SRI S.RAMASAMY NAIDU MEMORIAL COLLEGE, SATTUR-626203

(An Autonomous, Co-educational and Linguistic Minority Institution Affiliated to Madurai Kamaraj University)

(Re-Accredited with Grade 'A' by NAAC)

PG Degree Course

in

M.Sc. Computer Science

Programme Code: **PCS**

OBE - Regulations 2020

(For I to IV Semester)

Outcome Based Education

Under

Choice Based Credit System (CBCS)

(Those who joined in 2020-2021 and after)

Vision

To renovate the rural students into high quality Software Professionals &Technologists by affording practical training as well as ethical and moral values.

Mission

- To offer strong theoretical foundation harmonized with extensive practical training.
- To revamp the rural students into innovative, competent and high quality Computer professionals.
- To enrich the talents of students to keep pace with the current industrial trends.
- To provide the students with best job opportunities and environment for quality education, professional competencies and life skills.
- To support students for their career development, professional growth and to sustain in lifelong learning.

Programme Educational Objectives (PEOs)

PEO1: Research Development

Achieve as a successful researcher in Industry or Academia by applying knowledge in latest computing technologies.

PEO2: Career Opportunities

Attain Career Opportunities as Software Professionals in IT sectors as well as in Industry, Government or other multi-disciplinary environments.

Programme Objectives (POs):

Upon completion of the programme, the post graduate will be able to

PO1: Critically Think and solve problems

Apply critical thinking and problem solving skills through conceptual, analytical, quantitative and technical skills and adopt wide range of technologies.

PO2: Problems Solve

Investigate, design and apply appropriate strategies to solve the scientific, regional and societal problems.

PO3: Research Skill

Apply appropriate research methodologies, techniques and tools, to analyse and interpret data demonstrating higher order cognitive skill.

PO4: Effective Communication Skill

Communicate effectively and write reports, documents, make effective presentation on scientific achievements and recent developments with experts by developing the higher order affective skills.

PO5: Teamwork and Collaborative Skills

Create the opportunities and contribute positively in collaborative multidisciplinary scientific research.

PO6: Lifelong Learning Skills

Enhance social inclusion, active citizenship, and personal development, as well as competitiveness and employability ongoing, voluntary, and self-motivated pursuit of knowledge.

Programme Specific Outcomes (PSOs)

Upon completion of M.Sc in Computer Science, students will be able to:

PSO1: Explore innovative software solutions and apply their knowledge of programming skills for the real world problems in Industrial or Environment application areas.

PSO2: Expert in problem solving and logical thinking skills to solve need based problems in IT sector.

PSO3: Employ recent computing technologies and platforms to create innovative career path as a successful Entrepreneur.

PSO4: Acquire perspective with respect to ethics, social, cultural and cyber regulations.

PSO5: Develop inter-personal skills as socially responsible person and to enhance lifelong learning in computer science.

Eligibility for admission

The candidate should be a graduate in any discipline with Mathematics as compulsory subject at +2 level (or) any degree with Computer Science / Application as Major / Vocational courses.

Duration of the Course

The candidates shall undergo the prescribed course of study for a period of two academic years (four semesters).

Medium of Instruction

English

Courses of study

1. Core Courses (CS)
2. Major Electives (ME)

Credits

The term 'credit' refers to the weightage given to the propgramme, usually in relation to the instructional hours assigned to it. The total credit, required for completing a M.Sc.(CS) degree is 90. The particulars of credits for individual components and courses are placed on Table – 1.

Extra Credits Course:

1. This course is optional for students. If he/she selects this course and if he/she passes the course, then 2 extra credits will be added in his/her total credit to the degree, even otherwise, it won't affect the completion of degree.
2. The course is common to all UG Programmes.
3. The title of this course is "Model Paper for Competitive Examinations"
4. Examination for this course will be held at the end of the 6th semester examinations.
5. There is no internal examination and only external examination for this course.
6. Maximum marks for this course is 100.
7. There is no contact hours for this paper.

Scheme of Examination:

100 questions (multiple choice) - one mark for each.

Passing minimum is 50 marks.

Duration of the Examination is two hours.

Evaluation

	Theory	Practical	Project
Internal Mark	25	40	40
External Mark	75	60	60 (Project Evaluation (50% + Viva Voce Evaluation 50%)
Total Marks	100	100	100

Internal Assessment (Theory)		Internal Assessment (Practical)	
Average of two tests	15 marks	Average of two tests	15 marks
Assignment	5 marks	Record work	10 marks
Seminar/Group Discussion	5 marks	Attendance	5 marks
Total Marks	**25 marks**	**Total Marks**	**40 marks**

Passing Minimum

a) Theory

1. 50% of the aggregate (External + Internal)
2. No separate passing minimum for internal.
3. 34 marks out of 75 is the passing minimum for the External.

b) Practical

1. 50% of the aggregate (External + Internal)
2. No separate passing minimum for internal.
3. 27 marks out of 60 is the passing minimum for the External.

c) Project

1. 50% of the aggregate (External + Internal)
2. No separate passing minimum for internal.
3. 27 marks out of 60 is the passing minimum for External.

Pattern of Question Paper

The question paper may have 3 parts.

Duration of the external examination is 3 hours.

Part A 10 x 1 = 10 marks

Ten questions (Objective type with 4 alternatives)

(Two questions from each unit – No choice)

Part B 5 x 7 = 35 marks

Five questions (either or type)

(One question from each unit)

Part C 3 x 10 = 30 marks

Three questions out of five

(One question from each unit)

Total **75 marks**

From the Academic Year 2021-2022

Evaluation

The performance of a student is evaluated in terms of percentage of marks with a provision for conversion to grade points. Evaluation for each course is done by three Continuous Internal Assessment (CIA) tests by the concerned course teacher and by an End Semester written examination and will be consolidated at the end of the programme. The ratio of the marks to be allotted to Continuous Internal Assessment (CIA) and to End Semester Examination is 25 : 75 and for the Practical examinations the ratio is 40 : 60.
The components for Continuous Internal Assessment (CIA) are

Average of three written tests	20.0 marks
Seminar / Group Discussion / Quiz	2.5 marks
Assignment	2.5 marks
Total	**25.0 marks**

Assignment / Seminar marks will be awarded only to the candidates who have appeared for minimum two CIA tests. A candidate absenting for all the three CIA tests of a course cannot appear for the End Semester Examination even though he / she has required attendance / paid fee.

M.Sc. (COMPUTER SCIENCE) Course Pattern (Table - 1)

Semester	Study Components	I	II	III	IV	V	VI	VII	Total Hours	Total Credits	No of Courses	Total Marks
I	Core	5(5)	5(5)	5(5)	5(5)	-	-	-	30	24	6	600
	Practical	-	-	-	-		5(2)	5(2)				
II	Core	5(5)	5(5)	5(5)	-	-	-	-	30	24	6	600
	Elective	-	-	-	5(5)	-	-	-				
	Practical	-	-	-	-	-	5(2)	5(2)				
III	Core	5(5)	5(5)	5(5)	-	-			30	26	6	600
	Elective	-	-	-	5(5)	-	-	-				
	Practical	-	-	-	-	-	5(3)	5(3)				
IV	Project	-	-	-	-	-	-	-	-	16	-	100
	Extra Credit Course									3		

M.Sc (COMPUTER SCIENCE)

Table – 2: Course Details and Scheme of Examination

Semester	Core / Elective / Skill Based	Title of the course	Course code	Contact Hrs			Credit	Exam Hrs.	Marks		
				L	T	P			Int.	Ext.	Total
I	**Core - I**	Object Oriented System Development	P20CSC11	5	-	-	5	**3**	25	75	**100**
	Core - II	Computer Algorithms	P20CSC12	5	-	-	5	**3**	25	75	**100**
	Core - III	Data Communications and Networking	P20CSC13	5	-	-	5	**3**	25	75	**100**
	Core - IV	Advanced Java Programming	P20CSC14	5	-	-	5	**3**	25	75	**100**
	Core (P) - I	Computer Algorithms Using C++ Lab	P20CSC1P1	-	-	5	2	**3**	40	60	**100**
	Core (P) - II	Advanced Java Programming Lab	P20CSC1P2	-	-	5	2	**3**	40	60	**100**
	Total			**20**	-	**10**	**24**				**600**
II	**Core - V**	Digital Image Processing	P20CSC21	5	-	-	5	**3**	25	75	**100**
	Core - VI	Mobile Application Development	P20CSC22	5	-	-	5	**3**	25	75	**100**
	Core - VII	Operating Systems	P20CSC23	5	-	-	5	**3**	25	75	**100**
	Major Elective I	1.1 Cryptography and Network Security	P20CSE21	5	-	-	5	**3**	25	75	**100**
		1.2 Soft Computing	P20CSE22								
		1.3 System Software	P20CSE23								
	Core (P) - III	Digital Image Processing	P20CSC2P1	-	-	5	2	**3**	40	60	**100**
	Core (P) - IV	Mobile Application Development	P20CSC2P2	-	-	5	2	**3**	40	60	**100**
	Total			**20**	-	**10**	**24**	-	-	-	**600**
III	**Core - VIII**	NoSQL Databases	P20CSC31	5	-	-	5	**3**	25	75	**100**
	Core - IX	Data Analysis using Python	P20CSC32	5	-	-	5	**3**	25	75	**100**
	Core - X	Data Mining and Semantic Web	P20CSC33	5	-	-	5	**3**	25	75	**100**
	Major Elective II	2.1 Artificial Intelligence	P20CSE31	5	-	-	5	**3**	25	75	**100**
		2.2 Software Testing	P20CSE32								
		2.3 Principles of Compiler Design	P20CSE33								
	Core (P) - V	NoSQL Databases	P20CSC3P1	-	-	5	3	**3**	40	60	**100**
	Core (P) - VI	Data Analysis using Python	P20CSC3P2	-	-	5	3	**3**	40	60	**100**
	Total			**20**		**10**	**26**	-	-	-	**600**
IV	**Project - I**	Project Work & Viva Voce	P20CSPT41	-	-	-	16	-	40	60	**100**
	Extra Credits Course	Model Paper for NET /SET Examinations	P20CSX41	-	-	-	3	-	-	100	**100**

L – Lecture Hours **T –** Tutorial Hours **P –** Practical Hours

Core Course I - Object Oriented System Development

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	I	P20CSC11	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate object-based views for generic software systems.	**K2**
CLO2	Explain UML diagrams.	**K2**
CLO3	Outline model structure and behavioural concepts of the system.	**K2**
CLO4	Develop software applications using Object Oriented concepts.	**K3**
CLO5	Distinguish various testing methodologies for Object Oriented software.	**K2**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				**2**
CLO2	**3**	**2**				**3**
CLO3	**3**	**3**				**3**
CLO4	**3**	**3**			**2**	**3**
CLO5	**3**	**3**			**2**	**3**

Strong – 3 Medium – 2 Weak – 1

Unit I

An Overview of Object Oriented Systems Development: Introduction – Two orthogonal views of the Software - Development methodology- Why an Object orientation. **Object basics:** Introduction- An Object Oriented Philosophy- Objects – Attributes – Object behavior and Methods-Object respond to messages – Encapsulation and Information Hiding – Polymorphism – Object relationship and associations – Aggregations and Object Containment. **OOSD life cycle:** Introduction – The Software development process – OOSD Use case Driven Approach – Reusability.

Unit II

Object Oriented Methodologies: Rumbaugh Object Model, The Booch Methodology- The Jacobson Methodology, Patterns, Frameworks. **Unified ModelingLanguage** : Static and Dynamic models-UML diagrams - Class diagram - Use-case diagram - UML Dynamic Modeling - Packages and Model Organization.

Unit III

Object Oriented Analysis: Business Object Analysis – Use Case Driven OOA – Use Case Model - Effective Documentation. Object Analysis : Classification - Introduction – Classification Theory – Approaches for identifying classes - Noun Phrase Approach - Common class patterns Approach - Use case driven - CRC. Identifying Object Relationships Attributes and Methods : Introduction – Associations – Super sub class relationship – Aggregation – Class Responsibility – Object Responsibility.

Unit IV

Object Oriented Design: The Design Process – Design Axioms – Corollaries – Design Patterns – **Designing Classes** : Introduction – The OO design Philosophy - The Process – class visibility - Refining attributes – Designing Methods and protocols – packages and managing Classes.

Unit V

Software Quality Assurance: Introduction – Quality Assurance Tests – Testing strategies Impact of Object Orientation on Testing — Test Cases- Test Plan-Continuous testing – Myers's Debugging Principles. **System Usability and Measuring User satisfaction** : Introduction – Usability Testing - User satisfaction Testing.

Text Book:

Ali Brahami (2008), Object Oriented Systems Development, Tata-McGraw Hill Education, New Delhi.

Reference Books:

1. Martin Fowler, Kendall Scott, UML Distilled- Applying the Standard Object Modeling Language, Addition Wesley.
2. Grady Booch (1994), Object-oriented Analysis and Design with applications, 2nd Edition, Addition Wesley.

Core Course II - Computer Algorithms

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	I	P20CSC12	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate basic data structures for storage of ordered or unordered data.	**K2**
CLO2	Apply appropriate algorithm design techniques for solving problems.	**K2**
CLO3	Describe various algorithms like divide and conquer, dynamic programming and backtracking.	**K3**
CLO4	Explain algorithms in terms of time and memory complexity of basic operations.	**K3**
CLO5	Implement algorithms in programming languages.	**K3**

K2 – Understanding **K3 – Applying**

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**				
CLO2	**3**	**3**	**2**	**2**		**3**
CLO3	**3**	**3**				
CLO4	**3**	**2**			**2**	
CLO5	**3**	**3**	**2**	**2**	**2**	**3**

Strong – 3 **Medium – 2** **Weak – 1**

Unit I:

Introduction: What is an algorithm? - Algorithm Specification - Performance Analysis - Randomized Algorithms.

Unit II:

Divide and Conquer: General Method - Binary Search - Finding Maximum and Minimum – Mergesort - Quicksort.

Unit III:

Dynamic Programming: The General Method - Multistage Graphs - All Pairs Shortest Paths - Optimal Binary Search Trees- 0/1 Knapsack – The Travelling Salesperson Problem.

Unit IV:

Backtracking: The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamitonian Cycles - Knapsack Problem.

Unit V:

Basic Traversal and Searching Techniques: Techniques for Graphs – Connected Components and Spanning Trees – Biconnected Components and DFS – **Branch and Bound:** The Method (FIFO & LC) – 0/1 Knapsack Problem.

Text Book:

Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran (2014), Computer Algorithms/C++, 2nd Edition, Universities Press.

Reference Books:

1. Mark Allen Weiss (2002), Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education.
2. Ellis Horowitz, Sartaj Sahni (2007), Fundamentals of Computer Algorithms, 2nd Edition, Universities Press.

Core Course III - Data Communications and Networking

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	I	P20CSC13	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Describe the components of a data communications system	**K2**
CLO2	Identify key considerations in selecting various transmission media in networks	**K3**
CLO3	Describe the features and functions of multiplexing, modulation and to know the concept error detection and correction schemes.	**K2**
CLO4	Summarize the concepts in Local Area Networks and Frame relay.	**K2**
CLO5	Distinguish the functions of various networking devices.	**K2**

K2 – Understanding **K3 – Applying**

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**	**2**			**2**
CLO2	**3**	**2**	**2**			**2**
CLO3	**3**	**2**	**2**			**2**
CLO4	**3**	**2**	**2**			**2**
CLO5	**3**	**3**	**2**			**2**

Strong – 3 **Medium – 2** **Weak - 1**

Unit I:

Introduction : Data Communication - Networks - Protocols and Standards -Standards Organization. **Basic Concepts :** Line Configuration – Topology - Transmission Mode- Categories of Networks– Internetworks . **The OSI Model :** The Model- Functions of the Layers- TCP/IP Protocol Suite - Analog and Digital– Periodic and Aperiodic Signals- Analog Signals- Time and Frequency Domains – Composite Signals- Digital Signals.

Unit II:

Encoding and Modulating: Analog-To-Digital Conversion- Digital to Analog Conversion. **Transmission of Digital Data & Interfaces and Modems :** Digital Data Transmission- DTE-DCE Interface - **Transmission Media :** Guided Media- Unguided Media.

Unit III:

Multiplexing- Many to one / One to Many - Frequency Division Multiplexing (FDM) - Wave-Division Multiplexing (WDM) - Time-Division Multiplexing (TDM). **Error Detection and Correction:** Types of Errors- Detection- Redundancy – Vertical Redundancy Check (VRC) – Longitudinal Redundancy Check (LRC) – Cyclic Redundancy Check (CRC) – Checksum – Error Correction. **Data Link Control**: Line Discipline – Flow Control- Error Control.

Unit IV:

Local Area Networks : Project 802 - Ethernet - Token Bus - Token Ring. **Switching:** Circuit Switching- Packet Switching - Message Switching –**Frame Relay:** Introduction - Frame Relay Operation - Frame Relay Layers - Congestion Control - Leaky Bucket algorithm - Traffic Control.

Unit V:

Networking and Internetworking Devices : Repeaters- Bridges - Routers - Gateways – Other Devices- Routing Algorithms - Distance Vector Routing-Link State Routing - **TCP/IP Protocol Suite :** Overview of TCP/IP - Network Layer - Addressing - Subnetting.

Text Book:

Behrouz A Forouzan (2006), Data Communications and Networking, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.

Reference Books:

1. Andrew S. Tanenbaum (2006), Computer Networks, 4th Edition, Prentice Hall of India.
2. William Stallings (2007), Data and Computer Communications, Prentice Hall of India.
3. Achyut S Godbole (2005), Data Communications and Networks, Tata McGraw Hill of India.

Core Course IV - Advanced Java Programming

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	I	P20CSC14	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate event driven GUI and web related applications.	**K2**
CLO2	Design Graphical User Interface using AWT, swing components	**K3**
CLO3	Describe Server side applications using Servlets.	**K2**
CLO4	Develop applications using Java Beans and Enterprise Java Bean (EJB) concepts.	**K3**
CLO5	Explain Enterprise Application Architecture and JDBC concepts.	**K2**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**		**2**		**2**
CLO2	**3**	**2**		**2**		**2**
CLO3	**3**	**2**		**2**		**2**
CLO4	**3**	**2**			**2**	**2**
CLO5	**3**	**2**			**2**	**2**

Strong – 3 Medium – 2 Weak – 1

Unit I:

Input/Output: Exploringjava.io: The I/O Classes and Interfaces-File- The Auto Closeable, Closeable, and Flushable Interfaces-I/O Exceptions-Two Ways to Close a Stream-The Stream Classes-The Byte Streams-The Character Streams-The Console Class-Serialization-Stream Benefits.

Unit II:

Networking: Networking Basics-The Networking Classes and Interfaces- Inet4Address and Inet6Address-TCP/IP Client sockets-URL-URL connection- TCP/IP Server Sockets-Datagrams. **Event Handling:** Two Event Handling Mechanisms-The Delegation Event Model-Event Classes The Key Event Class-Sources of Events-Event Listener Interfaces-Using the Delegation Event Model-Adapter Classes-Inner Classes.

Unit III:

Introducing AWT: Windows Fundamentals - working with frame Windows. **Using AWT Controls, Layout Managers and Menus:** AWT Control Fundamentals – Labels – Using Buttons – Applying Check Boxes – Checkbox Group – Choice Controls – Using List – Managing Scroll Bars – Using a Text Field – Using a Text Area – Understanding Layout Managers – Menu Bars and Menus. **Introducing Swing:** The Origins of Swing- Swing Is Built on the AWT-Two Key Swing Features-Components and Containers.

Unit IV:

Exploring Swing:JLabel and ImageIcon-JTextField-The Swing Buttons-JTabbedPane-JScrollPane-JList-JComboBox-Trees-JTable.**Java Beans:**What Is a Java Bean?-Advantages of Java Beans-Introspection-Bound and Constrained Properties-Persistence-Customizers-The Java Beans API-**Introducing Servlets:** Background-The Life Cycle of a Servlet-Servlet Development Options-Using Tomcat-A Simple Servlet-The Servlet API-The javax.servlet Package-Reading Servlet Parameters-The javax.servlet.http Package-Handling HTTP Requests and Responses-Using Cookies-Session Tracking.

Unit V:

JDBC objects: The Concept of JDBC – JDBC Driver Types – JDBC Packages – A Brief overview of JDBC Process – Database Connection – Associating the JDBC/ODBC Bridge with the Database - Statement Objects – ResultSet –Transaction Processing – Metadata. **JDBC and Embedded SQL:**Tables – Indexing - Inserting Data into Tables – Selecting Data from a Table – Updating Tables – Deleting Data from a Table. **Java Remote**
Method Invocation: Remote Method Invocation Concept – Server Side – Client Side.

Text Books:

1. Herbert Schildt (2014), Java 2: The Complete Reference, 9th Edition, Tata McGraw Hill Publications, New Delhi.
2. Jim Keogh (2002), J2EE: The Complete Reference, Tata McGRAW-HILL.

Reference Books:

1. Steve Holzner (2008), Java2 Programming Black Book, Dreamtech Press.
2. Gay Horstmann (2010), BIG JAVA, 4th Edition, TATA MGRAW-HILL.
3. Mcgovern et al (2010), J2EE 1.4 Bible, Wiley Publication (P) Ltd.

Core Practical I - Computer Algorithms Using C++ Lab

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	I	P20CSC1P1	5	2

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Choose appropriate algorithm to solve real world problems	K3
CLO2	Design methods using divide and conquer and dynamic programming approaches.	K3
CLO3	Implement computer algorithms using C/C++	K3

K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**	**2**			**2**
CLO2	**3**	**3**	**2**			**2**
CLO3	**3**	**3**				**2**

Strong – 3 Medium – 2 Weak - 1

1. To search an element and its position in an array.
2. Binary Search
3. Merge Sort
4. Quick Sort
5. Prim's Algorithm
6. Kruskal's Algorithm
7. Binary Tree Traversal
8. Breadth First Search
9. Depth First Search

Core Practical II - Advanced Java Programming Lab

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	I	P20CSC1P2	5	2

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Design GUI in Java using Applet & AWT along with response to events.	**K3**
CLO2	Explore the advanced java programming concepts like Servlet, Java Bean EJB, RMI and JSP.	**K3**
CLO3	Create Beans using EJB and access remote methods using RMI	**K3**

K3 - Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**		**2**		**2**
CLO2	**3**	**2**		**2**		**2**
CLO3	**3**	**2**		**2**		**2**

Strong – 3 Medium – 2 Weak – 1

1. Write a Java program that reads a file and displays the file on the screen, with a line number before each line?
2. Write a Java program that handles all mouse events 40-42 and shows the event name at the center of the window when a mouse event is fired. (Use adapter classes).
3. Write a Java program to Get Detailed IP Address of a System.
4. Write a Java program to Send Data from Client to Server Using UDP/TCP.
5. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with “stop” or “ready” or “go” should appear above the buttons in a selected color. Initially there is no message shown.
6. Write a Program in Java to implement Calculator using Swing technology.
7. Write a JAVA Servlet Program to implement a dynamic HTML using Servlet (user name and password should be accepted using HTML and displayed using a Servlet).
8. Write a JAVA Servlet Program to implement and demonstrate get() and Postmethods (Using HTTP Servlet Class).
9. Using RMI, do Banking Transaction between Client and Server.
10. JDBC (Insert, Update, Delete).
11. JDBC (Searching a Telephone Directory).
12. Build a JSP program using JDBC.

Core Course V - Digital Image Processing

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSC21	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate the fundamental concepts of a digital image processing system.	**K2**
CLO2	Apply various techniques for image enhancement and restoration.	**K3**
CLO3	Implement spatial and frequency domain using various transforms.	**K3**
CLO4	Apply various compression techniques in real life problems.	**K3**
CLO5	Explain the methodologies for image segmentation.	**K2**

K2 – Understanding **K3 – Analysis**

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**	**2**	**2**		**2**
CLO2	**3**	**3**	**2**			
CLO3	**3**	**2**	**2**			
CLO4	**3**	**2**	**2**		**2**	
CLO5	**3**	**3**	**2**	**2**	**2**	**3**

Strong – 3 **Medium – 2** **Weak – 1**

Unit I

Introduction to Image Processing: Digital Image Representation - Types of Images -Digital Image Processing Operations- Fundamental Steps in Image Processing. **Digital Imaging System:**Sampling and Quantization - Image Storage and File Formats. **Digital Image Processing Operations:** Basic Relationship and Distance metrics - Classification of Image Processing Operations: Arithmetic Operations – Logical Operations.

Unit II

Geometrical Operations - Image Interpolation Techniques - Statistical Operations - Convolution and Correlation Operations - Data Structures and Image Processing Applications Development. **Image Enhancement and Restoration:** Image Quality and Need for Image Enhancement - Image Enhancement Point Operations - Spatial Filtering Concepts - Frequency Domain Filtering.

Unit III

Image Degradation (Restoration) Model - Categories of Image Degradations - Image Restoration in the Presence of Noise Only. **Image Compression:** Image Compression Model - Compression Algorithm and its types - Types of Redundancy - Lossless Compression Algorithms: Run-length coding - Huffman Coding - Bit-plane Coding - Arithmetic Coding - Lossy Compression Algorithms: Vector Quantization – Block Transform Coding - Image and Video Compression Standards.

Unit IV

Image Segmentation: Introduction - Classification of Image Segmentation Algorithms - Deduction of Discontinuities - Edge Detection: Stages in Edge Detection - Types of Edge Detectors - First Order Edge Detection Operators – Principle of Thresholding - Principle of Region-growing – Dynamic Segmentation approaches – Validation of Segmentation Algorithms.

Unit V

Colour Image Processing: Introduction - Devices for Colour Imaging - Colour Image Storage and Processing - Colour Models - Pseudocolour Image Processing **- F**ull Colour Processing. **Image Morphology:** Need for Morphological Processing - Morphological Operators - Hit or Miss Transform - Basic Morphological Algorithms - Gray Scale Morphology.

Text Book:

S. Sridhar (2001) Digital Image Processing, OXFORD (University Press).

Reference Books:

1. Rafael C Gonzalez, Richard E Woods (2003), Digital Image Processing, 2nd Edition, Pearson Education.
2. Rafael C.Gonzalez (2014), Image Processing Using Matlab, McGraw Hill Education(India) Private Limited.

Core Course VI - Mobile Application Development

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSC22	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate the basic concepts of Android Programming.	**K2**
CLO2	Design User Interface and develop activity for Android App.	**K3**
CLO3	Develop programs using Menus and Views in Android App.	**K3**
CLO4	Describe Content providers and Messaging in Android App	**K2**
CLO5	Explain interactive Android Services and App creations with database	**K2**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				**2**
CLO2	**3**	**2**				**2**
CLO3	**3**	**3**				**2**
CLO4	**3**	**2**			**1**	**2**
CLO5	**3**	**3**			**1**	**2**

Strong – 3 Medium – 2 Weak - 1

UNIT I

Getting Started with Android Programming : Android- Android Versions – Features of Android – Architecture of Android – Android Devices. **Obtaining the Required Tools -** Android SDK – Installing the Android SDK Tools – Configuring the Android SDK Manager – Eclipse – Android Development Tools (ADT) – Creating Android Virtual Devices (AVDs) - Creating First Android Application - Anatomy of an Android Application.

Activities, Fragments and Intents : Activities - Applying Styles and Themes to an Activity – Hiding the Activity Title – Displaying a Dialog Window – Displaying a Progress Dialog –**Linking Activities Using Intents:** Resolving Intent Filter Collision – Returning Results from an Intent – Passing Data Using an Intent Object. **Fragments -** Adding Fragments Dynamically – Life Cycle of a Fragment – Interactions between Fragments. **Calling Built-in Applications Using Intents -** Understanding the Intent Object – Using Intent Filters – Adding Categories - Displaying Notifications.

UNIT II

Android User Interface: Components of a Screen – Views and View Groups – Linear Layout – Absolute Layout – Table Layout – Relative Layout – Frame Layout– Scroll view - Adapting to Display Orientation – Anchoring Views – Resizing and Repositioning -**Managing Changes to Screen Orientation** – Persisting State Information during Changes in configuration – Detecting Orientation Changes – Controlling the Orientation of the Activity.

Designing User Interface with Views: Using Basic Views – Text view View – Button, Imge Button, Edit Text, Check Box, Toggle Button, Radio Button and Radio Group Views – Progress Bar View – Auto

Complete Text View View - Using Picker Views – Time Picker View – Date Picker View. Using List Views to Display Long Lists – List View View – Using the Spinner View. Understanding Specialized Fragments – Using a List Fragment – Using a Dialog Fragment – Using a Preference Fragment.

UNIT III

Displaying Pictures and Menus With Views: Using Image Views to Display Pictures – Gallery and Image View Views – Image Switcher – Grid View **-Using Menus with Views** – Creating the Helper Methods – Options Menu – Context Menu.

Data Persistence: Saving and Loading User Preferences – Accessing Preferences Using an Activity – Programmatically Retrieving and Modifying the Preferences Values – Changing the Default Name of the Preferences File - Persisting Data to Files – Saving to Internal Storage – Saving to External Storage (SD Card) – Choosing the Best Storage Option – Using Static Resources.

UNIT IV

Content Providers: Sharing Data in Android – Using a Content Provider – Predefined Query String Constants – Projections – Filtering – Sorting – Creating Own Content Providers – Using the Content Provider.

Messaging: SMS Messaging – Sending SMS Messages Programmatically – Getting Feedback after Sending a Message – Sending SMS Messages Using Intent – Receiving SMS Messages - Caveats and Warnings – Sending E-mail.

UNIT V

Location Based Services : Displaying Maps – Creating the Project – Obtaining the Maps API Key – Displaying the Map – Displaying the Zoom Control – Changing Views – Navigating to a Specific Location – Adding Markers – Getting the Location That was Touched – Geocoding and Reverse Geocoding - Getting Location Data – Monitoring a Location.

Developing Android Services : Creating Own Services – Performing Long-Running Tasks in a Service – Performing Repeated Tasks in a Service – Executing Asynchronous Tasks on Separate Threads Using Intent Service – Establishing Communication between a Service and an Activity – Binding Activities to Services – Understanding Threading.

Publishing Android Applications: Preparing for Publishing – Versioning Your Application – Digitally Signing Your Android Applications – Deploying APK Files – Using the adb.exe Tool – Using a Web Server – Publishing on the Android Market.

Text Book:

WeiMeng Lee (2012), Beginning Android Application Development, Wrox Publications (John Wiley, New York).

Reference Books:

1. Ed Burnette (2010), Hello Android: Introducing Google's Mobile Development Platform, 3rd Edition, The Pragmatic Publishers, North Carolina USA.
2. Reto Meier (2012), Professional Android 4 Application Development, Wrox Publications (John Wiley, New York).

Core Course VII - Operating Systems

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSC23	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Explain the basic concepts of Operating Systems.	**K2**
CLO2	Apply various concept related with Deadlock to solve real life problems.	**K3**
CLO3	Describe the role of Process synchronization.	**K2**
CLO4	Demonstrate distributed operating system concepts.	**K2**
CLO5	Summarize the mechanisms adopted for file sharing in distributed Applications.	**K2**

K2 – Understanding **K3 – Applying**

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**				
CLO2	**3**	**3**				
CLO3	**3**	**2**				
CLO4	**3**	**3**		**2**		
CLO5	**3**	**2**		**2**		

Strong – 3 **Medium – 2** **Weak - 1**

Unit -I: Overview

Introduction: What operating system do-Computer system organization-Computer system architecture-Operating system structure-Operating system operations-Process management-Memory management-Storage management-Protection and security-Distributed systems.

System structures: Operating system services-System calls-Types of system calls-System programs-Operating system design and implementation- Operating System Structures.

Unit-II: Process Management

Process concept: Overview-Process scheduling-Operations on processes- Inter Process communication.

Process scheduling: Basics concepts-Scheduling criteria-Scheduling algorithms-Multiprocessor scheduling -Algorithm evaluation.

Unit-III: Process Coordination

Synchronization: Background-The critical section problem-Peterson's solution-Synchronization Hardware-Semaphores-Classic problems of synchronization – Monitors – Synchronization in Windows XP.

Deadlocks: System model-Deadlock characterization-Methods for handling deadlock-Deadlock prevention-Deadlock avoidance-Deadlock detection - Recovery from deadlock.

Unit-IV: Memory Management

Memory management strategies: Background-Swapping-Contiguous memory allocation-Paging-Structure of the page table-Segmentation.

Virtual Memory Management: Background-Demand Paging– Copy-on-Write - Page replacement-Allocation of frames-Thrashing – Memory Mapped Files – Allocating Kernel Memory.

Unit-V : Storage Management

Implementing File Systems: File system structure-File system implementation-Directory implementation-Allocation methods-Free space management – Efficiency and Performance – Recovery.

Secondary Storage Structure: Overview of mass storage structure-Disk structure - Disk Attachment-disk scheduling-disk management- Swap Space Management.

Text Book:

Abraham Silberschatz, Peter Baer Galvin and Greg Gagne (2008), Operating System Concepts, 7th Edition, John Wiley & Sons, Inc.

Reference Books:

1. Achyut S Godbole (2005), Operating Systems, 2nd Edition, Tata McGraw-Hill Publishing Company, New Delhi.
2. William Stallings (2008), Operating Systems, Internals and Design Principles, PHI.

Major Elective I–1.1Cryptography and Network Security

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSE21	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Explain different encryption and decryption techniques.	**K2**
CLO2	Describe DES and AES algorithms to secure applications.	**K2**
CLO3	Summarize asymmetric key cryptography.	**K2**
CLO4	Design secure applications using cryptographic hash functions and authentication mechanisms.	**K3**
CLO5	Apply the knowledge of entity authentication and key management in various network security applications.	**K3**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				
CLO2	**3**	**3**	**2**			
CLO3	**3**	**2**				
CLO4	**3**	**3**	**2**			**2**
CLO5	**3**	**3**	**2**			**2**

Strong – 3 Medium – 2 Weak – 1

UNIT-I

Introduction: Security Goals – Attacks – Services and Mechanism – Techniques. **Traditional Symmetric-Key Ciphers**: Introduction – Substitution Ciphers – Transposition Ciphers – Stream and Block Ciphers-Modern Block Cipher-Modern stream ciphers.

UNIT-II

Data Encryption Standard (DES): Introduction – DES Structure – DES Analysis – Multiple DES – Security of DES. **Advanced Encryption Standard (AES):** Introduction – Transformations – Key Expansion – Ciphers.

UNIT-III

Asymmetric-Key Cryptography: Introduction – RSA Cryptosystem-Rabin cryptosystem-Elgamal cryptosystem-Elliptic curve cryptosystem.

UNIT-IV

Message Integrity and Message Authentication: Message Integrity -Random oracle model-Message Authentication. **Cryptographic Hash Functions**: Introduction – SHA 512-Whirlpool. **Digital Signature**: Comparison – Process – Services – Attacks on Digital Signature – Digital Signature Schemes.

UNIT-V

Entity Authentication: Introduction – Passwords – Challenge-Response – Zero- Knowledge – Biometrics. **Key Management**: Symmetric Key Distribution –Kerberos-Symmetric Key Agreement – Public Key Distribution.

Text Book:

Behrouz A. Forouzan, Debdeep Mukhopadhyay (2007), Cryptography and Network Security, 2nd Edition, Tata McGraw Hill.

Reference Books:

1. William Stallings (2008), Cryptography and Network Security, Prentice Hall of India.
2. Charles P Pfleeger, Shari Lawrence Pfleeger (2005), Security in Computing, Prentice Hall of India.

Major Elective I–1.2 Soft Computing

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSE22	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Describe the concepts of Soft Computing and Artificial Neural Networks.	**K2**
CLO2	Summarize various types of supervised learning network.	**K2**
CLO3	Evaluate the training algorithms of pattern association.	**K3**
CLO4	Demonstrate the Fuzzy logic concepts.	**K2**
CLO5	Compare various genetic algorithms.	**K4**

K2 – Understanding K3 – Applying K4 – Analysis

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				
CLO2	**3**	**3**				
CLO3	**3**	**3**				
CLO4	**3**	**2**			**1**	**2**
CLO5	**3**	**2**	**3**		**1**	**2**

Strong – 3 Medium – 2 Weak – 1

Unit I

Introduction: Neural Networks-Applications scope of Neural Networks-Fuzzy Logic-Genetic Algorithm-Hybrid Systems-Soft Computing. **Artificial Neural Networks**: Fundamental concepts of ANN-Evolution of Neural Networks-Basic models of ANN-Important Terminologies of ANN-McCulloch-Pitts Neuron-Linear Separability - Hebb Network.

Unit II

Supervised Learning Network: Introduction- Perceptron networks, Adaline, Madaline, Back Propagation Network – Radial basis function network.

Unit III

Associate Memory Networks: Introduction-Training Algorithms for pattern Association-Bidirectional Associative Memory-Hopfield Networks. **Unsupervised Learning Networks**: Kohonenself organizing Feature Map- Adaptive Resonance Theory Network

Unit IV

Fuzzy Logic: Fuzzy sets-Fuzzy Relations-Tolerance and Equivalence Relations-Membership Functions-Defuzzifications-Fuzzy Decision Making.

Unit V

Genetic Algorithm: Introduction – Basic Operators and Terminologies in genetic algorithm – Traditional Algorithm vs Genetic Algorithm-Simple GA-Classification of Genetic Algorithm-Hybrid Genetic Algorithm-Parallel Genetic Algorithm-Independent sampling Genetic Algorithm-Genetic Programming-Applications of Genetic Programming.

Text Book:

Sivanandam S N, Deepa S N (2008), Introduction to Soft Computing, Wiley India Publications.

Reference Books:

1. Goldberg, David E, Genetic Algorithms in Search, Optimization and Machine Learning, Addison-Wesley, New Delhi.
2. Timothy J Ross (2006), Fuzzy logic with Engineering Application, Tata McGraw Hill, New Delhi.

Major Elective I–1.3 System Software

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSE23	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Distinguish System Software and Application Software.	**K2**
CLO2	Illustrate the functions of assemblers, loaders and linkers.	**K2**
CLO3	Describe the operations of macro processor and compilers.	**K2**
CLO4	Explain macro processor functions and design options.	**K2**
CLO5	Compare machine dependent and independent compiler features.	**K4**

K2 – Understanding K4 – Analysis

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				
CLO2	**3**	**2**				
CLO3	**3**	**2**				
CLO4	**3**	**3**				
CLO5	**3**	**3**				

Strong – 3 Medium – 2 Weak - 1

Unit I:

Background: Introduction – System software & Machine Architecture – The simplified Instructional Computer(SIC) – Traditional (CISC) Machines- RISC Machines.

Unit II:

Assemblers: Basic Assembler Functions- Machine Dependent Assembler Features – Machine Independent Assembler Features-Assembler Design Options.

Unit III:

Loaders and Linkers: Basic Loader Functions – Machine –Dependent Loader Features-Machine – Independent Loader Features – Loader Design Options.

Unit IV:

Macro Processors: Basic Macro Processor Functions – Machine –Independent Macro Processor Features – Macro Processor Design Options.

Unit V:

Compilers: Basic Compiler Functions – Machine Dependent Compiler Features – Machine Independent Compiler Features – Compiler Design Options.

Text Book:

Leland L.Beck, D.Manjula (2011), System Software :An Introduction to Systems Programming, Pearson Education.

Reference Books:

1. Santanu Chattopadhyay (2008), System Software, 1st Edition, PHI Learning.
2. Nick Rozanski (2005), Software Systems Architecture, 2nd Edition, Mc Graw –Hill.

Core Practical III - Digital Image Processing Lab

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSC2P1	5	2

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Develop Programs with arithmetic and logical operations on images.	**K3**
CLO2	Explain Image Filtering Techniques.	**K2**
CLO3	Apply segmentation techniques and morphological operations on images.	**K3**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**	**3**			**2**
CLO2	**3**	**3**	**3**			**2**
CLO3	**3**	**3**	**3**			**2**

Strong – 3 Medium – 2 Weak - 1

MATLAB Program to implement

1. Arithmetic operations on images.
2. Logical operations on images.
3. Geometrical operations on images.
4. Statistical operations on images.
5. Image enhancement point operations.
6. Image Smoothing Operations.
7. Image Sharpening Operations.
8. Image Degradations(Noise Models).
9. Image Restoration using mean, order statistic filters.
10. To calculate the entropy for the images.
11. Huffman coding.
12. Edge Detection algorithm.
13. Find the Optimal Threshold for the given image.
14. Segmentation algorithm.
15. Colour conversion.
16. Colour image segmentation.
17. Morphological operations.

Core Practical IV - Mobile Application Development

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	II	P20CSC2P2	5	2

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Create interactive mobile apps with different layouts.	**K5**
CLO2	Design an interactive App with GUI design using different Controls	**K4**
CLO3	Develop Animation and gaming Apps with data persistence	**K3**

K3 – Applying K4 – Analysis K5 – Evaluation

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				
CLO2	**3**	**3**			**2**	**3**
CLO3	**3**	**2**			**2**	**2**

Strong – 3 Medium – 2 Weak – 1

1. Create a Hello World App.
2. Create an App to accept the users name and to greet him/her.
3. Develop an App named AppRater that suggests other Applications for users to download.
4. Develop an App using the Check Box component.
5. Create an App with two different activities using the user interface, Intent.
6. Design an App using the List View Component to add desired items to a list.
7. Demonstrate an App using Menu groups.
8. Create an Application to demonstrate a Radio group button.
9. Develop an App to demonstrate the Time picker dialog.
10. Develop an app with two buttons named Save and Load using the concept of internal Storage. Create a file by specifying its name. File must be saved and loaded when the appropriate buttons are clicked.
11. Develop an Application with a button called “Send” to send text messages from one device to another using the SMS Action.
12. Create a simple Animation App with an Image View to perform following activities:
    Zoom In/Zoom Out
    Clockwise/Anticlockwise
    Move
    Fade
    Blink
13. Create an app to demonstrate a simple login page which authenticates existing users and allows new users to sign up.
14. Create an Internet Connection app.

Core Course - VIII – NoSQL Databases

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSC31	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Explain the concept of variety of databases for different requirements and the significance of NOSQL.	**K2**
CLO2	Describe the key-value databases and its methodologies	**K2**
CLO3	Explain the concepts of Designing key value databases with the mapping of illustrations	**K2**
CLO4	Demonstrate document database terminologies and its related concepts.	**K2**
CLO5	Design Column family databases and its functionalities.	**K3**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**				**3**
CLO2	**3**	**2**				**2**
CLO3	**3**	**2**				**2**
CLO4	**3**	**3**			**2**	**2**
CLO5	**3**	**3**			**2**	**2**

Strong – 3 Medium – 2 Weak - 1

Unit I

Different Databases for Different Requirements : Relational Database Design- Early Database Management Systems – The Relational Database Revolution – Motivations for Not Just/No SQL (NoSQL) Databases. **Variety of NoSQL Databases :** Data Management with Distributed Databases – ACID and BASE – Four Types of NoSQL Databases.

Unit II

Introduction to Key-Value Databases : From Array to Key-Value Databases – Essential Features of Key-Value Databases – Keys – Values- **Key-Value Database Terminology :** Key-Value Database Data Modeling Terms – Key-Value Architecture Terms – Key-Value Implementation Terms.

Unit III

Designing for Key-Value Databases : Key Design and Partitioning – Designing Structured Values – Limitations of Key-Value Databases – Design Patterns for Key-Value Databases**. Introduction to Document Databases :** Document - Avoid Explicit Schema Definitions – Basic Operations on Document Databases.

Unit IV

Document Database Terminology: Document and Collection Terms – Types of Partitions – Data Modeling and Query Processing. **Designing for Document Databases :** Normalization, Denormalization and the search for Proper Balance.

Unit V

Introduction to Column Family Databases :Differences and Similarities to Key-Value and Document databases – Architectures Used in Column Family Databases – When to Use Column Family Database. **Column Family Databases Terminology** : Basic Components of Column Family Databases – Structures and Processes: Implementation of Column Family Databases – Processes and Protocols. **Designing for Column Family Databases :** Guidelines for Designing Tables – Guidelines for Indexing – Tools for Working with Big Data.

Text Book:

Dan Sullivan (2016) NoSQL for Mere Mortals, Pearson.

Reference Books:

1. Pramod J.Sadalage, & Martin Fowler(2012), NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison wesley.
2. Guy Harrison(2015), Next Generation Databases: NoSQL, NewSQL, and Big Data: What every professional needs to know about the future of Databases in world of NOSQL and Bigdata, Apress.

Core Course - IX – Data Analysis Using Python

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSC32	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate the fundamental concepts of Python.	**K2**
CLO2	Describe different data structures in Python.	**K2**
CLO3	Develop applications using object-oriented features.	**K3**
CLO4	Identify Array operations using numpy and data Analysis using pandas.	**K2**
CLO5	Summarize Data wrangling operations and Visualization using Python.	**K2**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**3**	**2**			**2**
CLO2	**3**	**3**	**2**			**2**
CLO3	**3**	**3**	**2**			**2**
CLO4	**3**	**3**	**2**			**2**
CLO5	**3**	**3**	**2**			**2**

Strong – 3 Medium – 2 Weak - 1

Unit I

Python Programming: An Introduction: IDLE – An Interpreter for Python – Python Strings – Relational Operators – Logical Operators – Bitwise Operators – Variables and Assignments Statements – Keywords – Script Mode. **Functions:** Built-in-Functions – Function Definition and Call – Importing User-Defined Module – Assert Statement. **Control Structures:** Conditional Statement – Iteration (for and while statement).

Unit II

Strings: Strings – String Processing Examples – Pattern Matching. Mutable and Immutable Objects: Lists – Sets – Tuples – Dictionary. **Classes I:** Classes and Objects – Person: An Example of Class – Class as Abstract Data Type – Date Class.

Unit III

Classes II : Polymorphism – Encapsulation, Data hiding and Data Abstraction – Modifier and access methods – Static Method – Adding Methods Dynamically – Composition – Inheritance – Built-in Functions for Classes. **Applications of Python:** Collecting Information form Twitter – Managing Databases using Structured Query Language – Developing Mobile Application for Android.

Unit IV

Preliminaries: Why Python for Data Analysis?-Essential Python Libraries. **NumPy Basic:** Arrays and Vectorized computation: The NumPy ndarray: A Multi-dimensional Array Object –Universal Functions: Fast Element-wise Array Functions-Data Processing Using Array-File Input and Output with Arrays – Linear Algebra – Random Number Generation. **Getting started with pandas:** Introduction to pandas Data Structures-Essential Functionality-Summarizing and Computing Descriptive Statistics-Handling Missing Data-Hierarchical Indexing.

Unit V

Data Loading, Storage, and File Formats: Reading and Writing Data in text format-Binary Data Formats-Interacting with HTML and Web APIS-Interacting with Databases. **Data wrangling: Clean, Transform, Merge, Reshape:** Combining and Merging Data Sets-Reshaping and Pivoting-Data Transformation-String Manipulation-Example: USDA Food Database. **Plotting and Visualization:** A Brief matplotlib API Primer-Plotting Functions in pandas-Plotting Maps: Visualizing Haiti Earthquake Crisis Data-Python Visualization Tool Ecosystem.

Text Books:

1. Sheetal Taneja, Naveen Kumar(2018), Python Programming – A modular Approach(Based on Python 3.x), Pearson, First Edition.
2. Wes MCKinney(2013), Python for Data Analysis, Oreilly.

Reference Books:

1. Paul Gries(2013), Practical Programming: An Introduction to Computer Science using Python 3, Third Edition.
2. Bharti Motwani(2020), Data Analytics using Python,wiley.
3. Phuong Vo.T.H , Martin Czygan , Ashish Kumar , Kirthi Raman (2017), Python Data Analytics and Visualization Learning Path, Packt Publishing Limited.

Core Course - X – Data Mining and Semantic Web

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSC33	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate the importance of data mining and the principles of business intelligence.	**K2**
CLO2	Explain the preprocessing techniques.	**K2**
CLO3	Apply classification and clustering methods on real life datasets.	**K3**
CLO4	Outline the concept of semantic web with query languages.	**K2**
CLO5	Describe concept of Ontology and its representation with Rule languages.	**K2**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				**2**
CLO2	**3**	**2**				**2**
CLO3	**3**	**3**		**1**	**3**	**3**
CLO4	**3**	**3**			**2**	**3**
CLO5	**3**	**3**			**2**	**3**

Strong – 3 Medium – 2 Weak - 1

Unit I:

Introduction to Data mining: Introduction-Definition – Motivation for Data mining- Data mining tasks –Data mining Elements-Architecture of Data mining –Advantages of Data mining-Disadvantages of Data mining –**Data preprocessing** : Data cleaning – Inconsistent Data-Data Integration-Data transformation-Data Reduction- Data Discretization and Concept Hierarchy Generation - The KDD process-Introduction – The KDD Process in Detail.

Unit II:

Data Mining Techniques: Decision Tree – Neural Networks – nearest Neighbor and Clustering - Genetic Algorithm – Rule Induction – statistical measures in large Databases. **Association Rule Mining in large databases**: Mining Single-Dimensional Boolean Association rules from Transactional Databases - Mining Different kinds of Association rules.

Unit III:

Classification and Prediction: Classification by Decision Tree Induction-Bayesian Classification-Classification by Backpropagation-Classification methods-**Cluster Analysis**: Cluster Analysis in data mining-Categories of clustering methods-Partitioning methods – Hierarchical Clustering – CURE – Chameleon – Density based Methods – Grid based method-Model based Method.

UNIT -IV:

Introduction –Motivation: Why Semantic Web? –A Framework for Semantic Web- Use Case -Use Case and Functional Requirements –Detailed Clinical Use Case-Stakeholders and Information Needs-Conceptual Architecture – Functional Requirements – Research Issues. Semantic Web Content – Nature of Web Content – Nature of Semantic Web Content – Metadata –Ontologies: Vocabularies and Reference Terms for Metadata.

Metadata Frameworks- Examples of Metadata Frameworks- Two Perspectives: Data Models and Model-Theoretic Semantics- Query Languages-Clinical Scenario Revisited.

UNIT-V:

Ontologies and Schemas –Ontology – Ontology Representation Languages – Integration of Ontology and Rule Languages – Clinical Scenario Revisited.

Ontology Authoring and Management – Ontology Building Tools – Ontology Bootstrapping Approaches- Ontology Merge and Integration Tools- Ontology Engines and Reasoners – Clinical Scenario Revisited.

Text Books:

1. Bharat Bhushan Agarwal and Sumit Prakash Tayal (2009), Data Mining and Data Warehousing**,** University Science Press.
2. Vipul Kashyap, Christoph Bussler, Matthew Moran (2015), The Semantic web, Springer.

Reference Books:

1. K.P.Soman, Shyam Diwakar, V.Ajay, PHI (2008), Insight into Data Mining Theory and Practice.
2. Prof.(Dr.) Jayant Shekhar, Ram Kumar Singh, Dr.Amit Asthana, Manik Chandra Pandey(2014), Data mining and Data Warehousing, International Book House Private Limited.
3. Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra (2012), Semantic Web Primer, 3rd Edition, MIT Press.

Major Elective II–2.1 – Artificial Intelligence

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSE31	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Explain artificial intelligence techniques.	**K2**
CLO2	Describe search strategies and solve problems by applying a suitable search method.	**K2**
CLO3	Demonstrate the Knowledge Representation.	**K2**
CLO4	Implement appropriate AI solutions for planning problems.	**K3**
CLO5	Outline fuzzy sets and fuzzy logic.	**K2**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				**3**
CLO2	**3**	**2**				**2**
CLO3	**3**	**2**	**2**			**2**
CLO4	**3**	**2**	**2**			**2**
CLO5	**3**	**2**	**2**			**2**

Strong – 3 Medium – 2 Weak - 1

Unit I:

What is Artificial Intelligence: The AI Problems - The Underlying Assumption - What is an AI Technique? **Problems, Problem Spaces and Search**: Defining the Problem as a state Space search - Production Systems - Problem Characteristics - Production System Characteristics - Issues in the Design of Search Programs.

Unit II:

Heuristics Search Techniques: Generate-and-Test - Hill Climbing - Best-first Search - Problem Reduction - Constraint Satisfaction- Means - ends Analysis. **Representation of Knowledge Issues:** Representations and Mappings - Approaches to knowledge Representation.

Unit III:

Using Predicate Logic: Representing Simple Facts in Logic - Representing Instance and ISA Relationships -Computable Functions and Predicates - Resolution. **Representing Knowledge Using Rules:** Procedural Versus Declarative knowledge - logic Programming - Forward Versus Backward Reasoning - Matching.

Unit IV:

Game Playing: Overview – The Minimax search Procedure – Adding alpha-beta cutoffs – Additional Refinements – Iterative deepening. **Prolog – The Natural Language of Artificial Intelligence –** Introduction – Converting English to prolog facts and Rules – Goals – Prolog terminology – Variables – Control Structures – Arithmetic Operators – Matching in Prolog – Backtracking – cuts – Recursion – Lists – Dynamic Databases – Input / Output and Streams

Unit V:

Fuzzy Logic Systems – Introduction – Crisp Sets – Fuzzy Sets – Some Fuzzy Terminology – Fuzzy Logic Control – Sugeno Style of Fuzzy Inference Processing – Fuzzy Hedges – α Cut Threshold – Neuro Fuzzy Systems.

Text Book:

Elaine Rich, Kevin Knight, Shivashankar B Nair (2014), Artificial Intelligence, 3rd Edition, MC Graw Hill Edition.

Reference Books:

1. Kelvin Warwick (2012), Artificial Intelligence The Basics, Taylor and Francis Group.
2. Stuart Russell, Peter Norvig (2014), Artificial Intelligence: A Modern Approach, Pearson New International Edition.

Major Elective II–2.2 – Software Testing

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSE32	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Explain test cases suitable for a software development for different domains.	**K2**
CLO2	Identify suitable test cases for the software project.	**K3**
CLO3	Create test data for validation.	**K4**
CLO4	Describe Test Tool Concepts.	**K2**
CLO5	Demonstrate Selenium Test Tool.	**K2**

K2 – Understanding K3 – Applying K4 – Analysis

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**			**3**	**3**
CLO2	**3**	**3**				**3**
CLO3	**3**	**2**			**3**	**3**
CLO4	**3**	**2**				**3**
CLO5	**3**	**2**				**3**

Strong – 3 Medium – 2 Weak – 1

Unit I:

Introduction to Testing as an Engineering Activity – Testing as a Process – Overview of the Testing Maturity Model - Testing Fundamentals: Basic definitions – Software Testing Principles – The Tester‘s Role in a Software Development Organization – Defects, Hypotheses, and Tests : Origins of Defects — Defect Classes – The Defect Repository and Test Design –Defect Examples- Developer/Tester Support of Developing a Defect Repository.

Unit II:

Strategies and Methods For Test Case Design : Test case Design Strategies – Using Black Box Approach to Test Case Design – Random Testing - Equivalence Class Partitioning -Boundary Value Analysis — Black Box Test Design Approaches : Cause-and-Effect Graphing - State Transition Testing - Error Guessing–Using White Box Approach to Test design – Test Adequacy Criteria, Coverage and Control Flow Graphs- Covering Code Logic - Paths: Their Role in White-box Based Test Design, Additional White Box Test Design Approaches, Evaluating Test Adequacy Criteria.

Unit III:

The need for Levels of Testing –Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning –System Test : The Different Types –Regression Testing, Alpha, Beta and Acceptance Tests - Controlling And Monitoring The Testing Process Defining Terms - Measurements and Milestones for Controlling and Monitoring- Status Meetings, Reports and Control Issues, Criteria for Test Completion.

Unit IV

Testing Tools and Automation: Testing Tool Acquisition-Testing Tool Introduction and Deployment-Testing Tool Categories-Standards and Test Process Improvement

Test Techniques-Introduction-Test Tool Concepts-Test Tool Categories-Keyword Driven Test Automation-Performance Testing.

Unit V

Selenium: Writing the First Test-Choosing Selenium over other tools- The Record and Playback pattern- Getting started with the Selenium IDE- Understanding Selenium commands- Comparing Ruby to Selenese- Writing a Selenium test in Ruby- Introducing Test::Unit-Introducing assert-Interactive test debugging.

Data-driven Testing-Hardcoding input data-Introducing test fixtures-Using an API as a source of fixture data-using data stubs-The default values pattern.

Text Books:

1. Ilene Burnstein (2003), Practical Software Testing, Springer International Edition.
2. Anne MetteJonassen Hass (2008), Guide to Advanced Software Testing, artech house, inc.
3. Rex Black, Jamie L.Mitchell (2011), Advanced software testing: guide to the ISTQB advanced certification as an advanced technical test analyst,Rocky Nook.
4. Selenium Design Patterns and Best Practices, DimaKovalenko (2014),Packt Publishing.

Reference Books:

1. Ron Patton (2007), Software Testing, Second Edition, Sams Publishing, Pearson Education.
2. Naik and Tripathy(2008), Software Testing and Quality Assurance, Wiley.
3. Roger Pressman (2010), Software Engineering – A Practitioner's Approach, 7th Edition, Tata McGraw Hill.

Major Elective II–2.3-Principles of Compiler Design

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSE33	5	5

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Describe the importance of Compiler.	**K2**
CLO2	Explain the method of designing lexical analyzer.	**K2**
CLO3	Outline the concept of constructing Parser.	**K2**
CLO4	Implement syntax directed translation schemes.	**K3**
CLO5	Identify techniques for intermediate code and machine code optimisation.	**K3**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				
CLO2	**3**	**3**				
CLO3	**3**	**2**			**2**	
CLO4	**3**	**2**				
CLO5	**3**	**2**				

Strong – 3 Medium – 2 Weak - 1

Unit I:

Introduction to Compilers: Compilers and translators-the structure of a compiler-lexical analysis Syntax analysis-intermediate code generation-optimization-code generation –book keeping –error handling-compiler writing tools.

Unit II:

Lexical Analysis: The role of the lexical analyzer –a simple approach to the design of lexical analyzer-regular expressions-Finite Automata-From regular expressions to finite automata-Minimizing the number of states of a DFA. Context Free grammars-Derivation and parse trees.

Unit III:

Basic Parsing Techniques: Parsers - shift reduce parsing –operator precedence parsing-top down parsing -predictive parsers. **Automatic Construction of Parsers:** LR parsers-The canonical collection of LR(0) items-Constructing SLR parsing tables-Constructing Canonical LR parsing tables-constructing LALR parsing tables.

Unit IV:

Syntax Directed Translations: Syntax directed translations schemes-implementations of syntax directed translators-intermediate code-postfix notation-three address code, quadruples, and triples. **Symbol Tables:** The contents of a symbol tables - Data structures for symbol tables - representing scope information.

Unit V:

Error Detection and Recovery: Error - Lexical phase errors - syntactic phase errors - semantic errors. **Introduction to Code Optimization:** The principle source of optimization - Loop optimization - DAG representation of basic blocks. **Code Generation:** Object programs-Problems in code generation-code generation from DAG's-peephole optimization.

Text Book:

Alfred V.Aho, Jeffrey D.Ullman(2001), Principles of Compiler Design, Naraso Publishing House.

Reference Books:

1. Compiler Writing (1987)**,** Jean,Paul TremBlay & Sorenson, McGraw Hill, 1987.
2. Andrew W.Appel (2002), Modern Compiler Implementation in Java, 2nd Edition, Cambridge University Press.

Core Practical V - NoSQL Databases Lab

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSC3P1	5	3

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Create a simple application using MongoDB.	**K4**
CLO2	Implement the Commands in MongoDB effectively for problem solving.	**K3**
CLO3	Develop different types of basic query operations and map reduce concepts.	**K3**

K3 – Applying K4 – Analysis

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**			**3**	
CLO2	**3**	**2**			**2**	
CLO3	**3**	**2**	**2**		**2**	**1**

Strong – 3 Medium – 2 Weak - 1

1. Create a Database in MONGO Shell and show the database.
2. Implement the basic Commands and data manipulation language in MongoDB.
3. Code and develop the Insert, Query, Update, Delete and Projection operations in MongoDB.
4. To implement Where Clause equivalent in MongoDB.
5. To code AND, OR operations in MongoDB – and to implement the sorting and Limiting Record operations.
6. Implement the Advanced Indexing operation in MongoDB.
7. Develop and implement Aggregation and Map Reduce techniques.
8. Import document oriented database and column oriented database and apply queries to display specified output.
9. Create a Program with real time database and rich query operations.
10. Create a Program with MongoDB file system.

Core Practical VI – Data Analysis Using Python

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	III	P20CSC3P2	5	3

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Develop code to solve complex problems.	**K3**
CLO2	Implement various data structures operations.	**K3**
CLO3	Create python applications with data analysis.	**K4**

K3 – Applying K4 – Analysis

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**2**	**3**	**3**		**2**	**3**
CLO2	**2**	**3**	**3**		**2**	**3**
CLO3	**3**	**3**	**2**		**2**	**3**

Strong – 3 Medium – 2 Weak – 1

1. Programs based on conditional constructs.
2. Programs based on looping constructs.
3. Perform string manipulation.
4. Illustrate operations on Lists, Tuples and Dictionaries.
5. Programs related to functions & modules.
6. Illustrate Single and Multiple Inheritance.
7. Program to demonstrate the use of regular expressions.
8. Programs to do searching and sorting in arrays.
9. Illustrate Object Oriented Concepts.
10. Access Twitter data using Python.
11. Perform Data Processing in array using numpy.
12. Perform File Operations using Array.
13. Create Text applications using Python.
14. Import and access data using Pandas.
15. Feature Engineering – Data Cleaning Operations in dataset.
16. Perform Data wrangling operations in any dataset.
17. Analysing Dataset using Pie Chart.
18. Analysing Dataset using Bar Chart.

Project I – Project and Viva Voce

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	IV	P20CSPT41	-	16

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Develop the skills to prepare a project.	**K3**
CLO2	Demonstrate the Stages involved in Project Development.	**K2**
CLO3	Create module based projects.	**K4**

K2 – Understanding K3 – Applying K4 – Analysis

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**2**	**2**		**2**		**2**
CLO2	**2**	**2**		**2**		**3**
CLO3	**3**	**3**		**2**	**3**	**2**

Strong – 3 Medium – 2 Weak - 1

Rules governing the evaluation of Project and Viva Voce:

1. Project may be System Oriented or Application Oriented.
2. Students can select a problem of their choice pertaining to their course, in consultation with the guide assigned to them.
3. The project report should be submitted to the Department on or before the date fixed by the Controller of Examinations.
4. Each student has to submit two copies of his / her project report for evaluation.
5. Evaluation Method for Project:

	Maximum Marks		Credits
	Internal	**External**	
Project	80	80	
Viva voce		40	
Total	200		16

6. For awarding Internal Marks, there will be 3 reviews. In each review the candidate has to run / present his/her project and has to attend viva voce. Each review will be evaluated for 80 marks and the average of three reviews will be the internal mark of the candidate.
7. The students are only allowed to attend the viva-voce if they have qualified in both internal and external project evaluation. The viva-voce carries a maximum of 40 marks and it will be conducted jointly by the internal examiner and the external examiner.
8. Passing minimum:
    - No minimum for internal marks.
    - 54 out of 120 or 45% of the external is the minimum for external marks.
    - 50% in aggregate (Internal + External) is the passing minimum.

Extra Credit Course – Model Paper for Net /Set Examinations

Programme	Programme Code	Semester	Course Code	Hours	Credits
M.Sc. Computer Science	PCS	IV	P20CSX41	-	3

Course Learning Outcomes (CLOs)

Upon Completion of this course the students will be able to

No.	Course Learning Outcomes	Levels
CLO1	Demonstrate the basics of compiler and parsing techniques.	**K2**
CLO2	Describe the concepts of computer system architecture.	**K2**
CLO3	Apply scheduling algorithms and memory management techniques.	**K3**
CLO4	Outline the concepts of Networking.	**K2**
CLO5	Apply normalization techniques in relational database design.	**K3**

K2 – Understanding K3 – Applying

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	**3**	**2**				
CLO2	**3**	**2**				
CLO3	**3**	**3**				
CLO4	**3**	**2**				
CLO5	**3**	**2**				

Strong – 3 Medium – 2 Weak - 1

Unit I:

Introduction to Compilers: Structure of a compiler–book keeping – error handling-compiler writing tools - Finite Automata- NFA to DFA -Minimizing the number of states of a DFA- **Basic Parsing Techniques:** Parsers - shift reduce parsing –operator precedence parsing-top down parsing -predictive parsers - LR parsers- The canonical collection of LR(0) items-Constructing SLR parsing tables-Constructing Canonical LR parsing tables-constructing LALR parsing tables - intermediate code-postfix notation-three address code, quadruples, and triples - The contents of a symbol tables - Data structures for symbol tables - Lexical phase errors - syntactic phase errors - semantic errors - The principle source of optimization - Loop optimization - DAG representation of basic blocks -Problems in code generation-a simple code generator-peephole optimization.

Unit-II:

Digital logic Circuits: Logic Gates - Boolean algebra - Map Simplification – Combinational Circuits: Half-Adder, Full Adder- Flip Flops - Sequential Circuits. **Data representation:** Data Types – Complements – Fixed Point representation, Floating Point representation – Other Binary Codes. **Basic Computer Organization and Design:** Instruction Codes – Computer Registers – Computer Instructions – Timing and Control – Instruction Cycle – Memory Reference Instructions – I/O and Interrupt. **Memory Organization:** Memory Hierarchy – Main Memory – Auxiliary Memory – Associative Memory – Cache Memory – Virtual Memory – Memory Management Hardware – CPU: General Register Organization – Control Word – Stack Organization – Instruction Format – Addressing Modes – Data Transfer And Manipulation – Program Control.

Unit-III:

Operating System : Operating System Services – Scheduling Algorithms – Synchronization – Deadlock – Memory Management –Virtual Memory Management.

Unix : Basic Commands – File Attributes – Filters – Editor – Regular Expressions – Process System – Shell Programming – AWK Command.

Unit –IV:

Network Fundamentals : Local Area Network (LAN) – Metropolitan Area Network(MAN) – Wide Area Networks(WAN) – Wireless Networks – Inter networks - Topologies - The OSI Reference Model – TCP/IP model – Channel Capacity - Analog and Digital Transmission – Asynchronous and Synchronous transmission – Transmission Media – twisted pair, coaxial cables – fiber-optic cables, wireless transmission – radio, microwave, infrared and millimeter waves. Lightwave transmission - Telephones – Local loop – Trunks – ISDN – ATM – High Speed LANs - Cellular Radio – Communication Satellites – geosynchronous and low-orbit. Multiplexing– Switching Techniques – Polling –Networking Devices – Routing – Virtual Circuits and datagrams – Routing Algorithms – Congestion Control -Protocols for Data Link Layer – Network Layer – Transport Layer – TCP/IP Protocols – Network Security – Network Administration.

Unit-V:

Relational Database Design and SQL : E – R diagrams and their transformation to relational design, Normalization – 1 NF, 2NF, 3NF, BCNF and 4NF. Limitations of 4NF and BCNF.

SQL : Data Definition Language (DDL), Data Manipulation Language(DML), Data Control Language (DCL) commands. Database objects like – views, indexes, sequences, synonyms, data dictionary.

Reference Books:

1. Alfred V.Aho, Jeffrey D.Ullman(2001), Principles of Compiler Design, Naraso Publishing House.
2. C M.Morris Mano(2001), Computer System Architecture, Prentice Hall of India.
3. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Principles, 7th Edition, John Wiley & sons Pte Ltd.
4. M.G.Venkateshmurthy(2007), Introduction to UNIX SHELL Programming, 2nd Edition, Pearson Education.
5. Behrouz A Forouzan (2008), Data Communications and Networking, 4th Edition, Tata McGraw Hill.
6. Andrew S. Tanenbaum (2006), Computer Networks, 4th Edition, Prentice Hall of India.
7. Abraham Silberschatz, Henry F.Korth and S.Sudarshan(2006), Database System Concepts, 5th Edition, Tata McGraw Hill Publications.
8. Christopher, Allen Simon Chatwin, Catherine A. Creary(2004), Introduction to Relational Databases and SQL Programming, Tata McGraw Hill Publications.

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