocols for IoT service Discovery-Security. Integration Technologies And Tools For IoT Environments: Sensor And Actuator Networks.
Extra Reading / Keywords: *OS-Contiki, Cooja.*

UNIT IV **12 Hrs**

IOT AND M2M: Introduction – M2M – Difference between IoT and M2M – SDN and NFV for IoT.

DEVELOPING IOT: IoT design methodology.

Extra Reading/Keywords: Software *reviews, Formal technical reviews.*

UNIT V **12 Hrs**

Building IoT With Raspberry Pi And Arduino: Building IoT with RASPERRY PI - IoT Systems - Logical Design using Python - IoT Physical Devices and Endpoints - IoT Device - Building blocks- Raspberry Pi - Board-Linux on Raspberry
Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platform- Arduino.

Extra Reading/ Keywords: *simulator-Proteus.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recall and compare Internet of computer with Internet of Things.	PSO 2	R, U
CO-2	Identify the application of wireless technologies in various Applications.	PSO 2	R
CO-3	Analyze different protocols in various IoT Layer.	PSO 3	An
CO-4	Differentiate IoT from Machine to Machine Communication.	PSO 3	An
CO-5	Design and demonstrate IoT Applications using Python in Raspberry Pi.	PSO3, PSO4	Ap
CO-6	Identify different simulators used in various applications of IoT.	PSO 4	U
CO-7	Create a solution for existing real time problem in various Domain.	PSO1, PSO6	C, Ap
CO-8	Develop smart systems and environment using IoT Technology.	PSO 4	Ap

PSO-Programme Specific Outcomes; CO - Course Outcomes; R-Remember,U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, **"Internet of Things, A Hands-On Approach"**, Universities Press (INDIA) Private Limited, Edition 2018, Reprint 2019.

   UNIT I : Chapters 1, 2.
   UNIT IV : Chapters 5
   UNIT V : Chapters 6

2. Pethuru Raj and Anupama C. Raman, **"The Internet of Things Enabling Technologies, Platforms, and Use Cases"**, Taylor & Francis, CRC Press,2017.

   UNIT II : Chapter 3
   UNIT III : Chapter 4

BOOKS FOR REFERENCE:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence"**, First Edition, Academic Press,2014.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian(Eds), **"Architecting the Internet of Things"**,Springer,2011.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, **"The Internet of Things- key applications and Protocols"**,Wiley,2012.
4. Ovidiu Vermesan and Peter Friess, **"Internet of Things –From Research Innovation to Market Deployment"**, RiverPublisher,2014.
5. Andrew Minteer, "**Analytics for the Internet of Things (IoT): Intelligent analytics for your Intelligent devices**", Packt Publishing, ISBN-13 978-1787120730, 2017.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Elective Course 3 – Big Data Analytics
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4ECT10
Course Type	Theory
Credits	3
Marks	100

General Objective:
To impart knowledge in Fundamental of Big Data Analytics and Map Reduce Fundamentals and to recognize the key concepts of Hadoop framework, MapReduce with Hive and Pig.

Course Objectives:
The learners will be able to

CO No.	Course Objectives
CO-1	Understand fundamentals of Big Data analytics
CO-2	Explore the Hadoop framework and Hadoop Distributed File system
CO-3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data
CO-4	Employ MapReduce programming model to process the big data
CO-5	Understand various machine learning algorithms for Big Data Analytics, Web Mining and Social Network Analysis.

UNIT I **12 Hrs**

INTRODUCTION TO BIG DATA ANALYTICS: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies

Extra Reading/Keywords: *Ecosystem Service, Solr, Lucene.*

UNIT II **12 Hrs**

INTRODUCTION TO HADOOP (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. Hadoop **DISTRIBUTED FILE SYSTEM BASICS (T2):** HDFS Design Features, Components, HDFS User Commands.

Extra Reading/Keywords: *Apache Hadoop, Social Media data.*

UNIT III **12 Hrs**

NOSQL BIG DATA MANAGEMENT, MONGODB AND CASSANDRA: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.

Extra Reading / Keywords: *YARN, Zookeeper.*

UNIT IV **12 Hrs**

MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.

Extra Reading/Keywords: *Apache Spark, Flume.*

UNIT V **12 Hrs**

Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Machine Learning Algorithms: Regression Model, Clustering, Collaborative Filtering, Association Rule Making, Decision Tree. Text mining, Web Mining, Web Content and Web Usage Analytics.

Extra Reading/ Keywords: *Social Network Analytics, Web Graph.*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain concepts, and technique to understand the fundamentals of Big Data analytics.	PSO1,7	R
CO-2	Investigate Hadoop framework and Hadoop Distributed File system.	PSO7	An
CO-3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.	PSO7	Ap
CO-4	Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.	PSO7	Ap
CO-5	Use Machine Learning algorithms for real world big data.	PSO1,7	Ap,An
CO-6	Analyse web contents and Social Networks to provide analytics with relevant visualization tools	PSO7	An

PSO-Programme Specific Outcomes; CO - Course Outcomes; R-Remember,U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Raj Kamal and Preeti Saxena, "**Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning**", McGraw Hill Education, 2018. ISBN: 9789353164966, 9353164966.
2. Douglas Eadline, "**Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem**", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351.

UNIT I **:** Text book 1: Chapter 1: 1.2 -1.7
UNIT 2 **:** Text book 1: Chapter 2 :2.1-2.6 Text Book 2: Chapter 3
Text Book 2: Chapter 7
UNIT III **:** Text book 1: Chapter 3: 3.1-3.7
UNIT IV **:** Text book 1: Chapter 4: 4.1-4.6
UNIT V **:** Text book 1: Chapter 6: 6.1 to 6.2Text book 1: Chapter 9: 9.1 to 9.3

BOOKS FOR REFERENCE:

1. Tom White, "**Hadoop: The Definitive Guide**", 4th Edition, O"Reilly Media, 2015. ISBN-13: 978-9352130672
2. Boris Lubinsky, Kevin T Smith, Alexey Yakubovich, "**Professional Hadoop Solutions**", 1stEdition, Wrox Press, 2014ISBN-13: 978-8126551071
3. Eric Sammer, "**Hadoop Operations: A Guide for Developers and Administrators**",1st Edition, O'Reilly Media, 2012.ISBN-13: 978-9350239261
4. Arshdeep Bahga, Vijay Madisetti, "**Big Data Analytics: A Hands-On Approach**", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577
5. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnky, Bruce Brown, Rafael Coss, "**Hadoop For Dummies**", Wiley Publications, 2014

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Elective Course 3 – Data Science and Applications
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4ECT11
Course Type	Theory
Credits	3
Marks	100

General Objective:

To provide strong foundation for data science and application area related to it, and understand the underlying core concepts and emerging technologies in data science.

Course Objectives:

The learners will be able to

CO No.	Course Objectives
CO-1	Explore the fundamental concepts of data science
CO-2	Discuss data analysis techniques for various applications
CO-3	Explain various algorithms used in data science
CO-4	Analyze the difference between various database systems with NOSQL
CO-5	Create an interactive dashboard.

UNIT I **12 Hrs**

INTRODUCTION TO DATA SCIENCE: Benefits and uses of data science and big data - Facets of data - The data science process - The big data ecosystem and data science

Extra Reading /Key Words*:* *Skills needed in doing data science.*

UNIT II **12 Hrs**

DATA SCIENCE PROCESS: Overview of the data science process - Defining research goals and creating a project charters - Retrieving data -Cleansing, integrating, and transforming data – Exploratory data analysis - Build the models - Presenting findings and building applications on top of them.

Extra Reading /Key Words*:* *Vectors, Data models and data frames.*

UNIT III **12 Hrs**

MACHINE LEARNING AND BIG DATA: Machine learning – Modeling Process – Types of machine learning – Handling large data – Handling big data – Distributing data storage and processing with Frameworks – Case study.

Extra Reading /Key Words*:* *supervised learning, unsupervised learning, Case Studies*

UNIT IV **12 Hrs**

DATA VISUALIZATION: Introduction to data visualization – Data visualization options –Cross Filters – Map reduce – Dashboard development tools – Creating an interactive dashboard with dc.js – summary.

Extra Reading /Key Words*: visualization libraries (matplotlib, seaborn, D3.js, bokeh, ggplot)*

UNIT V **12 Hrs**

NOSQL and Data Science: NOSQL movement – Introduction – ACID principles – CAPS theorem – BASE principle – Types of NoSQL – Case study – graph database – text mining and text analytics.

Extra Reading /Key Words*: MongoDB, Redis, Couch DB, Riak, Neo4j,HBASE*

Note: Texts given in the Extra Reading /Key words must be tested only through Assignment and Seminars.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explore the fundamental concepts of data science.	PSO 1, PSO4	R, U
CO-2	Discuss data analysis techniques for various applications.	PSO 2	Ap
CO-3	Explain various algorithms used in data science.	PSO 2	U
CO-4	Analyze the difference between various database systems with NOSQL.	PSO 3	U
CO-5	Create an interactive dashboard.	PSO 4	Ap

PSO-Programme Specific Outcomes; CO - Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

PRESCRIBED TEXT BOOK:

1. Davy Cielen, Arno D. B. Meysman and Mohamed Ali, **"Introducing Data Science"**, Manning Publications Co., 2016.
   - **UNIT I** **:** Chapter 1.1 - 1.4
   - **UNIT II** **:** Chapter 2.1 - 2.7
   - **UNIT III** **:** Chapter 3.1 - 3.4.4.1-4.3,5.1
   - **UNIT IV** **:** Chapter 9.1-9.4
   - **UNIT V** **:** Chapter 6.1, 7.1-7.3,8.1-8.3

BOOKS FOR REFERENCE:

2. Joel Grus, **"Data Science from Scratch using Python"**, O'Reilly Publications, 2015.
3. Cathy O'Neil and Rachel Schutt, **"Doing Data Science"**, Straight Talk From The Frontline, O'Reilly Publications, 2014.
4. Valliappa Lakshmanan, , **"Data Science on the Google Platform"**, O'Reilly MediaInc, USA, 2016.
5. SinanOzdemir, **"Principles of Data Science"**, Packt Publishing Ltd,. 2016
6. Thomas Barton , Christian Müller, "**Apply Data Science: Introduction, Applications and Projects "** First EdItion, 2023.

Note: Learners are advised to use latest edition of books.

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Elective Course 4 – Internet of Things - Practical VIII
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4ECP12
Course Type	Theory
Credits	3
Marks	100

General Objective:
To design, implement, and analyze smart systems connected for real-world applications.

Course Objectives:
The learners will be able to

CO No.	Course Objectives
CO-1	Understand the core components of IoT systems through hands-on exercises.
CO-2	Develop IoT devices for data collection, processing, and communication.
CO-3	Implement IoT communication technologies for perfect device interaction.
CO-4	Analyze IoT system performance, focusing on energy efficiency and security.
CO-5	Design IoT-based applications for solving real-world problems in various domains.

List of Exercises:
Implement the following concepts:

1. Smart Home Automation System
Automate everyday tasks like lighting, temperature control, and security in home using IoT
2. Smart Waste Management System
IoT-enabled waste bins that alert authorities when they are full, optimizing waste collections
3. IoT-enabled Smart Energy Meter
Monitor and track electricity consumption remotely to promote energy savings and efficiency
4. Wearable Health Monitoring System
Track vital health signs like heart rate, temperature, and oxygen levels using IoT sensors, sending data to a mobile app
5. Smart Door Lock System
An IoT-based door lock that allows you to control access remotely and track entry logs
6. IoT-based Smart Lighting System
Automatically adjust lighting based on ambient light levels or time of day to save energy and enhance user comfort
7. IoT-enabled Smart Fridge
Track food items, expiration dates, and temperature control, while providing shopping suggestions and inventory management
8. Remote Patient Monitoring System
Monitor patients' health remotely, including vitals like heart rate and blood pressure, and send updates to medical staff

9. IoT-based Air Quality Monitoring System

Detect and track pollutants and allergens in indoor or outdoor air, providing real-time quality readings

10. Smart Shoe with IoT

A pair of shoes equipped with sensors to track steps, posture, and activity levels, syncing data to a mobile app for fitness tracking

11. IoT-based Smart Gas Leakage Detection System Detect gas leaks in homes or industrial settings and automatically alert users through a mobile app for safety

12. IoT-based Smart Shoes for Elderly Monitoring

Shoes embedded with sensors to track elderly movements, falls, and location, ensuring better health monitoring for seniors

13. IoT-based Smart Water Leak Detection System

Detect and alert users about water leaks in homes or industrial environments, helping to prevent damage and waste.

14. IoT-based Smart Coffee Machine

A coffee machine that can be controlled and customized via a smart phone app, from brewing time to strength preferences

15. Smart Doorbell with IoT

A video-enabled doorbell system with motion sensors and remote access, allowing users to see and interact with visitors remotely

16. IoT-based Smart Garden Monitoring

Use sensors to track environmental conditions (temperature, humidity, soil moisture) in a garden and automate the care process.

Course Outcomes(CO):

The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Design and implement IoT-enabled automated systems for real-world applications	PSO 2	R, U
CO-2	Develop smart IoT devices that can collect, process, and transmit data for automation purposes	PSO 2	R
CO-3	Integrate IoT communications and sensors to create automated, data-driven solutions	PSO 3	An
CO-4	Analyse the performance, scalability, and security of smart IoT-enabled systems	PSO 3	An
CO-5	Design and deploy IoT-based automated systems that enhance efficiency and solve practical challenges	PSO3, PSO4	Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Elective Course 4 – Data Analytics - Practical IX
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4ECP13
Course Type	Practical
Credits	3
Marks	100

General Objective:

To develop skills in data analysis, representation, interpretation, and decision-making for practical applications

Course Objectives:

The learners will be able to

CO No.	Course Objectives
CO-1	Develop skills to preprocess and clean raw data for analysis.
CO-2	Apply statistical techniques to analyze and interpret data.
CO-3	Create informative visualizations to present data.
CO-4	Implement models for predictive analysis for current applications
CO-5	Interpret data findings with insights for real time decision-making.

List of Exercises:

Implement the following concepts:

1. Develop a program to calculate the frequency of a given word in a given file.
2. Develop a program to analyse the result for a particular course in every year
3. Develop a program to find the maximum temperature in each year.
4. Develop a program to find the Students grades of a particular programme.
5. Develop a program to implement Matrix Multiplication.
6. Develop a program to find the maximum electrical consumption in each year given electrical consumption for each month in each year.
7. Develop a program to analyze weather data set and print whether the day is shinny or cool day.
8. Develop a program to find the number of products sold in each country by considering sales data containing fields like

    Transaction _Date
    Product Price
    Payment _Type
    Name
    City
    State
    Country
    Account_ Created
    Last_Login
    Latitude
    Longitude

9. Develop a program to find the frequency of books published each year and find in which year maximum number of books were published using the following data.

Title
Author
Published year
Author country
Language
No of pages

10. Develop a program to calculate the maximum recorded temperature by yearwise for the weather dataset

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Develop the ability to prepare data for analysis.	PSO 2	R, U
CO-2	Apply Analytical methods to process datasets.	PSO 2	R
CO-3	Create data representations to visualise the data integrity	PSO 3	An
CO-4	Implement and evaluate different programming models for data set analysis.	PSO 3	An
CO-5	Interpret the data for making informed decisions.	PSO3, PSO4	Ap

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create

(For Candidates admitted in the academic year 2023 - 2024)
M.C.A - Second Year – Semester – IV

Course Title	Elective Course 4 – Data Science using R - Practical X
Total Hours	60
Hours/Week	4 Hrs/Wk
Code	P23CA4ECP14
Course Type	Practical
Credits	3
Marks	100

General Objective:
To learn R programs to meet routine and specialized data manipulation, management and analysis.

Course Objectives:
The learners will be able to

CO No.	Course Objectives
CO-1	To develop skills in basic data analytics.
CO-2	To manipulate and manage data using R's data structures
CO-3	To visualize data with R's plotting capabilities
CO-4	To utilize R functions and control structures for efficient coding.
CO-5	To conduct statistical analysis and interpret results using R.

List of Exercises:
Implement the following concepts:

1. Basic Data Manipulation.
2. Basic Plotting.
3. Loops and Functions.
4. Basic Statistics.
5. Advanced Data Manipulation.
6. Vector and operations on Vector.
7. Matrix and operations on Matrix.
8. Create factorization in R environment.
9. Data Frame and operations on Data Frame.
10. Write R Program to pre-defined functions in R.

Course Outcomes(CO):
The learners will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Show the installation of R Programming Environment.	**PSO-1**	**R, U**
CO-2	Utilize and R Data types for developing programs.	**PSO-2**	**Ap, U**
CO-3	Make use of different R Data Structures.	**PSO-1**	**Ap, An**
CO-4	Develop programming logic using R Packages.	**PSO-2**	**Ap, An**
CO-5	Analyze the datasets using R programming capabilities.	**PSO-3**	**An, E**

PSO-Programme Specific Outcomes; CO- Course Outcomes; R-Remember, U-Understand; Ap-Apply; An-Analyse; E-Evaluate; C-Create